PROPOSED RESIDENTIAL DEVELOPMENT BEHIND 65 PETERBOROUGH ROAD CROWLAND PE6 0BB

FLOOD RISK ASSESSMENT



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This flood risk assessment has been prepared solely to support the planning application for the proposed development at 65 Peterborough Road, 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

An application is due to be submitted to South Holland District Council for planning permission for a residential development of three houses behind 65 Peterborough Road, Crowland, PE6 0BB.

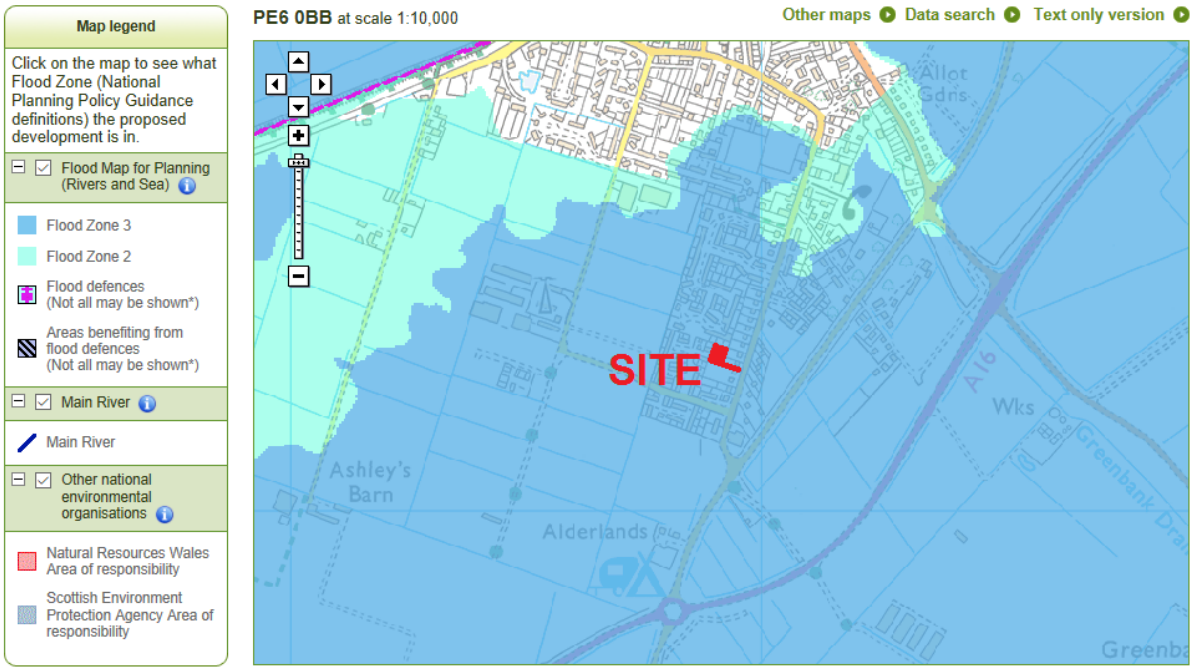
The site is within Flood Zone 3 as shown on the Environment Agency's Flood Zone Map. These maps do not take into account existing flood defences.

The Planning Application requires a Flood Risk Assessment to be carried out as required in the Technical Guidance to the National Planning Policy Framework.

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 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 all of the site is in Flood Zone 3.

Application Site

The development is located behind the existing bungalow (No 65 Peterborough Road) with an access on the south side of the bungalow. The National Grid Reference of the site is 523915 309335.

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, the site is classified as “more vulnerable” and Table 3 of the Guidance states that sequential and the exception test is required.

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 the whole of this area on the southern side of Crowland is in Flood Zone 3. The central part of Crowland is in flood zone 1 and there are no available sites in this area that are available for residential development.

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 this area of Crowland. The safety of the development will be delivered by ensuring the floor level of the proposed new dwelling is above predicted residual flood levels for this area.

South Holland District Council’s emerging Local Plan indicates a need for additional dwellings in Crowland. Policy SG3 of the adopted Council Local Plan states that Crowland is an area centre, and that area centres should continue to provide for housing, employment and commercial development to support their roles as service centres for surrounding rural areas.

