PROPOSED RESIDENTIAL DEVELOPMENT ON THE SITE OF MILLFIELD NURSERIES, SPALDING COMMON, SPALDING, PE11 3AU.

FLOOD RISK ASSESSMENT

View of buildings and glasshouses

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 the proposed development at Millfield Nursery, Spalding Common, 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 purposes other than for which it was originally commissioned.

Introduction

An outline planning application (reference H16-0668-16) was approved by South Holland District Council on the 3th March 2018 for a residential development on the site of Millfield Nursery, Spalding Common, Spalding, PE11 3RZ. The site is located east of Spalding Common and west of Cradge Bank. An application has now been submitted for approval of reserved matters (reference H16-1070-20).

A flood risk assessment was undertaken by RM Associates to accompany the outline planning application in 2016. Since that date the maps showing the predicted flood risk have been updated which can now be referred to at the South East Lincolnshire Planning website and this revised flood risk assessment for this site uses this information.

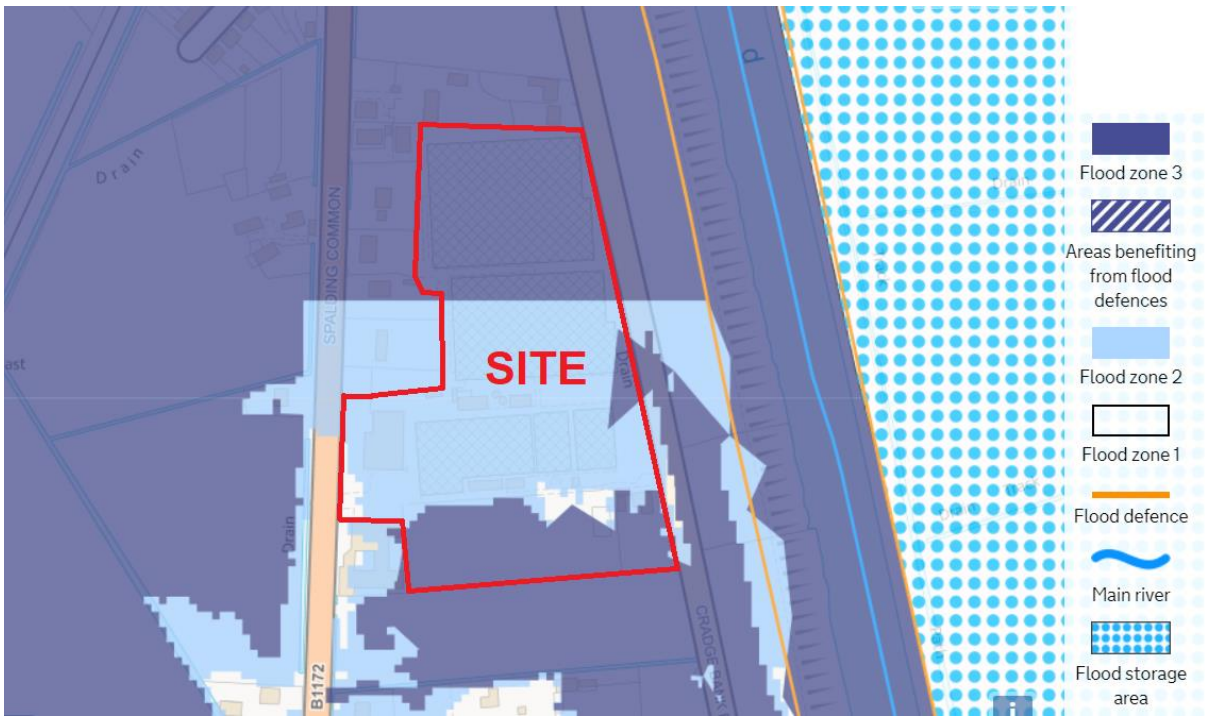
The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone Map. These maps do not take into account existing flood defences.

The Technical Guidance to the National Planning Policy Framework Development and Flood Risk states that if a development lies within Flood Zone 3 a Flood Risk Assessment should be carried out to accompany any Planning Application.

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 Welland and Deepings 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 northern and southern part of this site is in Flood Zone 3., with the central area being in flood zone 2 and some very small areas in flood zone 1.

