PROPOSED BUNGALOW AND GARAGE AT 12 PETERBOROUGH ROAD, CROWLAND, PETERBOROUGH, PE6 0BA

FLOOD RISK ASSESSMENT

View of site looking east

S M Hemmings B Sc C Eng MICE MIWEM,

13 Lea Gardens

Peterborough

PE3 6BY

stuart.hemmings@btinternet.com

This flood risk assessment has been prepared solely to support the planning application for a development of a bungalow at 12 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

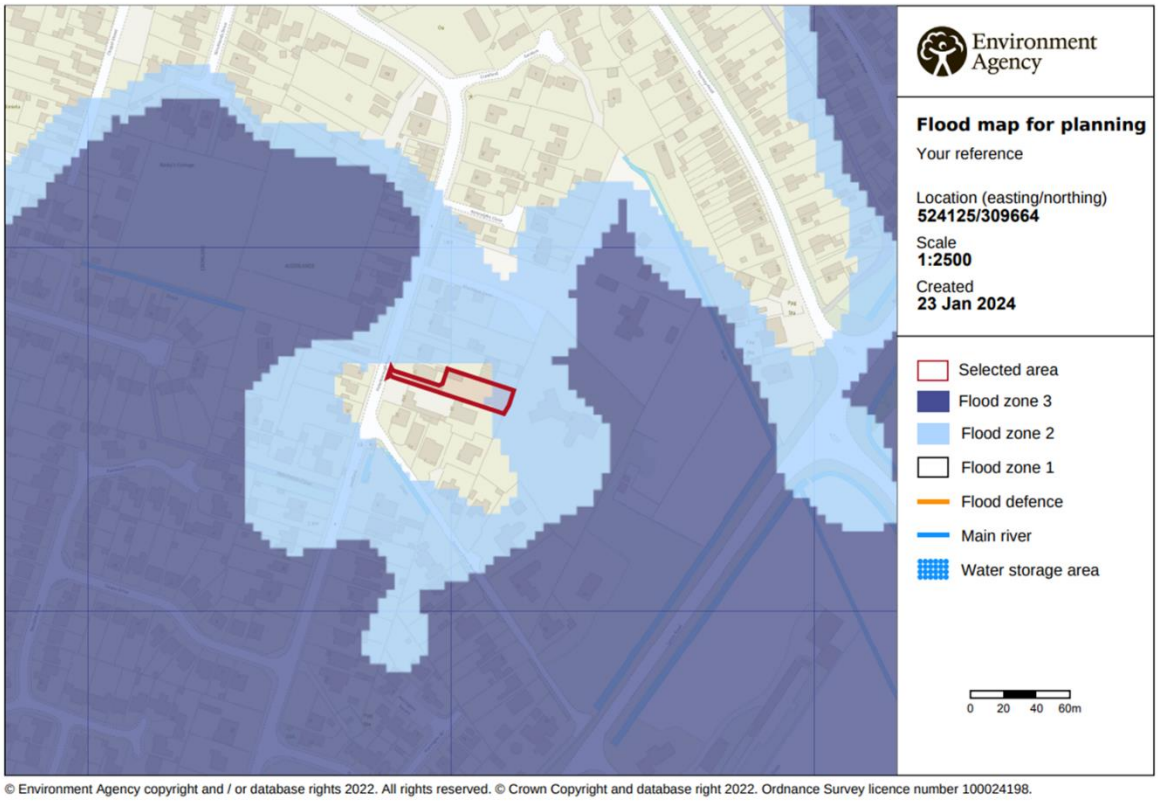
A planning application is due to be submitted to South Holland District Council for a development of a bungalow and garage east of the existing bungalow at 12, Peterborough Road in Crowland, Peterborough.

The site of the proposed development is within Flood Zones 1 and 2 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 most of the site is in Flood Zone 1, and a small part at the east end is in flood zone 2.

Application Site

The National Grid Reference of the site is 524125 309665.

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

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

From the above table it can be seen that “More Vulnerable” development is satisfactory within flood zones 1 and 2.

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 the site of this development is within flood zones 1 and 2. There are areas of Crowland that are within flood zone 1, but there are no sites in these areas which are available for the type of development that is proposed. Most available sites in the Crowland area are within flood zone 3 and therefore the proposed site can be considered to be better than most sites in the Crowland area.

