PROPOSED BARN CONVERSION AT THE CHESTNUTS, CHEAL ROAD, SURFLEET CHEAL, SPALDING, PE11 4BA

FLOOD RISK ASSESSMENT

View of barns

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 at The Chestnuts, Cheal Road, Surfleet Cheal. 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

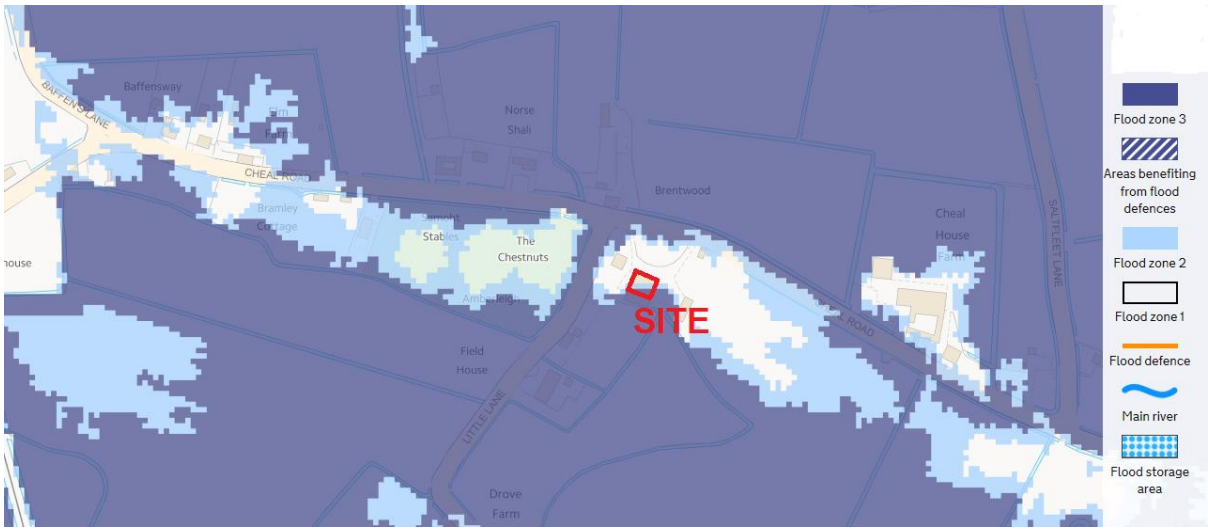
A planning application is due to be submitted to South Holland District Council to convert an existing barn for residential use at The Chestnuts, Cheal Road, Surfleet Cheal, PE11 4BA. The site is situated 1.6km north of the River Glen and 2.0km west of the village of Surfleet, which is approximately 4 km north of Spalding.

The site of the proposed house is within Flood Zone 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 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 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 this area.



It can be seen that the area is on the boundary between flood zone 3 to the south and flood zones 1 and 2 on the northern side of the site.

Application Site

The site is located 4.7 km from the tidal section of the River Welland. The National Grid Reference of the site is 523235 328810.

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

The proposed development will be considered to be within Flood Zones 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 development 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 for “More Vulnerable” development the sequential and the exception tests need to be applied to the development.

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 north of Spalding with the exception of the narrow strip of higher land south of Cheal Road is in Flood Zone 3.

As the development is the conversion of an existing barn it is not possible to site the development at a different location. 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.

The Design and Access statement will confirm that the proposed development is in accordance with the relevant South Holland District Council Core Strategy policies.

Therefore I consider that the sequential test has been 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

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 - 0.5m
	Extent of flooding… High
	Peak Velocity …… 0 - 0.1m/sec

The maps showing the residual flood hazard were revised in the 2016 update of the South Holland District Council Strategic Flood Risk Assessment and these are now shown on the website of the South East Lincolnshire Joint Planning Committee. The hazards are as follows:

For the present day	Depth of flooding .. zero
	Extent of flooding .. Low or medium flood probability
	Hazard…… None
	Peak Velocity .. zero
For the year 2115	Depth of flooding …0 - 0.5m
	Extent of flooding .. High
	Hazard…… Low (Less than 0.75)
	Peak Velocity .. 0 - 0.1m/sec

Figure 16 of the general maps show that the site is not within the rapid inundation zone for the present day or 2115.