Application Site

The development is located on the western side of the River Welland. The National Grid Reference of the site is 523440 320030.

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

As the site is within a defended area the part of the site with flood zone 3 can be designated to be within Flood Zone 3(a) "High Probability" as detailed on the Environment Agency's flood zone maps without defences, as defined in Table 1 of the Technical Guidance.

Applying the flood risk vulnerability classification in Table 2 of the Guidance, the development of a dwelling house is classified as "more vulnerable" and Table 3 of the Guidance states that residential use is only permitted after the sequential and exception test is followed.

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 can be seen from viewing the Environment Agency flood zone map almost the whole of the area of Spalding is in Flood Zone 3. Therefore it would be difficult to find a similar site for development that is in a lower flood zone.

As the site has the benefit of outline planning permission then the sequential test can be deemed to be 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

A Strategic Flood Risk Assessment (SFRA) was produced for the South Holland District Council (SHDC) in 2010. This document provides details of the flood risk in the Council's area.

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

For the present day	Depth of flooding … zero
	Extent of flooding .. zero
	Hazard …. Nil
	Velocity … Nil
For year 2115	Depth of flooding … zero
	Extent of flooding .. Low or medium flood probability
	Hazard … Low
	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 for the 1% fluvial or 0.5% tidal event probability are as follows:

For the present day	Depth of flooding …..250mm – 1.0 metre
	Extent of flooding ….High
	Hazard ……. 0.75 – 2.0 (danger for some and danger for most)
	Velocity ……. 0 – 0.3m/sec

For the year 2115 Depth of flooding … 500mm – 2.0 metres

Extent of flooding .. High

Hazard …… 1.25 – 2.0 (danger for most)

Velocity …….. 0 – 0.3m/sec

The hazards for the 0.1% fluvial and tidal event probability are as follows:

For the year 2115 Depth of flooding ….500mm – 2.0 metres

Extent of flooding …High

Hazard …… 1.25 – 2.0 (danger for most)

Velocity ……. 0 – 0.3 m/sec

Figure 16 of the general maps in the 2010 SFRA show that the site is within the rapid inundation zone for the present day and in 2115.

1. **The maximum flood levels in the fluvial section of the Spalding Welland is shown in the reports as follows:**

	Peak 1 in 100 year		Peak 1 in 1000 year	
Year	2007	2115	2007	2115
Level	4.49	4.67	4.50	4.68

The chainage of the River Welland directly east of the development site is 2.0km. All of the bank levels between chainage 0.2km at Little London and 2.1km are above 6.0m OD. Further upstream top of bank levels vary between 5.80m OD and 6.00m OD.

2. **The extreme tide levels in the section of the River Welland north of Fulney Lock is shown in the report as follows:**

	2007	2055	2115
1 in 100 year	5.98	6.31	7.12
1 in 1,000 year	6.32	6.65	7.46

The lowest bank level occurs 200 metres north of Fulney Lock, where a section 300 metres long has a minimum level of 6.98m OD.

<u>Information from the Environment Agency</u>

The Environment Agency has provided predicted flood levels for the River Welland approximately 1 km north of the site, which are taken from the Welland Catchment Model. The levels will be very similar in the river immediately east of the site.

	Present Day	Present day with 20% increase of flow for climate change
Peak 1 in 100 year flood level	4.39m OD	4.68m OD
Peak 1 in 1,000 year flood level	4.40m OD	4.68m OD

Site Levels

The level of the glasshouses is between 2.35m and 2.55m ODN and land levels around these three areas are similar with levels between 2.30m and 2.60m ODN.

There are lower areas, particularly in the south eastern corner of the site where levels are between 2.00 and 2.10m ODN.

The level of Cradge bank east of the site varies from 2.50m to 2.60m ODN although one of the levels seems to be higher at 3.00m ODN

The level of Spalding Common is higher with level of approximately 3.10m ODN north and south of the site rising to 3.40m ODN near the site entrance.

All of these levels are shown on a topographical study which was carried out in February 2016.

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" and is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding due to overtopping or failures of the defences is considered to be very low.

The site is approximately 125 metres from the River Welland, which is main river and maintained by the Environment Agency.