The safety of the development of a bungalow with sleeping accommodation on the ground floor will be delivered by ensuring the floor level of the proposed bungalow is above the predicted residual flood levels for this area in a 1 in 1000 year fluvial or tidal event in 2115.

Therefore I consider that the sequential test has been passed.

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.

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

For the present day	Depth of flooding … zero
	Extent of flooding .. Low or medium flood probability
	Peak Velocity ……. Nil
For year 2115	Depth of flooding … 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 …0 – 250mm
	Extent of flooding .. High
	Hazard rating…… Less than 0.75 (Low hazard)
	Peak Velocity .. 0 – 0.3 metres/second
For the year 2115	Depth of flooding … 250mm – 1.0 metre
	Extent of flooding .. High
	Hazard rating…… 0.75 – 2.0 (Danger for most)
	Peak Velocity .. 0 – 1.0 metres/second

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

For the year 2115	Depth of flooding … 500mm – 1.0metre
	Extent of flooding .. High
	Hazard rating…… 1.25 – 2.0 (Danger for most)
	Peak Velocity .. 0 – 1.0 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 defence bank on the east side of 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

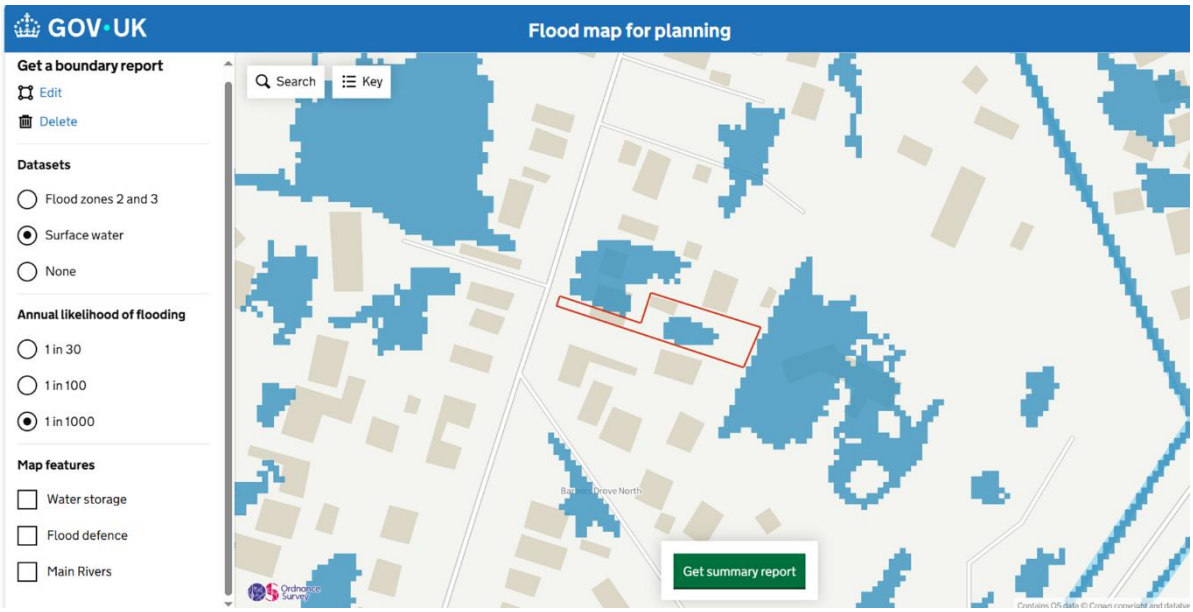
Tables in the SFRA show the following details for the defence bank on the east side of the fluvial section of the River Welland at chainage 13.0 km.

	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 6.35m OD. Therefore it can be seen there is a minimum freeboard of 1300mm to the predicted design maximum levels in 2115.

Information on Surface Water Flooding on Environment Agency Website

The map on the next page shows the annual likelihood of surface water flooding in this area of Crowland in a 1 in 1000 year event.



It can be seen the map predicts that flooding could occur on the site in a 1 in 1000 year event. The flooding is shown on the 1 in 100year map but not on the 1 in 30 year map.