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 River Glen outfall sluice, between chainage 15.0km and 16.1km.

	2007	2055	2115
Peak 1 in 200 year extreme tide level	5.99m OD	6.32m OD	7.13m OD
Peak 1 in 1,000 year extreme tide level	6.32m OD	6.65m OD	7.46m OD

With an average defence crest level between 7.50 and 7.70 m OD, apart from one low recorded level of 7.30m OD, the minimum freeboards are as follows:

	2007	2055	2115
Peak 1 in 200 year freeboard	1510mm	1180mm	370mm
Peak 1 in 1,000 year freeboard	1180mm	850mm	40mm

Tables in the SFRA show the following details for the predicted flood levels in the River Glen at chainage 4.5 km.

	2007	2115
Peak 1 in 100 year flood level	4.29m OD	4.65m OD
Peak 1 in 1,000 year flood level	4.43m OD	4.68m OD

The bank levels on this section vary between 4.33m OD and 5.3m OD on this length of the River Glen. Therefore it can be seen there is a risk of overtopping of the lower lengths of bank of the River Glen overtopping in the 1 in 100 year event in 2115.

The site is not within the Rapid Inundation Zone specified on the maps for the present day or 2115.

Information from the Environment Agency

The Environment Agency has provided predicted flood levels for the River Glen which are taken from the Welland Catchment Model. These levels are approximately 1km south (upstream) of the nearest point of the River Glen to the development site.

	2007	2115
Peak 1 in 100 year flood level	4.32m OD	5.12m OD
Peak 1 in 1,000 year flood level	4.47m OD	5.30m OD

The predicted flood levels for 2115 seem to have been computed ignoring any effect of overtopping that will occur between Bourne and the outfall once the river levels rise above 4.80m OD.

Existing Ground Levels

Levels have been taken on the site, and these are shown on the plan on page 13 of this report.

The level of Cheal Road varies between 3.00m OD at the crossroads north west of the site to 3.30m OD approximately 50 metres east in front of the site as far as the existing building on the north eastern corner of the site.

The ground floor level of the existing house is 3.64m OD, and the hardstanding in front of the property and the northern part of the barn is between 3.60m and 3.80m OD.

The level of the buildings forming the northern part of the barn is approximately 3.70m OD. The site slopes down to approximately 2.80m OD on the southern boundary. The southern part of the barn is at a level of 2.85m OD.

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 4.7 km from the tidal section of the River Welland north of Surfleet, which has a tidal defence bank which is maintained by the Environment Agency.

The site is located 1.6 km metres north of the River Glen which is maintained by the Environment Agency.

There are watercourses in the area that are maintained by Welland and Deepings IDB. The watercourse approximately 350 metres south of the site (the Old Beach Drain West) directly south of Gubboles Drove is maintained by the Board.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Failure or overtopping of tidal defences of the River Welland.
2. Overtopping or breach in the River Glen.
3. Flooding from IDB watercourses

1. Failure or overtopping of tidal defences

As shown above, the west bank of the tidal River Welland, which is approximately 4.7 km east of the site and north of Surfleet Sluice, has at least a 1 in 200 year standard of protection. It is extremely unlikely that flood water from a breach in the west bank of the River Welland south of the outfall sluice from the River Glen would cause flooding to the development site. The higher land and old sea banks, as well as Vernatt's Drain, would prevent flood water reaching the new A16. It is possible that flood water from a breach in the River Welland north of the outfall sluice could flow westwards and may just affect the site.

The SFRA predicts flood depths of between 0 and 500mm on the proposed development site and between 500mm and 1.0 metre to land south of Gubboles Drove. The SFRA does not specify whether this flooding is caused by flooding from the tidal River Welland or flooding from the River Glen.

From the information available in the SFRA it can be concluded that the site is more at risk from flooding from the River Glen than flooding from the tidal River Welland.