Therefore the sequential test can be considered to be passed as there is a need for the housing and it cannot be accommodated in an area of 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

The following information about the flood risk at the location of the proposed development has been gained from the maps produced for the South Holland District Council Strategic Flood Risk Assessment:

1. **Report Maps**

- Map 5 indicates the site to be low or medium risk and protected by flood defences.
- Map 6 indicates the peak depth is zero for the present day 1% / 0.5% tidal event probability.
- Map 7 indicates the peak velocity is zero for the present day 1% fluvial / 0.5% tidal event probability.
- Map 12 indicates the actual risk extent for the year 2055 for the 1% fluvial / 0.5% tidal event probability is low or medium, and protected by flood defences.
- Map 13 indicates the actual risk extent site for the year 2115 for the 1% fluvial / 0.5% tidal event probability is low or medium, and protected by flood defences.
- Map 16 indicates the site is not within the rapid inundation zone.

2. **Flood Maps Table D1**

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
	Velocity … Nil
For year 2115	Depth of flooding … Zero
	Extent of flooding …low or medium
	Velocity ... Nil

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

For the present day	Depth of flooding ...zero
	Extent of flooding .. low or medium
	Velocity .. zero
For the year 2115	Depth of flooding ...zero
	Extent of flooding .. Low to medium
	Velocity .. zero

3. Maximum flood levels:

Maximum fluvial flood levels in the River Welland at Crowland at chainages between 10km and 14km are shown in the reports as follows:

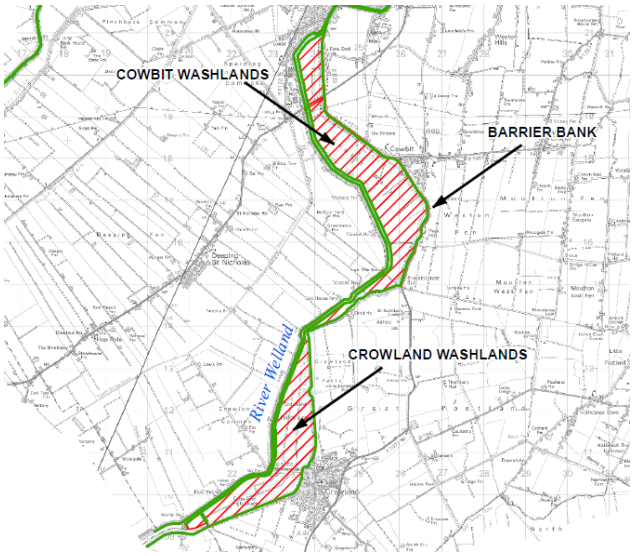
	Present	Present + Climate Change
1 in 100 year	4.76 - 4.99	4.81 - 5.03
1 in 1,000 year	4.79 - 5.03	4.82 - 5.05

The lowest level of the Barrier Bank of the River Welland stated in the SFRA is 5.81m OD at 10km and 6.08m OD at 14km.

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 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 5.10m 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.

The development site is approximately 750 metres from the Barrier Bank, the south east bank of the Crowland Washes.

Existing Ground Levels

The western half of the site is at an average level of 1.40m OD, and the south eastern quarter of the site is lower with levels between 1.05m OD and 1.23m OD. The patio behind the existing bungalow is at a level of 1.46m OD and the floor level of the bungalow is 1.66m OD. The level of Peterborough Road is higher at approximately 2.10m OD.

A plan with all the levels has been produced which is shown on page 11.

Potential Sources of Flooding

The following sources of flooding have been identified:

1. Failure or overtopping of the Barrier Bank
2. Flooding from IDB Drain

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. In Appendix 1 (pages 12 - 14) there are predictions of the depths of flooding and the hazard that could occur at the development site if a breach occurred. These have been worked out by calculating the flow through a breach 40 metres wide and then considering the flood water flowing through this area of south Crowland as a channel that becomes wider the greater the distance from the breach.

The result of this calculation gives an estimated level of flood water at the development site of 1.86m OD, which will produce depths of flooding at the development site of between 400mm and 800mm. However flood depths of this magnitude are unlikely because a large breach would result in a rapid reduction in the levels in the River Welland which would reduce the computed flow through the breach.