Existing Flood Alleviation Measures

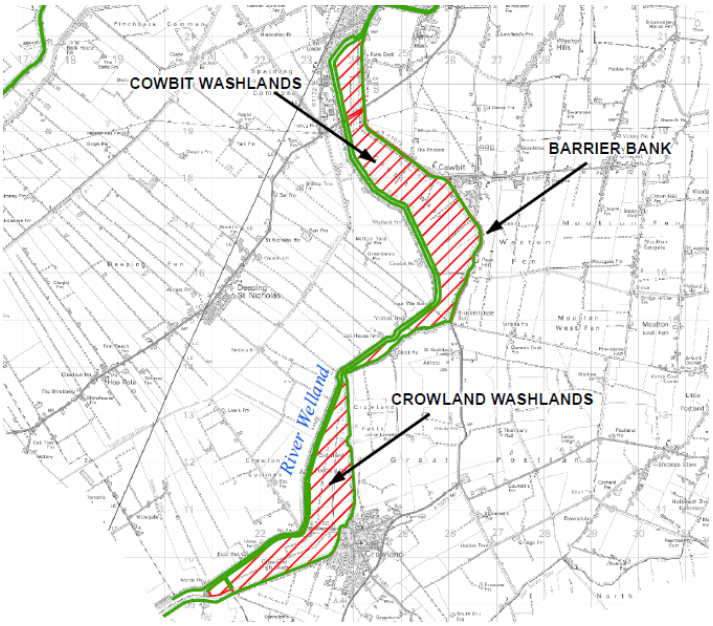
The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains", which is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding occurring 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 750 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. A map of the location of these is shown on the next page. 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 survey of the site has been carried out and the levels recorded are shown on the plan on page 13.

The average level of the rear area is between 1.50m and 1.70m OD. The finished floor level of the existing bungalow on the western end of No 12 Peterborough Road is at a level of 2.05m OD.

The level of Peterborough Road west of the property is 2.34m OD and the level of the footpath is 2.28m OD.

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 if the water level rises to a level approaching the top of the bank and prevent flooding from 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 River Welland or the Barrier Bank.

Mitigation will be provided by raising the ground floor level of the proposed bungalow above the predicted 1 in 1000 year flood level in 2115.

2. Flooding from IDB Drainage System

The nearest watercourse to the development is the upstream length of Greenbank Drain (drain 916), which is maintained by North Level IDB. This drain is 100 metres north west of the site and is usually dry during the summer months but as the drain will collect surface water from the surrounding areas it would be expected to have a small depth of water in it during the winter months. The drain flows in a south easterly direction beneath James Road and the new A16 By-pass and flows into New South Eau approximately 2.5 km south east of the development site. 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.

Surface water from 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.

Greenbank Drain is approximately 1.5 metres deep and therefore in normal times there is at least a 1.0 metre freeboard to the field east of the development site. 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.

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 banks of this drain are approximately 1.0 metre below the proposed level of the new bungalow then it is unlikely that any overtopping from the IDB drain would affect the proposed new bungalow.

3. **Localised Flooding in the area**

Although there is an adequate surface water drainage system in Peterborough Road there is still a risk of accumulations of surface water flowing onto the site. The Environment Agency surface water map predicts there could be some surface water flooding on the site.

The raising of the ground floor levels by approximately 800mm – 900mm above the existing ground level will provide adequate mitigation against any surface water flooding on the development site.

Extent of known Flooding

A combination of heavy snow, a sudden thaw, high tides, rain and wind, all caused the River Welland to break its banks in March 1947. The map on page 14 of this report shows the extent of the flooding which completely cut off Crowland for a few days. The map shows the proposed site was not affected by the flooding. Following this event banks have been raised and many other improvements have been carried out by the Environment Agency and its predecessors and the North Level IDB which significantly reduces the risk of an event such as this reoccurring.

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 the FRA. The effects of these new recommendations are considered in Appendix A 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.

South East Lincs Advice Matrix

Advice can be found on the recommended mitigation required by referring to a spreadsheet on the South East Lincolnshire website. As the proposed site is in flood zone 2 the standing advice matrix states "No comment".

If the advice for flood zone 3 is consulted with the flood hazard of 1.25 – 2.0 (danger for most) the advice shown in category D8, which is shown below.

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 250mm – 500mm, FFL must be set 500mm above existing ground level with flood resilient construction to a height of 300mm above the predicted flood depth.