2. Failure or overtopping of the banks of the River Glen

The SFRA gives predicted levels for the River Glen of 4.65m OD and 4.68m OD for the 1 in 100 year and 1 in 1000 year events in 2115. However the Environment Agency advise that the levels will be much higher at 5.12 and 5.30m OD for the 1 in 100 year and 1 in 1000 year events in 2115.

The levels of the earth bank on the north side of the River Glen between chainage 3.5km and 4.0 km, which is directly south of the development site are shown below:

Chainage (km)	4.2	4.3	4.4	4.5	4.6	4.7	4.8
Bank level (m OD)	5.07	4.79	4.65	4.59	4.70	4.89	4.92

Therefore it would seem very unlikely that maximum levels in the River Glen could actually rise to the levels above 5.00m OD predicted by the EA.

Peak water levels occur in the River Glen when the outfall into the tidal River Welland is tide locked. During this time the levels in the River Welland are higher than levels in the River Glen, even when the latter levels are very high. This closes the large timber doors at the sluices and prevents discharge from the River Glen into the River Welland for approximately 3 to 4 hours. Immediately upstream of the sluices is an area called Surfleet Reservoir where the area between the banks is much wider where excess water is stored.

What would happen in a 1 in 100 year event in 2115 would be that water would be overtopping the earth banks in numerous places between Surfleet and Bourne which would prevent river levels rising much above the levels predicted in the SFRA.

The SFRA predicts flood depths of between 0 and 500mm on the proposed development site and between 500mm and 1.0 metre to land south of Gubboles Drove. The SFRA does not specify whether this flooding is caused by flooding from the tidal River Welland or flooding from the River Glen. As stated above the risk of flooding from the River Glen seems to be higher than the risk from a failure of the tidal defences.

3. **Flooding from IDB watercourses.**

The water level in the IDB Drain on the south side of Gubboles Drove is controlled by Surfleet Village Pumping Station which is located north of Stockhouse Lane. It can be seen in the picture below the water level in the drain in February 2017 was at least 1.5 metres below land level.

Welland and Deepings IDB have advised that the pumping range at this pumping station is from 1.80m OD down to 1.50m OD, and the design maximum flood level is approximately 2.00m OD.

Therefore the risk of flooding from this source to a building with a floor level above 3.00m OD is remote.

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. 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 A of this report (pages 14 to 17).

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 part of the development is in flood zone 3 and the flood hazard is "Low Hazard" (less than 0.75) reference should be made to Category F8 which states for all predicted flood depths:

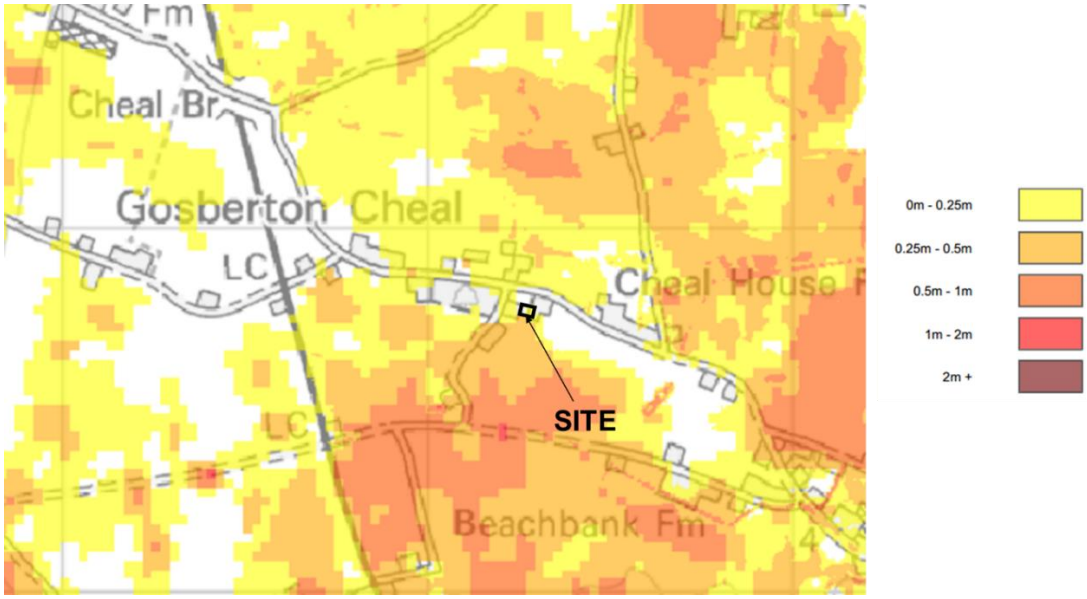
Finished Floor Levels must be set 300mm above ground level for two storey proposals. Single storey proposals must set FFL's above the 0.1% event breach depth in the 2115 scenario.

