PROPOSED DEVELOPMENT AT AUSTENDYKE ROAD, WESTON HILLS, SPALDING, PE12 6BX

FLOOD RISK ASSESSMENT



View from Austendike Road

S M Hemmings B Sc C Eng MICE MIWEM,

69 Charlotte Way

Peterborough

PE39ER

This flood risk assessment has been prepared solely to support the planning application for a development alongside Austendyke Road, Weston Hills, 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.

Introduction

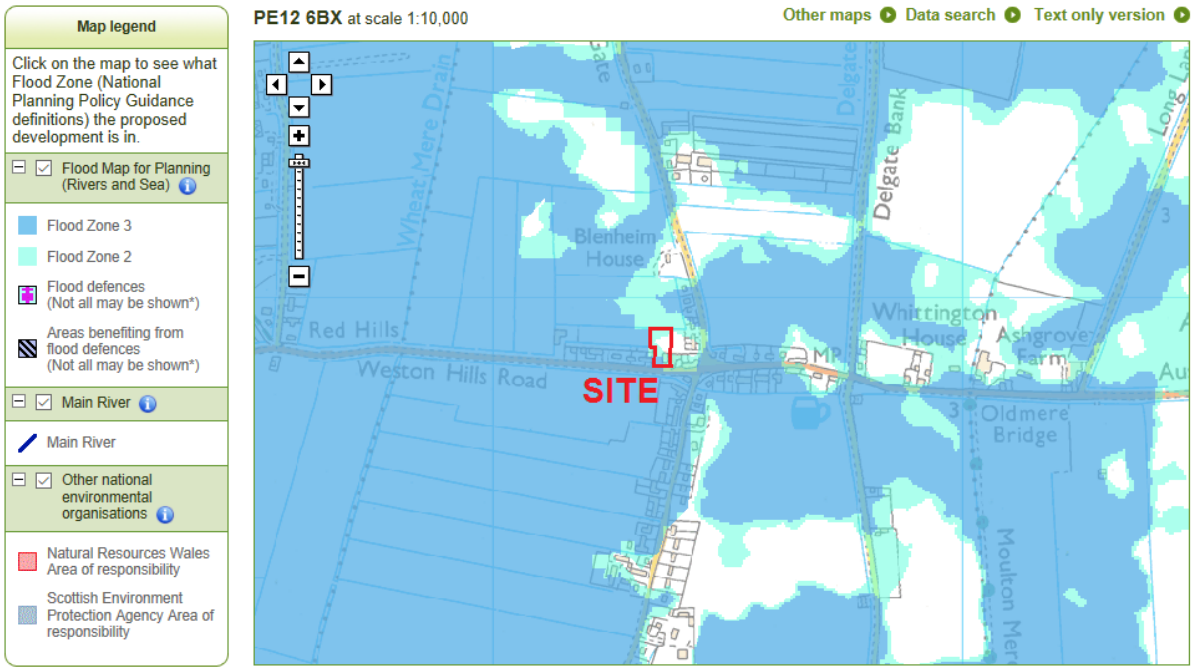
It is proposed to carry out a development of four detached houses on a site north of Austendyke Road and west of Broadgate at Weston Hills, near Spalding. The site is approximately 3.3 km east of the centre of Spalding.

The site is within Flood zones 1,2 and 3 as shown on the Environment Agency's Flood Zone map. The flood zone maps do not take into account existing flood defences.

The Planning Application requires a flood risk assessment to be carried out as required 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 the central part of the site is in flood zone 1, the north of the site is in flood zone 2 and part of the southern part of the site is within flood zone 3.

Application Site

The site is located 2.4km from the Coronation Channel and 3.4 km from the tidal section of the River Welland. The National Grid Reference of the site is 528350 321875.

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

The proposed development is within Flood Zones 1,2 and 3 as detailed on the Environment Agency's flood zone maps without defences, as defined in Table 1 of the Technical Guidance. As the site is within a defended area the part in flood zone 3 can be categorised as being within flood zone 3 (a).

Applying the flood risk vulnerability classification in Table 2 of the Guidance, a development 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 †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Therefore it can be seen that "More vulnerable" development is appropriate in flood zones 1 and 2 but only appropriate in Flood Zone 3(a) after the sequential and the exception test have been applied.