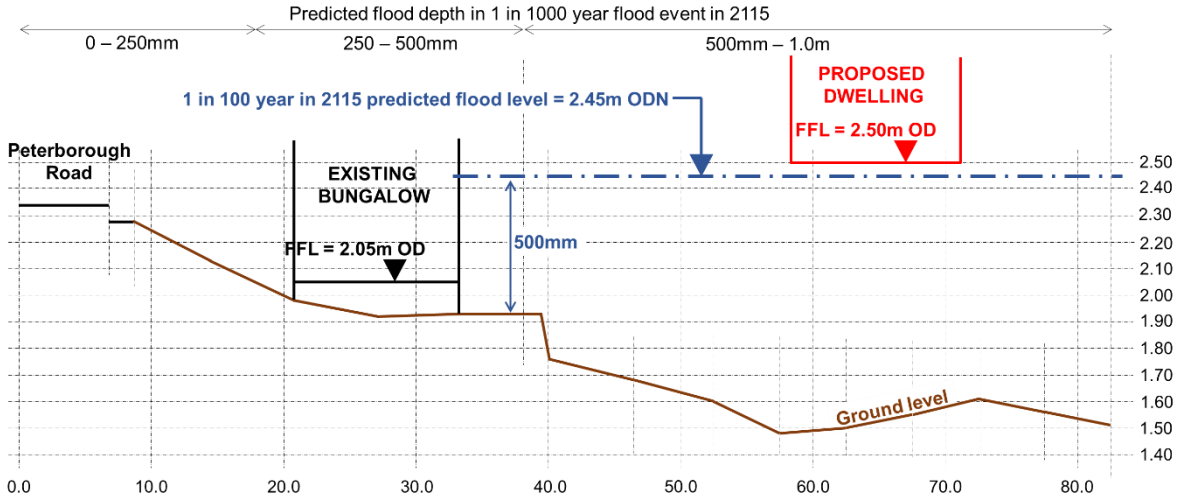
For flood depths of 0mm – 250mm, FFL must be set 300mm above existing ground level.

The conclusions set out on the next page will consider the ground levels on the site and this will enable a more accurate assessment of the flood level to be made, and a recommended level for the finished ground floor level of the building.

Conclusions

A plan of the predicted peak depth in a 1 in 1000 year event in 2115 is shown on the next page. This is an extract from the plan available on the South East Lincolnshire Planning website.

A section along the site has been drawn which is shown below using the above plan and the levels from the survey.



The boundary between the dark orange (predicted flood depths 500mm – 1.0 metre) and the lighter orange (predicted flood depths 250mm - 500mm) is where the predicted flood depth of 500mm, and this dimension is shown on the above section. From this an estimate for the 1 in 1000 year event in 2115 predicted flood level of 2.45m OD, which is also shown on this section.

The risk of flooding to the building from IDB drains can be considered low, especially as the ground floor level will be raised between 750mm and 950mm above the existing ground level.

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 2.50m OD and flood the proposed development.

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

Recommendations

In any area at risk of flooding it is preferable that new dwellings should be of two story construction with all bedrooms at first floor level. This is to provide a refuge for residents if the buildings were to become flooded after a major breach of the tidal bank, and ensure there is no danger to residents when they are asleep. However as a bungalow with sleeping accommodation on the ground floor is proposed then the finished ground floor level of the building should be raised to be above the predicted 1 in 1000 year flood level in 2115.

The ground floor level of the proposed new dwelling should be a minimum level of 2.50m OD which is approximately 160mm above the level of Peterborough Road on the western boundary of the site.

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.

The developer should advise owners and occupiers of the properties to register with the Environment Agency's Floodline Warnings Direct Service.