This area south of the centre of Spalding is drained by watercourses maintained by Welland and Deepings Internal Drainage Board. The water levels in the IDB channels are controlled by the water level in South Drove Drain which also is operated by Welland and Deepings IDB.

Potential Sources of Flooding

The following sources of flooding have been identified:

1. Failure or overtopping of the tidal defences.
2. Overtopping of the River Welland.
3. Flooding from IDB drainage channels
4. Blockages in local surface water sewers (highway or Anglian Water)

1. Failure or overtopping of tidal defences.

The River Welland is tidal north of Fulney Lock, which is more than 5.0km north of the site. The SFRA states that the defences are adequate to withstand a 1 in 200 year (0.5%) probability event for present day. In the future in 2115 some of the banks could be overtopped with a 0.5% probability event. However one would expect that during the next one hundred years defences will be raised to maintain a 1 in 200 year standard of defence.

If overtopping or a breach in the west bank of the tidal Welland allowed water to flow south westwards lower land to the west of the River Welland would be flooded and the

central area of Spalding would remain unaffected. If flood water from this source were to affect the development site it would have to flow south westwards towards Pode Hole then south eastwards towards Spalding Common. The railway line to the west of Spalding Common would be a final barrier to any substantial amount of flood water reaching the site.

Therefore flooding from this source can be considered to be adequately mitigated.

2. **Breaching or Overtopping of the River Welland.**

The west bank of the River Welland is at a level of above 6.00m O.D. directly west of the development site. If a breach were to occur in the west bank of the River Welland when the river is at the maximum predicted level in 2115 in a 1 in 1000 year event of 4.68m OD then water would flood into the area between the river and the road called Spalding Common. The maps in the SFRA predict that the flood depth would be between 500mm and 2.0 metres in a 1 in 1000 year event in 2115. In practice flood water would flow into the area between the river and Spalding Common and the level would rise until the flood water started to flow over the road. The flow over the road would be between 100mm and 200mm deep and from this the maximum level of the flood water can be estimated to be 3.35m OD. This would give a depth of water on the site of between 750mm and 1.0 metre over most of the site and up to 1.35 metres deep in the south east corner of the site.

Most breaching of river banks is caused by overtopping eroding the back of the bank and causing failure. In this case the west bank of the River Welland has a freeboard of more than 1.0 metre and the likelihood of overtopping is very low. If the river level approached 5.00m OD two large syphons which discharge water into the Cowbit and Crowland Washes would be activated and this would immediately reduce water levels in the river.

The risk of flooding to the proposed new dwellings will be mitigated by raising the ground floor levels of the properties above the predicted flood level in a 1 in 1000 year event in 2115.

3. **Flooding from IDB watercourses**

This area of Spalding Common is drained by the Welland Soke Dyke which is on the eastern side of Cradge Bank. Welland Soke Dyke is maintained by Welland and Deepings IDB (W & D IDB) and flows into South Drove Drain.

The water level in North and South Drove Drain, which is maintained by W & D IDB is controlled by Pode Hole Pumping Station. There are both electrically operated and diesel powered pumps which are operated at this location to control water levels. W & D IDB have stated that the normal pumping level is -1.20m OD and the maximum design water level in a 1 in 100 year event would be 0.18m OD. With climate change this could increase to around 0.7m OD.

However you would expect the IDB to increase capacity to keep pace with climate change over the next one hundred years.

Although the likelihood of water levels rising to 2.00m ODN in North Drove Drain is remote, if this happened low land around Deeping St Nicholas would start to flood and so the level in the Drain would be unlikely to increase further.

Therefore this source of flooding can be considered to be adequately mitigated as the proposed ground floor levels of the properties will be raised in excess of 1.0 metre above the 2.00m ODN level above.

4. **Blockages in local surface water drainage systems**

Highway drainage systems along Spalding Common could become blocked and water could flow onto the development site. However as it is proposed that the finished ground floor level will be at least 750mm above ground level this will ensure that flooding will not occur from this source to the proposed buildings.

Therefore this source of flooding can be considered to be adequately mitigated.

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.

Probabilities and Trends of Flooding

The probability of this development flooding from Environment Agency main river is very low. However in an extreme event at this location water levels could rise quickly.