Therefore the maximum predicted flood level of 1.86m OD can be taken as the 1 in 1000 year flood level in 2115. This is because the flood level used for the breach calculation uses the 1 in 1000 level in 2115 for the River Welland. Therefore taking a precautionary approach it is recommended that the floor level of all two story buildings should be a minimum level of 1.90m OD, which is 40mm above the highest predicted flood level.

2. Flooding from IDB Drain

Surface water from this area west of Peterborough Road flows into the catchment area of Newborough Pumping Station which discharges the water into the River Welland 2.5km south west of the development site. The Board maintain a watercourse (reference No 827) which is 170mm west of the development site and flows in a southerly direction. The section north and south of Harvester Way has recently been piped.

IDB drains were designed to provide at least a 1 in 10 year standard of service with a freeboard of at least 900mm. This normally provides 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. If water levels were to become high this drain would overflow onto lower land south of the new A16 road which prevent any flooding in this area of Crowland from the IDB system.

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.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the site or any of the adjoining properties having been flooded in the last 50 years. The last time that a breach occurred in the River Welland was 1947, and since that date considerable investment has been made to raise banks and provide a banks which are above the 1 in 100 year flood level.

Probabilities and Trends of Flooding

The probability of this site 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

There is a residual flood risk to the site if the Barrier Bank approximately 750 metres west of the site breached when the Crowland Washes are full. Water would flood eastwards towards the proposed development site.

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 16 to 19). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

Conclusions

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

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

There is no actual risk of flooding at the present time or in 2115.

There is a residual risk that the site could flood if a breach occurs in the Barrier Bank after the Crowland Washes have been flooded. It is likely that flood water from this source would substantially increase the flow in IDB watercourses south of Crowland which would flood lower areas south west of the development site before the site was affected. As the risk of flooding the Crowland Washes is between 1 in 20 years and 1 in 50 years, the risk that the Barrier Bank would fail is considerably less than this, and must be less than 1 in 1000 years.

The breach calculations for the Barrier Bank have been carried out using 1 in 1000 year levels in 2115 for the River Welland. Therefore the flood depths predicted will be 1 in 1000 year flood depths in 2115.

Calculations of flows and flood levels are shown in Appendix A (pages 12 to 14). These indicate that the maximum predicted level of flood water following a breach would be 1.86m OD.

As a suitable soakaway system will be constructed designed to BRE365 which will allow for the adequate disposal of the surface water from the roofs of the proposed buildings, and hardstandings will also be designed to allow adequate percolation of water into the sub strata, then no surface water will flow off the site and affect any of the adjoining properties.

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 an area where there is a flood risk, however small, it is preferable that new buildings should be designed with all sleeping accommodation located on the first floor.

The floor level of the proposed new dwellings with all bedrooms at first floor level should be raised above existing ground levels to at least a level of 1.90m OD.