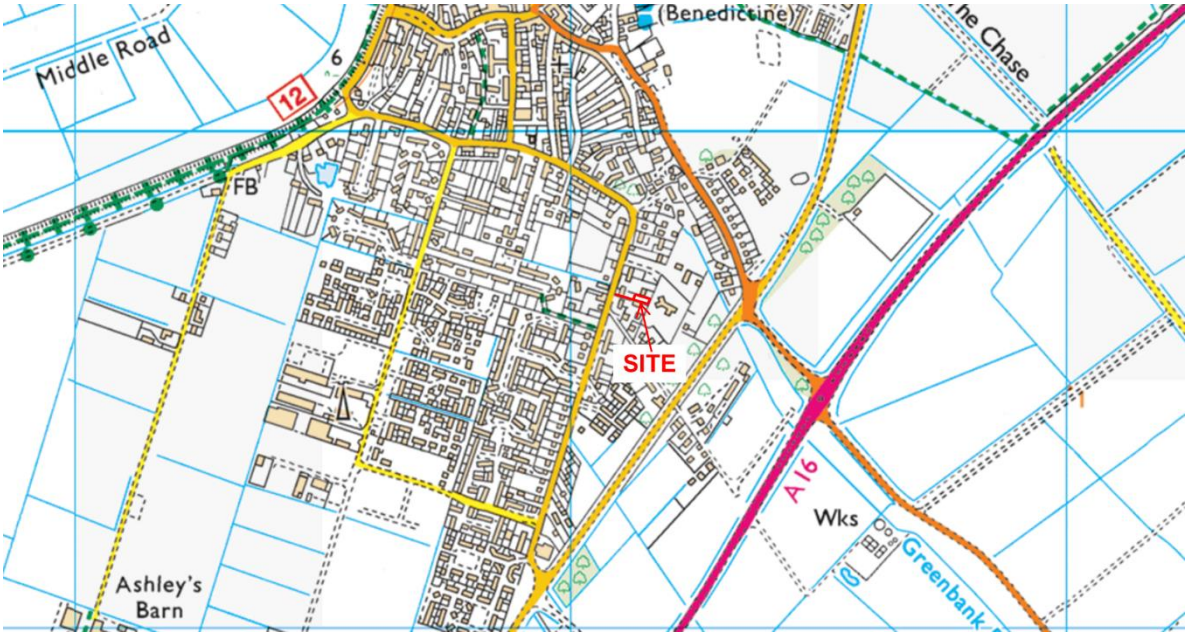
Rainwater from the roofs of the buildings should be discharged if possible into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations. New hardstandings around the building should be constructed with permeable paving.