Residual Risk – Extreme Events

The residual risk from extreme events is very low on this site.

There are no records of the Spalding Common area having been flooded in the last 60 years.

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 this FRA. The effects of these new recommendations are considered in Appendix A of this report (pages 14 to 17). 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 development is in flood zone 3 and the flood hazard (see above) is shown to be 1.25 – 2.0 (danger for most). The standing advice for this hazard is shown in column D and row 9 which is shown below.

The Environment Agency requires direct consultation on proposals in this hazard zone. 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 Environment Agency also wishes to be consulted on the Sequential Test Evidence. Applicants will need to demonstrate that housing proposals are required to meet an identified local housing need.

The applicant is advised to refer to the document "Improving Flood Performance of New Buildings Flood Resilient Construction (DCLG2007).

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 FFL).

Depths 1.0m – 1.6 metres:

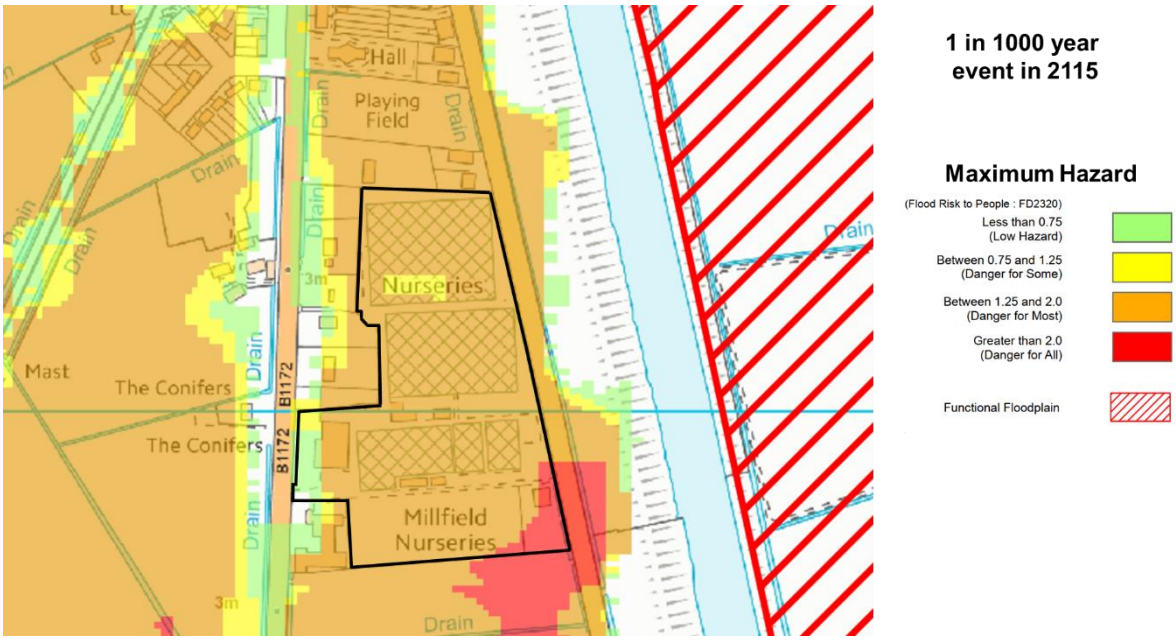
Proposals must have a minimum of 2 storeys, with FFL set a minimum of 1.0 metre above ground level, with flood resilient construction to a height of 300mm above the predicted flood depth, and demountable defences to 600mm above FFL.

Depths 0.5m – 1metre:

FFL must be set 1.0 metre above ground level, with flood resilient construction to a height of 300mm above the predicted flood depth.