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

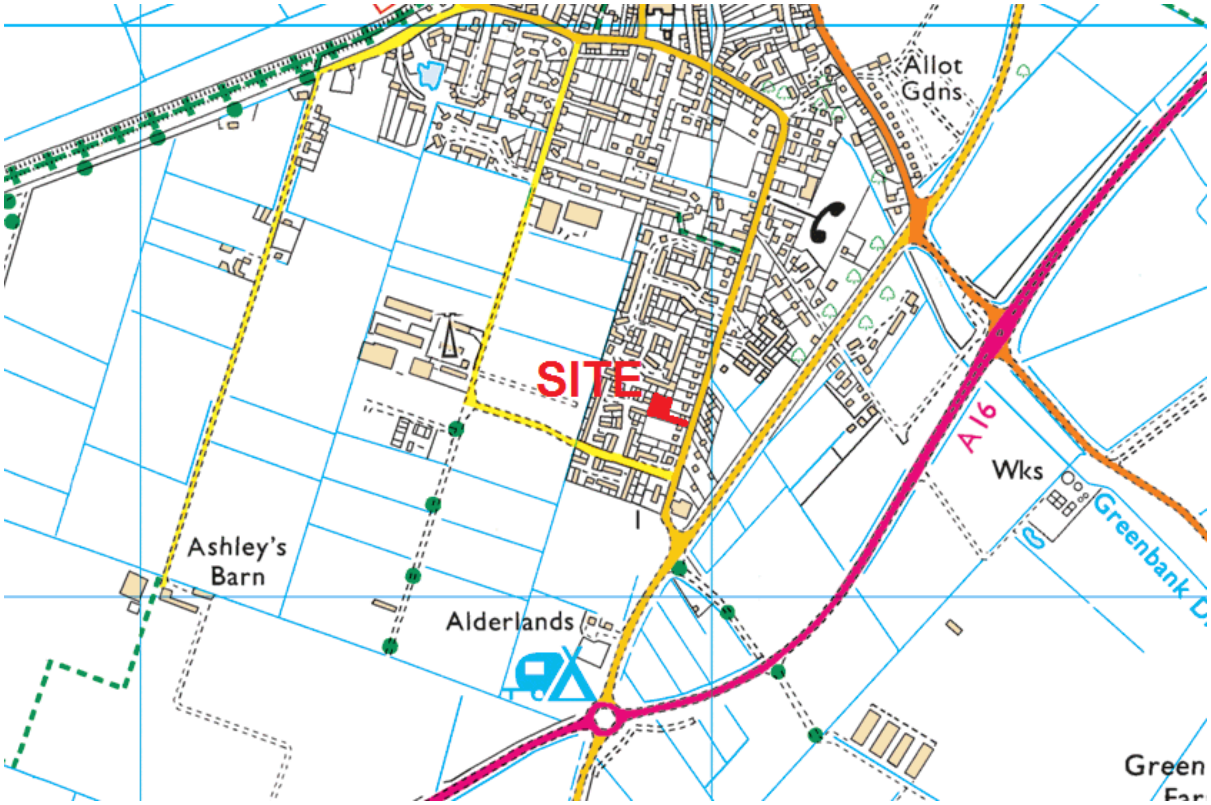
All future owners and occupiers of the dwellings should be given a copy of the Flood Risk Assessment so that they are fully aware of the risk of flooding in this area.

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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19th January 2017