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 the map on page 2 of this report much of the area around Weston Hills is in Flood Zone 3. However the proposed development is located within a small

area of flood zones 1 and 2 near the centre of Weston Hills which can be considered as favourable areas for development as far as flood risk is concerned.

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 Weston Hills area. The safety of the development will be delivered by ensuring the floor level of the proposed new houses are 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. As most of this site was used as a storage area but is at present unused it is an ideal area for development which will enable the Council to meet the RSS and Structure Plan requirement for 2021, as there is a requirement for further land to be brought forward and used for residential development.

With the above evidence it is considered that the proposed site passes the Sequential Test as there are no other more suitable sites in this area in Flood Zones 1 or 2 with a lower flood risk.

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 flood probability
Peak Velocity ……. Nil

For year 2115 Depth of flooding … 0 – 500mm
Extent of flooding….High
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 … 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 – 0.1m/sec

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

Tables in the 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, 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 between chainage 0 km and 2.0 km.

	2007	2115
Peak 1 in 100 year flood level	4.32m OD	4.69m OD
Peak 1 in 1,000 year flood level	4.34m OD	4.69m OD

The bank levels on this section vary between 5.35m OD and 6.0m OD. Therefore it can be seen there is a minimum freeboard of 650mm to the predicted design maximum levels in 2115.

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 3.4 km from 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 2.4 km from the Coronation Channel which is maintained by the Environment Agency.

The arterial system of watercourses in the area are maintained by South Holland IDB.

Existing Ground Levels

A survey of the ground levels on the site has been carried out and a plan showing these levels is shown on page 12 of this report.

The ground levels in the northern part of the site vary between 2.78m OD and 2.96m OD. The levels are slightly lower at the southern end of the site adjacent to Austendyke Road at 2.58m OD. The level of Austendyke Road is slightly higher at 2.63m OD. The level of the fields west and north of the site are lower than the site at 2.4m OD.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Overtopping or breaching in the Coronation Channel.
2. Failure or overtopping of tidal defences of the River Welland.
3. Failure of Wisemans Pumping Station (IDB).
4. Flooding from IDB watercourses.
5. Surface Water Flooding.

1. Overtopping or breaching in the Coronation Channel

The SFRA states that the maximum design water level in the Coronation Channel is 4.69m 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.

With the site being only 2.4 km from the Coronation Channel there is a risk that flood water from this source could reach the development site if a breach occurred in the east bank of the watercourse. As the most common cause of a breach is from overtopping of a bank the risk at this location can be considered very low. If a breach were to form the flood water would be held up on the western side of the new A16 for some time, because the road is higher than the surrounding grounds levels, giving residents in the Weston Hills area time to prepare for flooding.

The SFRA shows flood depths of up to 500mm in depth at the site in a 1 in 100 year fluvial event in 2115. However the maps do not indicate this will occur due to this source.

An assessment of the possible depths of flooding following a breach of the east bank of the Coronation Channel has been carried out in Appendix A (pages 13 and 14). These depths are between 75mm and 187mm in a 1 in 100 year event in 2115, and will be below the recommended ground floor level for the proposed houses.

2. Failure or Overtopping of tidal defences

The SFRA indicates that the east bank of the River Welland, which is approximately 3.4 km from the site, has at least a 1 in 200 year standard of protection. If the eastern bank of the tidal section of the River Welland breached then the maps in the SFRA indicate that flood depths of up to 500mm in depth could occur at the site in a 1 in 200 year event in 2115. However the maps do not indicate whether this flooding is fluvial or tidal.

Flood water from this source is more likely to flood onto lower land north of the A151 road rather than flow southwards and affect the development site. The precaution of raising ground floor levels to at least 500mm above lowest ground level will adequately mitigate the risk.

3. Failure of Little Holland Pumping Station

The water level west of Broadgate in Weston Hills is controlled by Wisemans Pumping station located approximately 9km south east of the site.

If levels in the system exceeded 2.5m OD low land south of Weston would start to flood and this would prevent levels rising and it follows that the possibility of levels rising to 2.70m OD and above and causing flooding to the proposed site is remote.

All of the pumping stations operated by South Holland IDB are retained in very good condition and the Board has a telemetry system that will warn of any failures that may occur. In the event of a serious breakdown or a lengthy electricity supply problem the IDB would bring in temporary pumping equipment or generators to adequately control water levels.