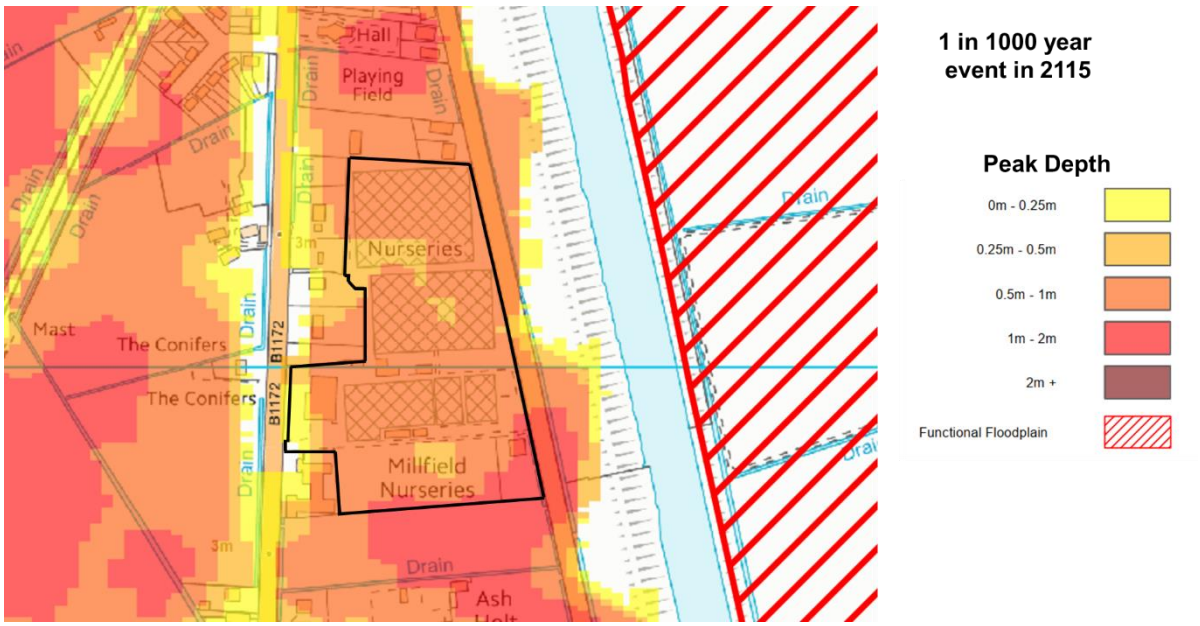
<u>Summary of Risk of Flooding to the Site</u>

The map showing the predicted flood hazard in a 1 in 1000 year event in 2115 is shown below.



The map shows most of the site, except for a small area in the south east corner, is designated to have a hazard of between 1.25 and 2.0 (danger for most).

The map showing the predicted flood depth in a 1 in 1000 year event in 2115 is shown below.



It can be seen that the predicted flood depth across most of the site is between 500mm and 1.0 metre. The maps showing the 1 in 100 year and the 1 in 1000 year predicted flood depths are almost identical.

If the levels along Spalding Common shown on the topographical survey are compared with the flood depths shown on the section of the road on the map above it can be shown that the length that is not predicted to flood is higher than 3.35m ODN and the length of road where flooding is predicted to happen is lower then 3.35m ODN.

The average level of the northern section of Cradge Bank is 2.45m ODN and the predicted flood depth is between 500mm and 1.0 metre, and therefore this would add weight to the calculated highest flood level of 3.35m ODN.

The greater part of the site where the flood depth is predicted to be between 500mm and 1.0 metre is at a level of between 2.35m and 2.60m ODN, which again fits with a predicted flood depth of 3.35m ODN. There are a few other areas lower than 2.35m ODN which are shown in the 500mm – 1.0m (orange) band.

Therefore the conclusion is that the best estimate of the maximum predicted flood level in a 1 in 1000 year event in 2115 is 3.35m ODN.

The risk of the level of flood water rising to 3.35m ODN in IDB drains can be considered extremely unlikely.

Conclusions

The following conclusions can be made:

The proposed development is not in a functional flood plain as defined by the Technical Guidance.

Although the site is in flood zone 3, the actual risk of the site flooding from any Environment Agency watercourse is very low.

There is a residual risk of flooding to the site, which is the risk caused by a breach in the west bank of the River Welland, and the maps in the SFRA predict that if this occurs in a 1 in 1000 year event in 2115 the depth of flooding could be up to 1.0 metres on a greater part of the site and greater than 1.0 metres in the area on the southeast corner of the site.

The risk of the site becoming flooded from any other source is extremely low.

In a flood risk area there is always a risk of an event occurring of greater magnitude than has been considered in this flood risk assessment.

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. However in this case the developer has stated that some bungalows should be included in the development.