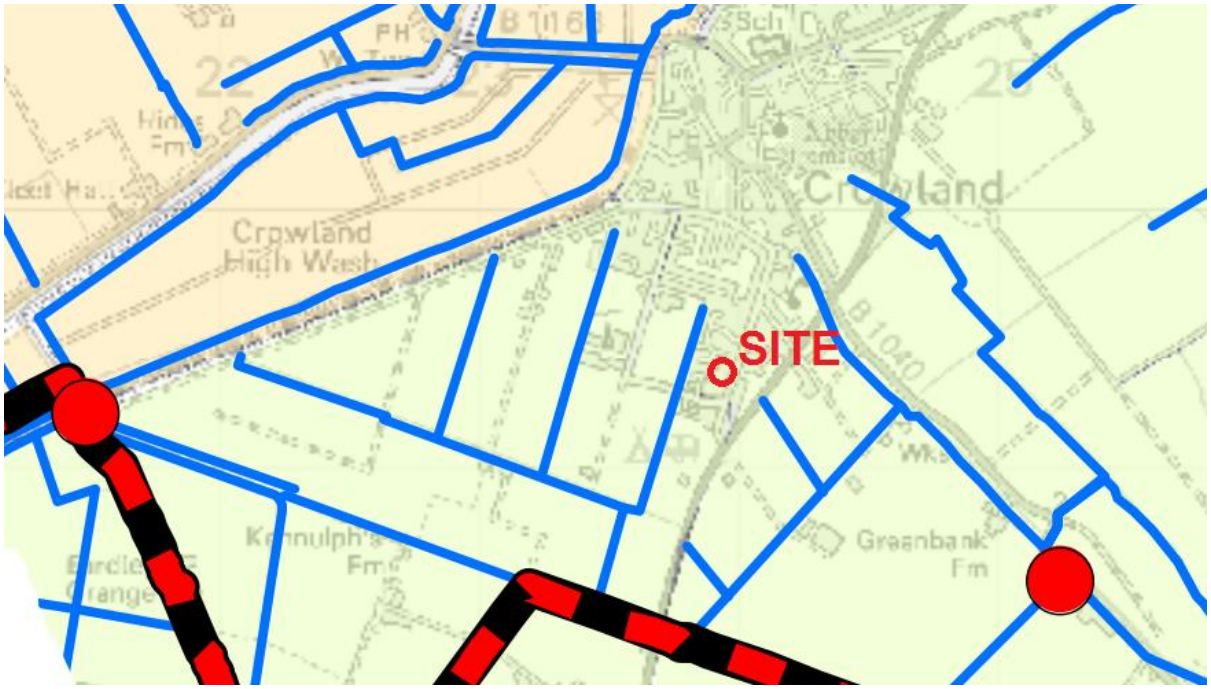
LOCATION PLAN



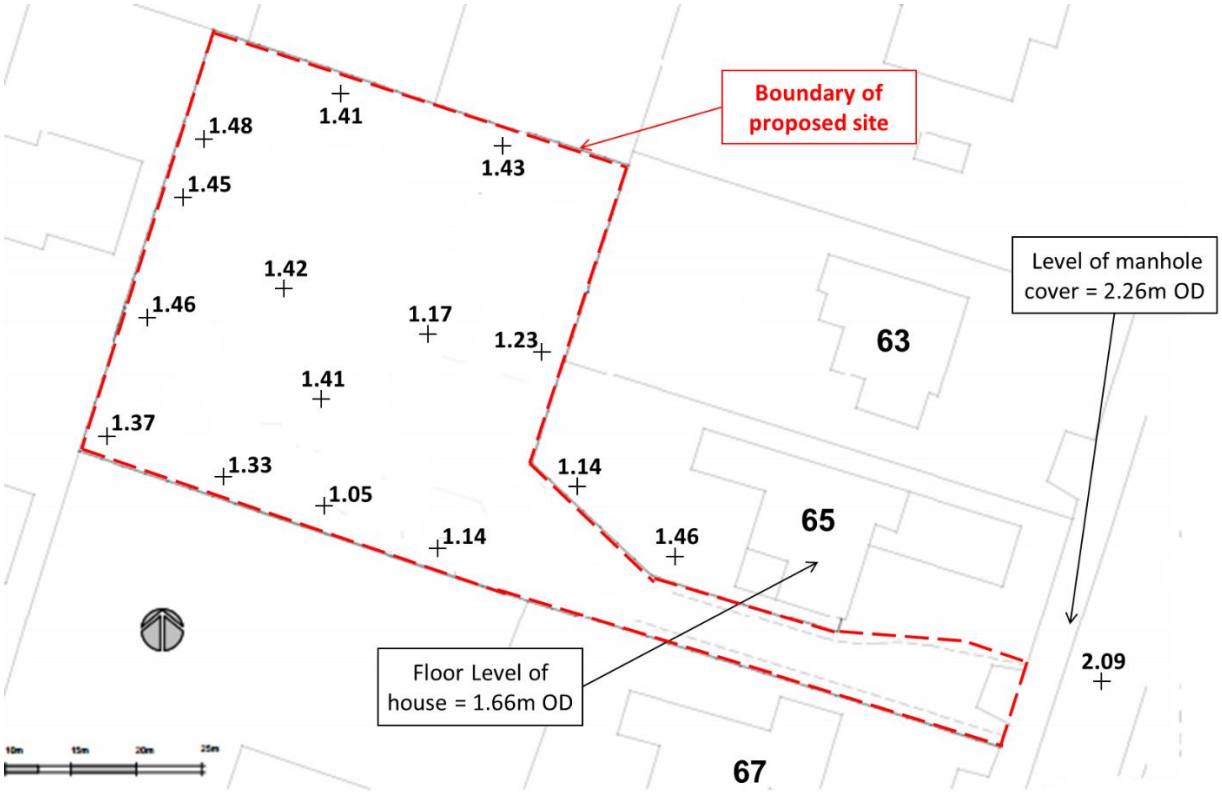
PLAN OF PROPOSED DEVELOPMENT



PLAN OF IDB WATERCOURSES



SITE PLAN SHOWING EXISTING GROUND LEVELS



APPENDIX A

BREACH CALCULATIONS FOR BARRIER BANK

The FRA has identified that if a breach were to occur in the Barrier Bank when this is full then flood water would flow in a south westerly direction and this flood water could affect the site of the proposed development. This scenario does not seem to have been considered in the SFRA.