Therefore the risk of flooding on this site because of a failure of Wisemans Pumping Station is considered remote as the proposed ground floor levels will be raised at least 500mm above the lowest ground levels on the site.

4. Flooding from IDB watercourses

Surface water from the site will flow eastwards through a series of dykes to discharge into the Wheat Mere drain which is located 550 metres west of the site. There is also an IDB drain on the southern side of Austendyke Road which flows westwards to discharge into the Wheat Mere Drain. This drain flows southwards for 5.7 km then flows eastwards to Wisemans Pumping Station.

The South Holland IDB have a regular maintenance programme which ensures that drains and culverts are regularly inspected and any blockages in the system are quickly rectified. The risk of a large blockage in the system causing very high water levels which would flood the proposed houses is extremely low.

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 could 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.

Therefore the risk of flooding from this source is extremely low.

5. Surface Water Flooding

Surface water could accumulate on the site if the on site disposal system for some reason fails to operate satisfactorily. However the raising of ground floor levels between 300mm and 600mm above the existing ground levels will provide sufficient mitigation to ensure the risk of flooding from this source is extremely low.

Extent of known Flooding

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

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

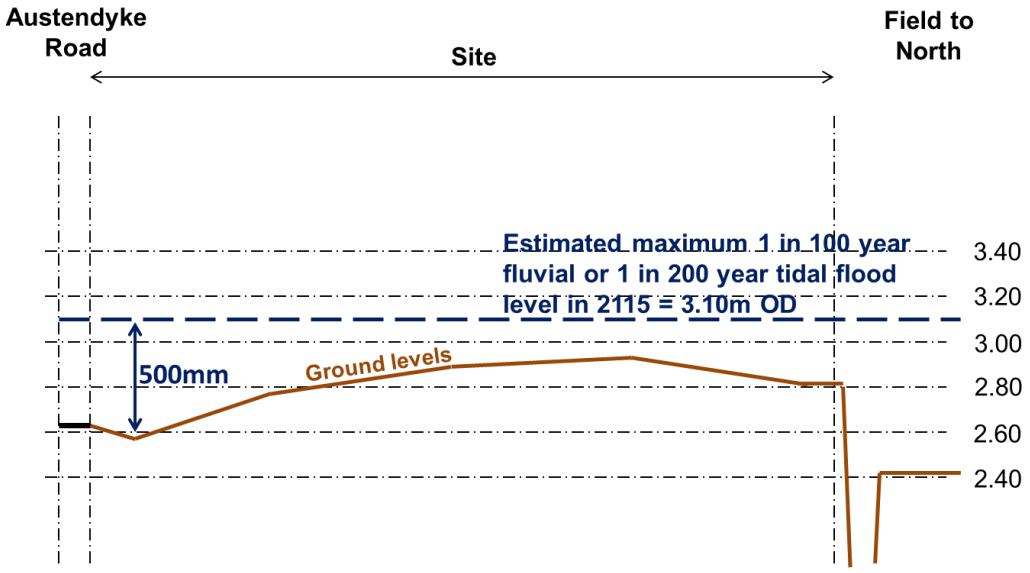
The risk of this happening in this case is low and the hazard from any flooding is also low.

Climate Change

The recommendations for flood depths for this flood risk assessment use information 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 B 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 maps in the SFRA show the depth of flooding across the site in a 1 in 100 year fluvial or a 1 in 200 year residual event in 2115 is up to 500mm. This dimension is shown on the cross section across the site which is shown below. This indicates that the best estimation of the maximum flood level in this event is 3.10m OD.



Therefore the recommended minimum ground floor level of the proposed houses is 3.20m OD.

The risk of flooding from IDB drains can be considered very low. The proposed floor level of 3.20m OD is higher than much of the land in the area which will flood to a depth of at least 500mm before the proposed houses would be affected, and this would prevent the level of any flood water from this source from rising above 3.00m OD. If the pumping stations were to fail then the IDB have adequate arrangements to operate pumps with alternative motive power, or to bring in mobile pumps.

It can be assumed that the IDB will continue to monitor predicted water levels in the area and carry out improvements to the system over the next 100 years to retain the present standard of defence.

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

Although a small part of the site is in flood zone 3, the actual risk of the site flooding from any Environment Agency or IDB watercourse is very 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. However if any flooding that did occur it would happen slowly and residents would have adequate time to prepare themselves for the event.