S M HEMMINGS B Sc C Eng MICE MIWEM

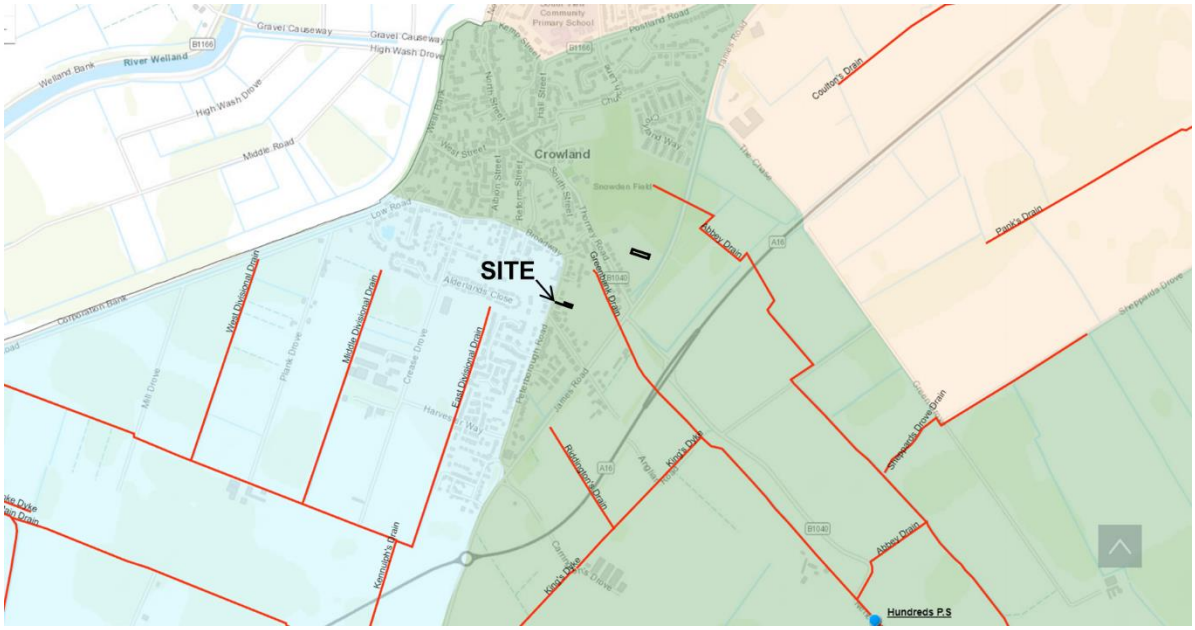
stuart.hemmings@btinternet.com

21st October 2025

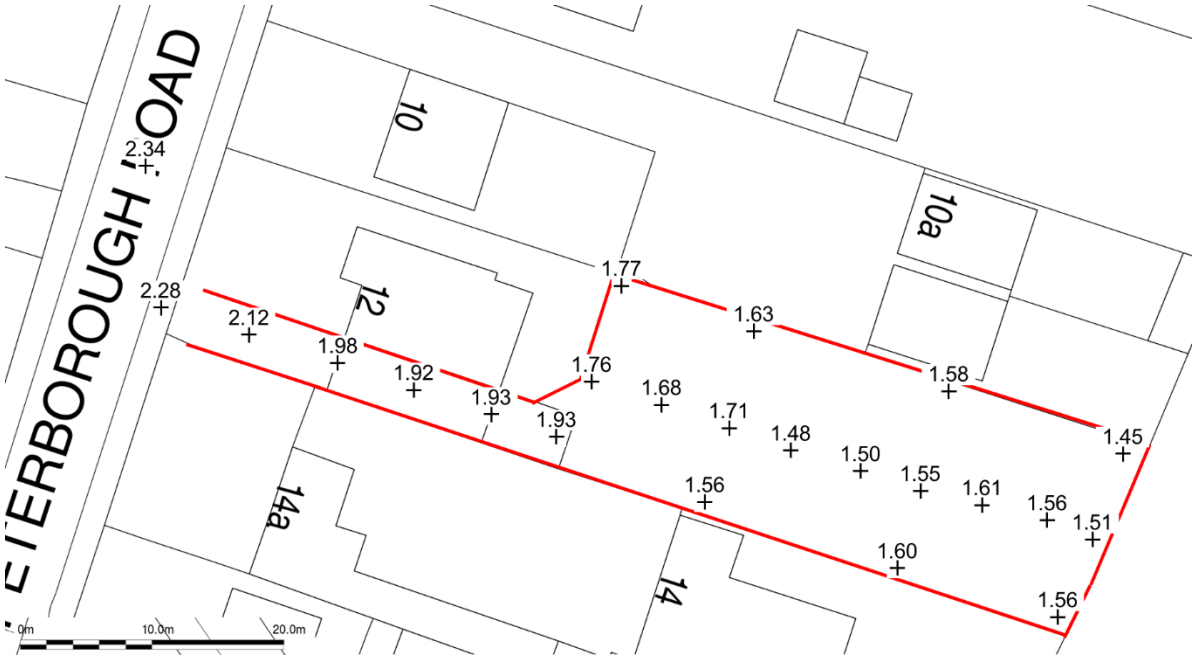
LOCATION PLAN



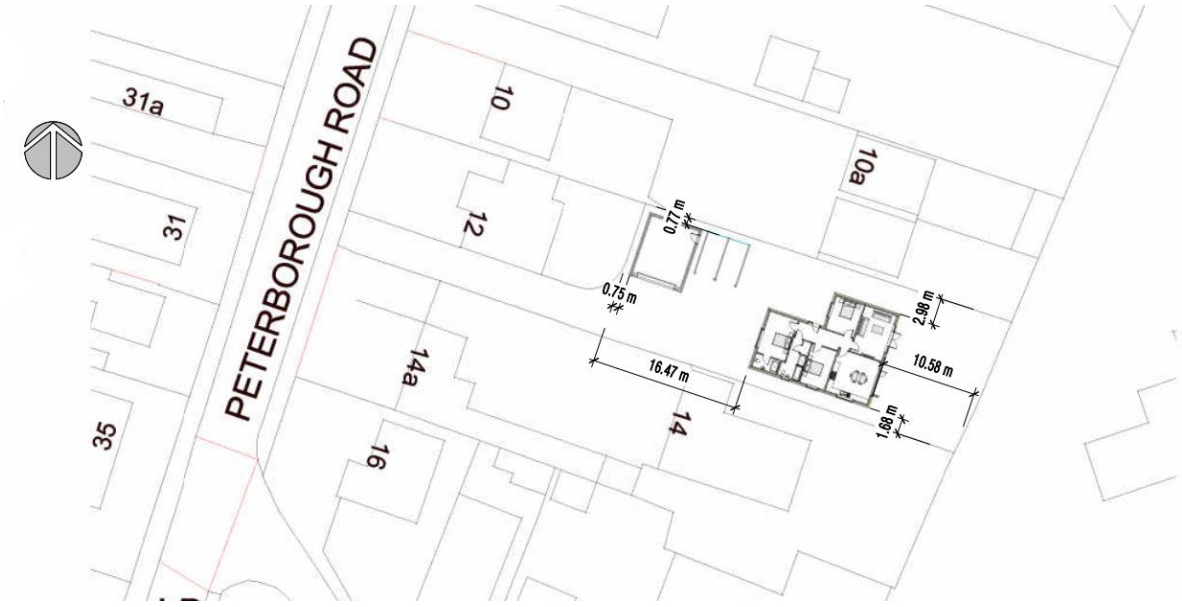
PLAN OF IDB DRAINS



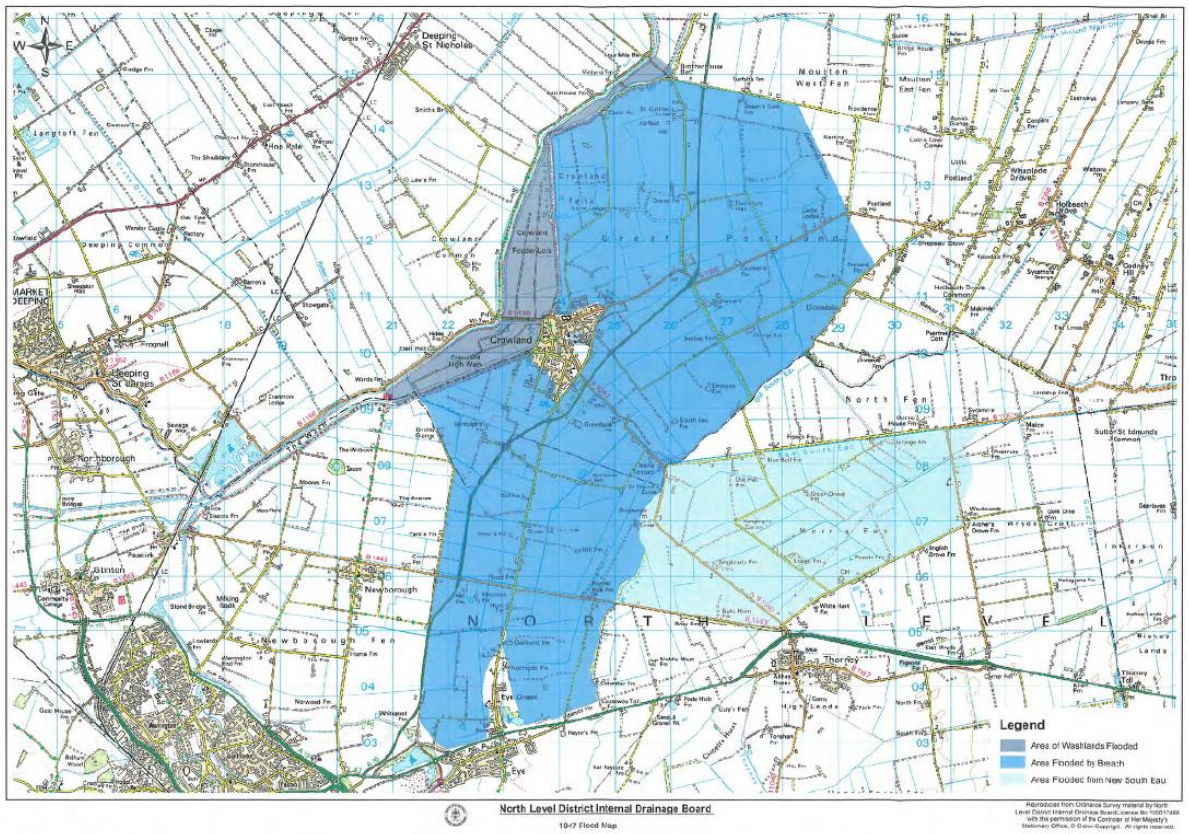
PLAN SHOWING SITE LEVELS



BLOCK PLAN OF PROPOSED DEVELOPMENT



PLAN OF FLOODED AREAS AROUND CROWLAND IN 1947



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

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%	

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 2 the central and higher central 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 part of the development is in flood zone 2 and is classed as more vulnerable, the central climate change allowance, which is 25%, should firstly be considered. After considering the effects of this increase the higher central, which is 35%, 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 25% and 35% will not significantly change the conclusion in the SFRA of what might happen if a breach occurred in the bank of the 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 should be raised by approximately 800 - 900mm above ground level and set at a level of 2.50m OD is satisfactory.