This calculation will firstly work out the volume that could flow through this breach.

Maximum level of the River Welland = 5.05m OD (1 in 1000 year flood in 2115)

The level of Low Road behind the earth embankment protecting the southern part of the village can be seen to be 3.50m OD and 3.20m OD further south west. Therefore the maximum depth of the breach will be taken to be 1.85 metres.

Width of breach = 40 metres

Assume the breach is a broad crested Weir

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

$= 1.7 \times 40 \times 1.85^{3/2}$

$= 171.1$ cumecs

Velocity of water through breach $= 171.1/(40 \times 1.85) =$ 2.3m/sec

The site is approximately 750 metres from the assumed breach position.

An estimate of the flood depth at the site where the ground level is approximately 1.40m OD will be made by building a model in HECRAS. The flow will be assumed to discharge through the breach in a 40 metre wide channel with a base level of 3.2m OD. This is shown in cross sections at 0m, 10m 20m 30m and 40m. Then at chainage 60m of the model the width of the channel will increase to 60 metres and the bed level will be assumed to be 3.0m. The channel widths and the bed widths will be widened to simulate the flow extending over south westwards from the breach. The flow will be in this direction because

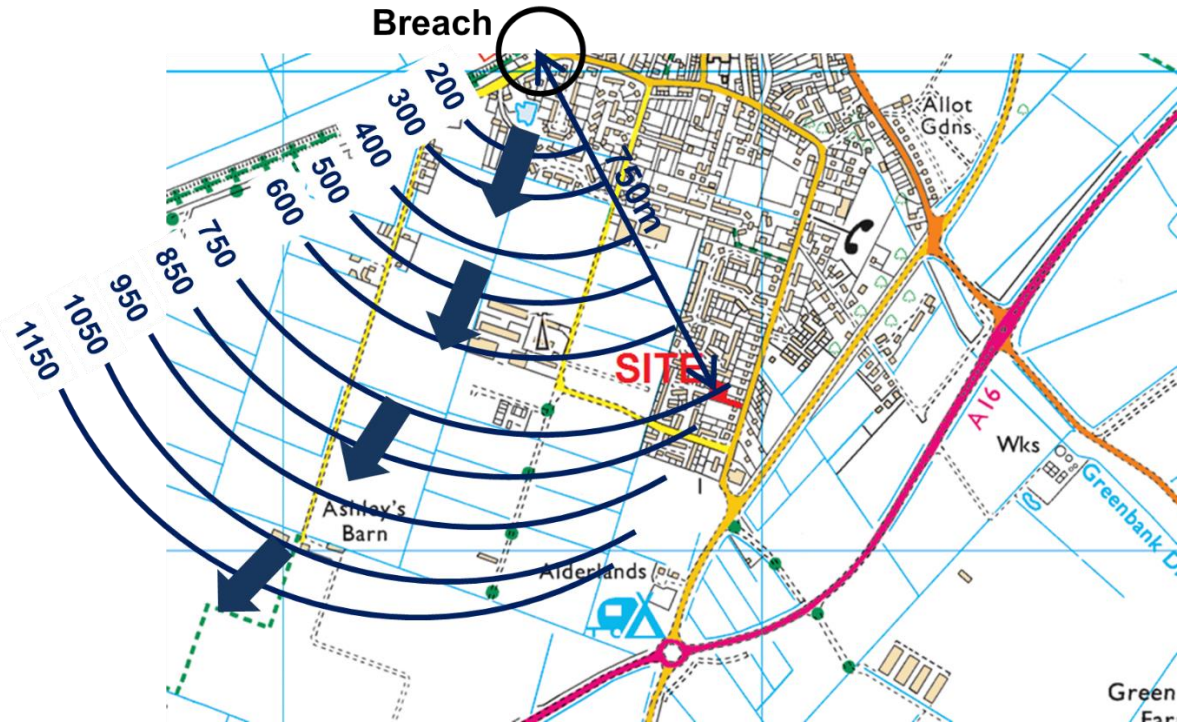
a) It will be restricted by the higher land in central Crowland to the north east.
b) It will also be restricted by the higher level of Peterborough Road.