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 building becomes flooded after a major breach of the Coronation Channel or the tidal River Welland, and ensure there is no danger to residents when they are asleep

The ground floor level of the proposed buildings should be at a minimum level of 3.2m OD.

All future occupiers of the properties should register with the Environment Agency's Floodline Warnings Direct Service.

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

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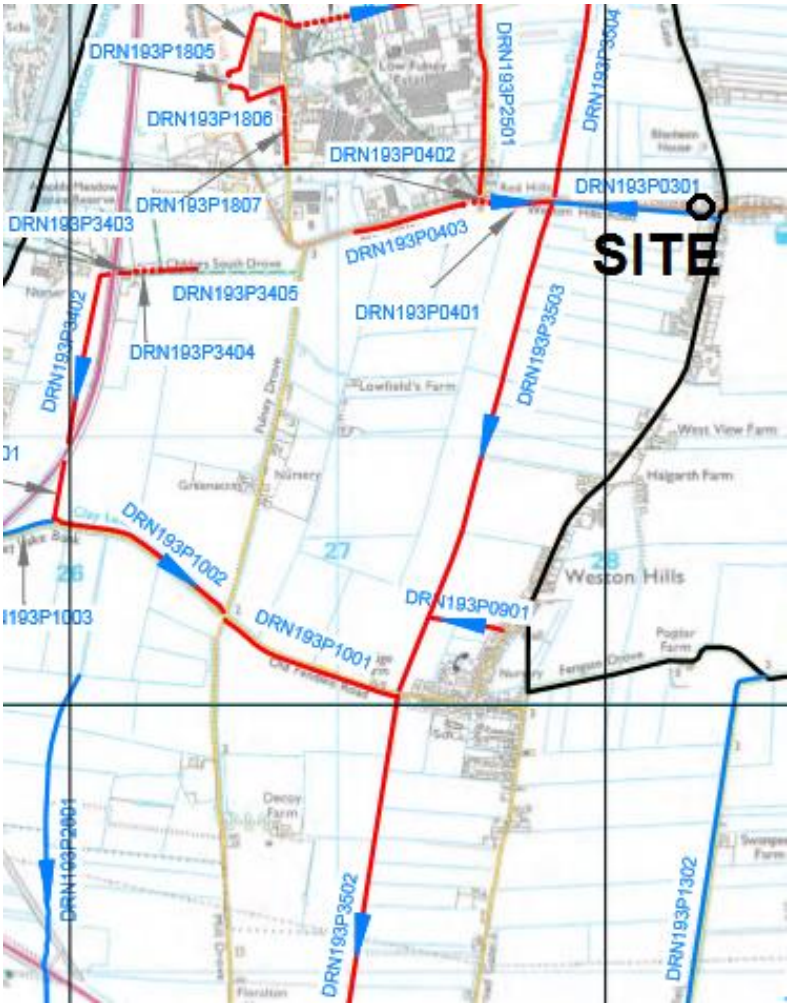
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12th December 2016