The finished ground floor level of new dwellings should be raised to a minimum level of 3.45m ODN which is 100mm above the predicted flood level in a 1 in 100 year event in 2115.

The finished ground floor level of any new bungalows with sleeping accommodation on the ground floor should be raised to a minimum level of 3.45m ODN which is 100mm above the predicted flood level in a 1 in 1000 year event in 2115. These properties should not be located where the ground level is lower than 2.35m ODN.

All buildings should include flood resilient construction to a height of 300mm above the predicted flood level.

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

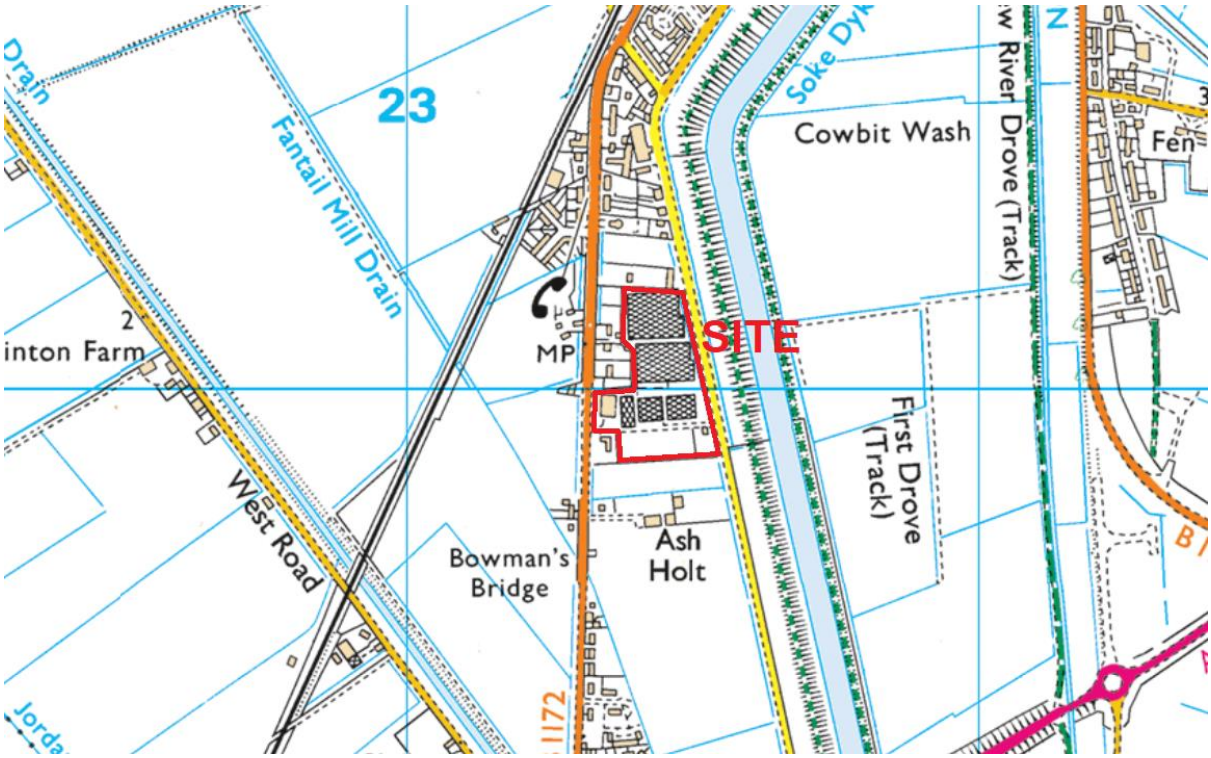
A suitable surface water drainage scheme should be set up for the site which will be approved by the planning authority who will be advised by the Lincolnshire County Council (the lead flood authority) and the Welland and Deeping IDB.