The channel widths assumed for the flow simulation are:

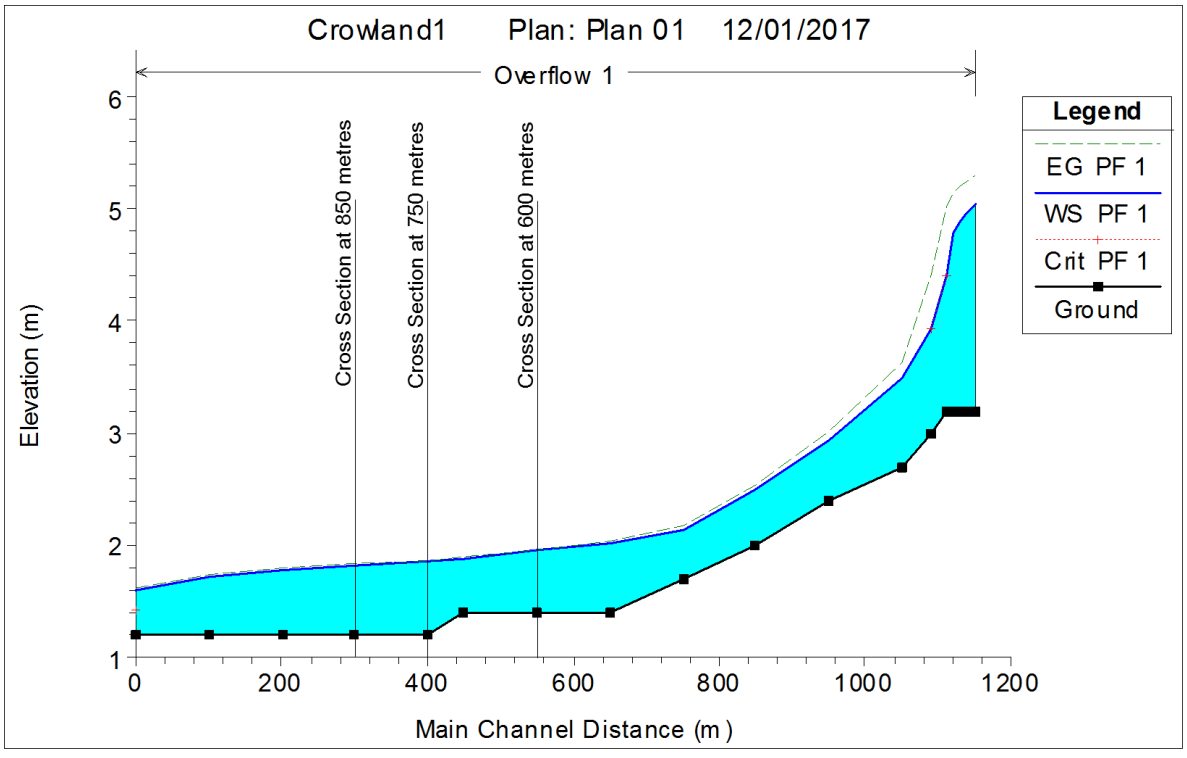
Chainage	Channel Width	Assumed ground level
60	60	3.0
100	125	2.7
200	270	2.4
300	400	2.0
400	540	1.7
500	680	1.4
600	820	1.4
700	960	1.4