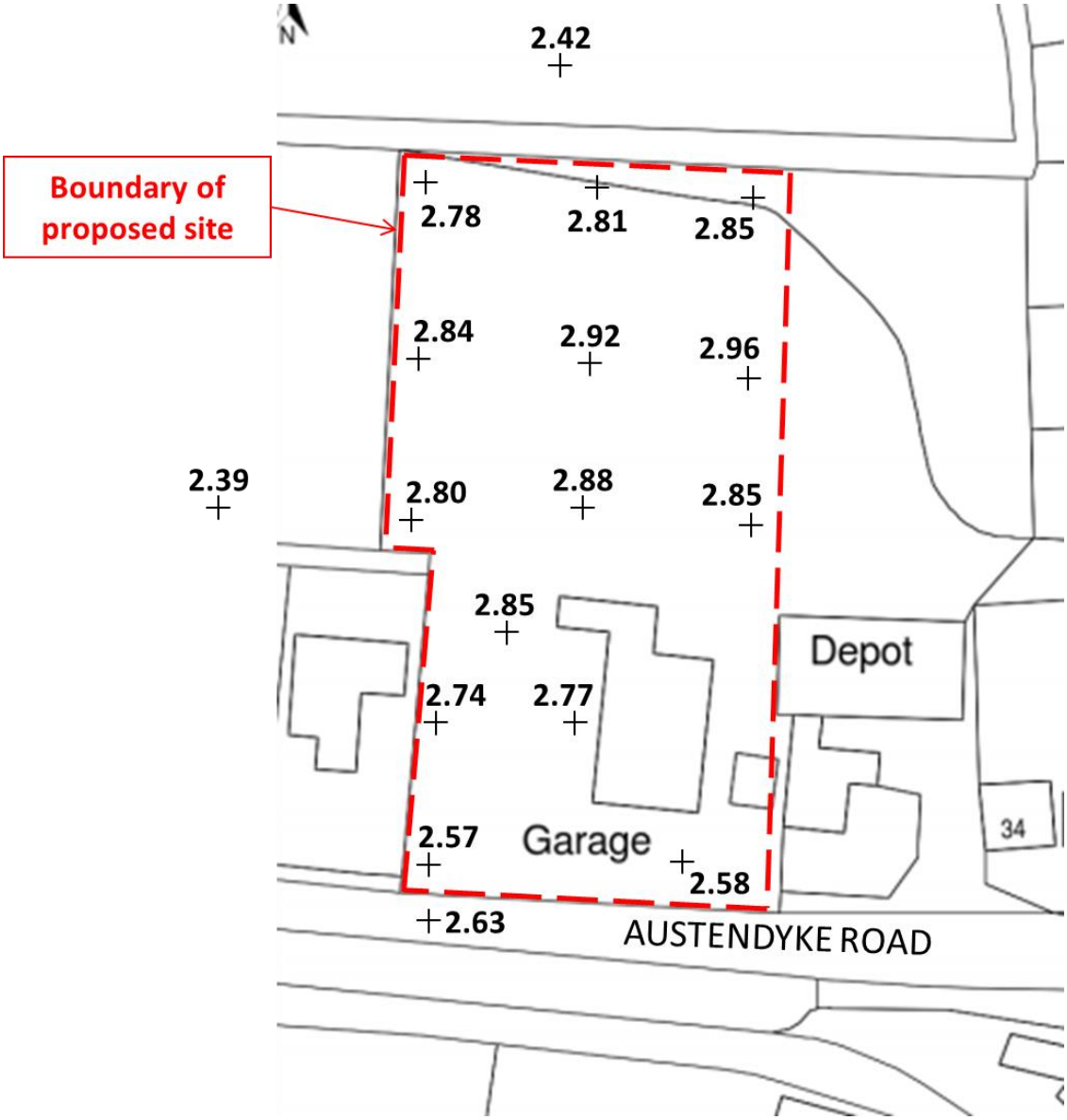
LOCATION PLAN



PLAN OF IDB DRAINS



PLAN SHOWING SITE LEVELS



APPENDIX A

BREACH CALCULATIONS FOR THE CORONATION CHANNEL

This calculation will work out an assumed volume that will flow through a 40 metre wide breach of the Coronation Channel when the water level is the maximum 1 in 100 year level in 2115.

A calculation of this volume will then be carried out at the development site to work out probable water depths, velocities and hazard rating for the site in this situation.