S M HEMMINGS B Sc C Eng MICE MIWEM

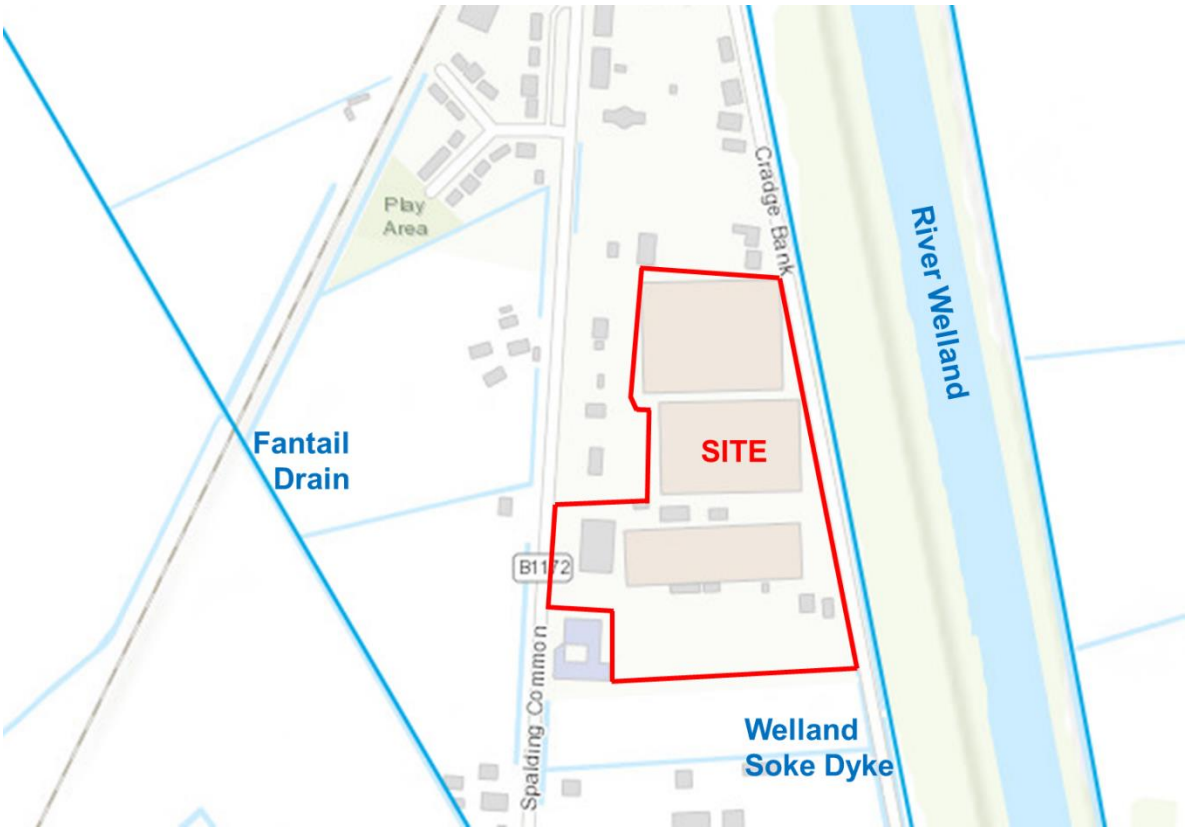
stuart.hemmings@btinternet.com

4th January 2021.

LOCATION PLAN



PLAN OF IDB DRAINS



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%	

has 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

Fluvial Flooding from River Welland.

As the development is in flood zone 3 and is classed as more vulnerable, the upper end climate change allowance, which is 35%, should first be considered. After considering the effects of this increase the upper end allowance, 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% will not significantly change the conclusion in the SFRA of what might happen if a breach occurred in the bank of the River Welland. 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.

The upper end allowance predicting a 65% increase in flows above the 1 in 100 year predicted flows now needs to be considered. The River Welland is an embanked

watercourse between Spalding and Market Deeping. There are flood reservoirs on the east side of the River called the Cowbit and the Crowland Washes. Excess water would flow into these Washes through two large syphons. In this scenario the Washes would fill up and also water would be flooding over lower banks of the River. The increases in rainfall leading to this would also lead to significant flooding in the upper part of the River Welland Catchment. It is unlikely that there will be any significant increase in the water level in the River. Therefore the consequence will not be significantly different to the maps produced in the SFRA.

Effect on IDB Systems

Welland and Deepings 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 Welland and Deepings 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 mitigation proposed for the development, with the recommendation that the floor level of the proposed dwellings should be a minimum level of 3.45m OD is satisfactory.