750	1050	1.4
850	1050	1.4 and 1.2
950	1050	1.4 and 1.2

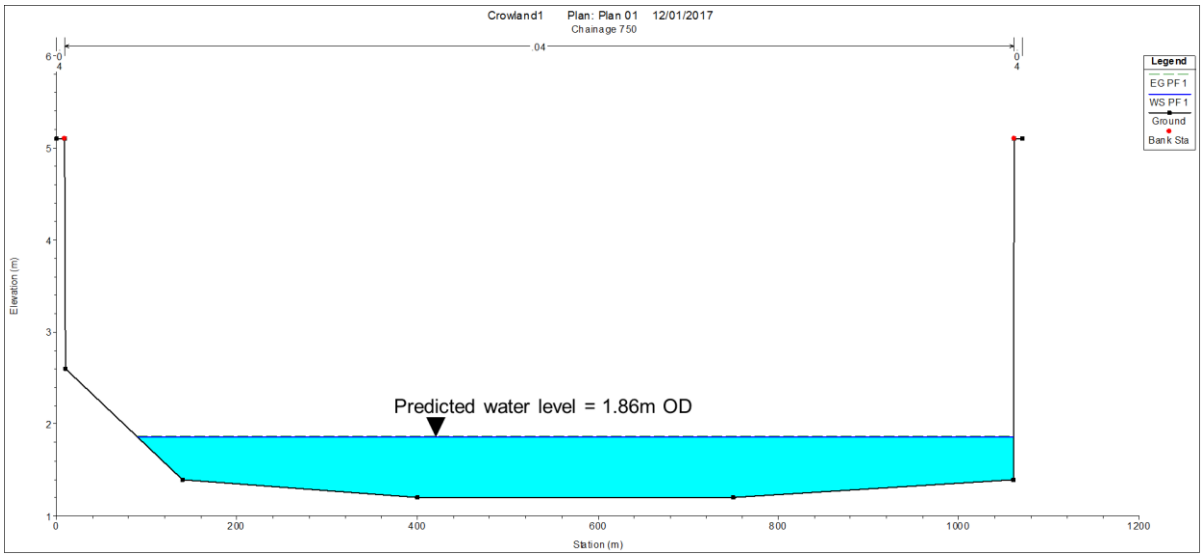
This can be illustrated on a map which is shown below. This shows the cross section positions and indicates how the flood water will flow in a southerly direction.



The results of the HECRAS flow calculation is shown on the cross section below.



The details of the cross section at 750 metres which affects the site of the development is shown below.



It can be shown that the Area of the flow is 559.2 square metres.

Therefore the velocity at this location is 171.1/559.2 = <u>0.306 metres/sec</u>

Taking the depth of water to be 600mm, the hazard at the centre of this virtual channel is:-

(0.6 x 0.806) + 0.5 = <u>0.98</u>

However the velocity on the edge of this flow of water from the breach is likely to be less than 0.1m/sec, which lower the hazard rating to:-

(0.6 x 0.6) + 0.5 = <u>0.86</u>

A hazard rating up to 0.75 is considered low hazard and above this up 1.5 it is considered moderate, or “danger for some” in the Supplementary Note to FD2320 and FD2321 on Flood Hazard Ratings and Thresholds for Development Planning.

It is concluded that the maximum flood level in a 1 in 1000 year event in 2115 would be 1.86m OD. Therefore it is recommended that the minimum floor level should be 1.90m OD as all the properties will have two stories with all bedrooms on the first floor.

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'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%

Effects on Predictions of Flood Risk in FRA

The SFRA does not predict any flooding in a 1 in 100 year event in 2115 in this part of Crowland. However it has been established that if the Barrier Bank were to breach when the flood level was the same maximum water level as the River Welland then the development site could be subject to flooding. This is the major risk of flooding to the site. There is a minor risk of flooding to the site from the IDB drainage system. The two sources of flooding will be considered below to establish whether the new climate change guidelines will affect the conclusions in the main part of the report.

1) Fluvial Flooding from the River Welland.

Fluvial flooding from the River Welland is considered to be the major flood risk to the site. As the development is in flood zone 3 and is classed as more vulnerable, the advice from the Environment Agency is that the higher central climate change allowance, which is 35%, should 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.

Maximum flood levels in the River Welland will not be increased by the increase in flows projected in the new climate change guidance. If flows increase by between

35% and 65% in this river systems it will have the effect of flooding over the long sections of bank between Market Deeping and Spalding and the maximum levels in the River will not increase significantly, and the maximum level in the Washes are not likely to increase above 5.05m OD.

2) Flooding from the IDB drainage system.

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 as the major flood risk to the site in Peterborough Road is from fluvial flooding then any increases in flow from the IDB system do not need to be considered further.

Therefore it is considered that the mitigation proposed for the development, with the recommendation that the ground floor levels should be a minimum level of 1.90m OD for the two story buildings.