Maximum level of the Coronation Channel = 4.70m OD

Average level of land immediately behind the Coronation Channel = 2.5m OD

Width of breach = 40 metres

Assume the breach is a broad crested Weir

Maximum Volume through Breach = $1.7 \times b \times H^{3/2}$

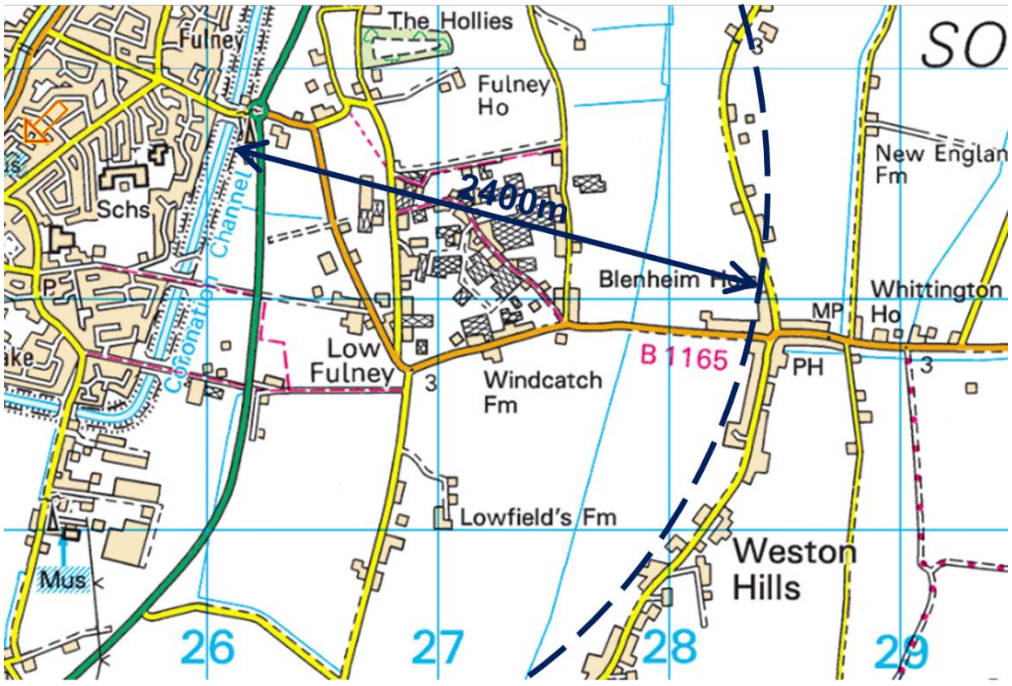
$= 1.7 \times 40 \times 2.23^{3/2}$

$= 226.4$ cumecs

Velocity of water through breach = $226.4/(40 \times 2.23)$ = 2.53m/sec

The site is approximately 2400 metres from the nearest breach position.

Assume that water will be flowing away from the breach along the dotted blue line at the same depth and velocity.



Assume a length of the dotted blue line is 0.4 x 3.142 x 2400 x 2 = 6032 metres

Therefore if we assume the same volume (226.4 cumecs) is flowing through the blue line we can work out flood depths for different chosen velocities.

For example choose velocity of 0.2 m/sec, therefore area of flow = 1132 sm

Therefore flood depth = 1132/6032 = 0.187 metres

Velocity	Flood depth	Hazard Rating	Hazard
0.2	187mm	(0.187 x 0.7) + 0.5 = 0.63	Low Hazard caution
0.3	125mm	(0.125 x 0.8) + 0.5 = 0.6	Low Hazard Caution
0.4	94mm	(0.094 x 0.9) + 0.5 = 0.59	Low Hazard Caution
0.5	75mm	(0.075 x 1.0) + 0.5 = 0.58	Low Hazard Caution

The hazard have been worked out following the guidance shown in the Supplementary Note to FD2320 and FD2321 on Flood Hazard Ratings and Thresholds for Development Planning.

It can be seen that in all the cases above the hazard rating is low.

APPENDIX B 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(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 three 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 Welland
2) Flooding from Coronation Channel
3) Flooding from IDB drainage system

1) Flooding from a breach in the tidal bank of the River Welland.

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 the new guidance increases the maximum predicted sea level in 2115 by 100mm compared with the allowance made in the SFRA.

A 100mm increase of maximum tide levels is unlikely to make the site susceptible to flooding from the Tidal Welland. It would only result in an increase in water level at the site of approximately 20mm.

With the proposed ground floor levels of the properties at a level of 3.20m OD which is 600mm above the average ground level on the site and 800mm above the level of the surrounding fields then the risk of flooding from a 1 in 200 year tidal event is extremely low.

2) Flooding from the Coronation Channel

As the development is mainly in flood zones 1 and 2 the central climate change allowance, which is 25%, will be considered. After considering the effects of this increase the higher central allowance, which is 35%, will be considered to assess the effect of this.

It is possible that the increase in climate change allowance from 20 % to 25% could slightly increase the predicted maximum water levels in the Coronation Channel. However the embanked section of the River Welland, which flows into the Coronation Channel, will be bank full and water will be flowing over the banks into the adjoining lower fenland fields in a 1 in 100 year event with flows increased by 20% for climate change. Therefore increasing flows by 25% and 35% will not significantly increase water levels, but will only increase the water flowing over the banks and therefore increase the risk of breaches occurring.

3) Flooding from IDB watercourses

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 a minimum level of 3.20m OD is satisfactory.