The conclusions set out below 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 level for the finished floor level of the building to be recommended.

Conclusions

The maps in the SFRA predict flood depths of 0 – 250mm on the southern part of the site in a 1 in 200 year tidal or 1 in 100 year fluvial event in 2115.

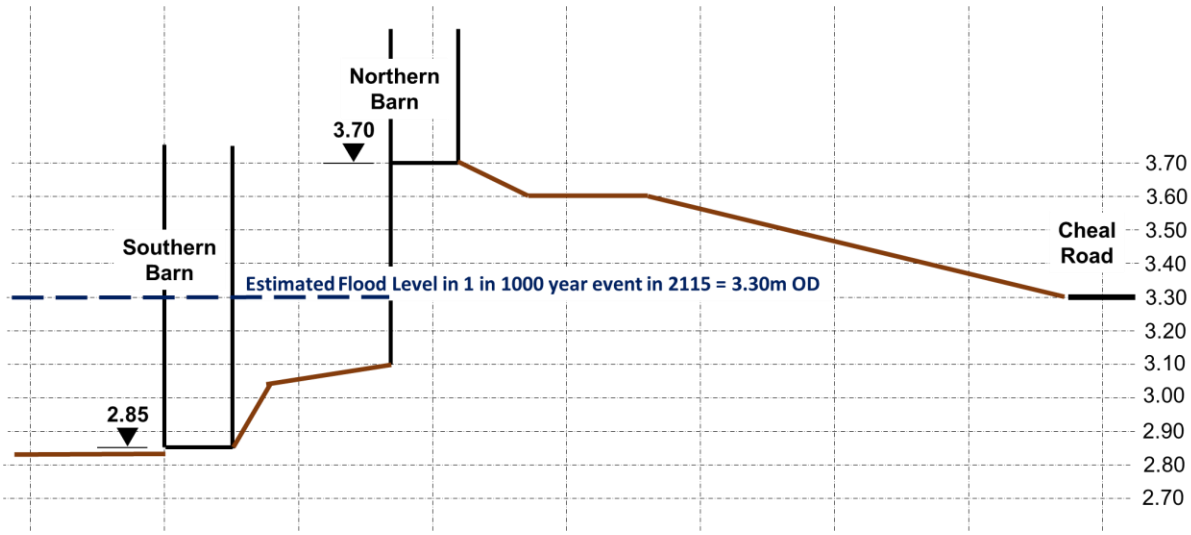
There is a risk of flooding from if a breach occurred in the north or west bank of the River Glen. It is assumed this risk produces the predicted flood depths on the residual flood depth map for a 1 in 200 tidal and 1 in 100 fluvial event in 2115, the relevant part of which is reproduced on the next page.



The plan above predicts flooding between 0 and 250mm depth over the southern part of the site. The ground levels on the site vary from approximately 2.80 m OD on the southern boundary to 3.60m OD north of the access roadway and then the level of Cheal Road is lower at 3.30m OD.

Levels were taken along Cheal Road and it was found that at the cross roads the level is 3.00m OD where the map above predicts between 0 and 250mm of flooding in a 1 in 200 year event in 2115. Further east along the road no flooding is predicted where the road level is 3.30m OD.

Therefore it can be concluded that the 1 in 200 year flood level in 2115 is 3.20m OD and the 1 in 1000 year level will probably be 3.30m OD. This is shown on the cross section south to north across the site below.



It would seem reasonable to recommend the proposed ground floor level of the southern barn is raised to a level of 3.35m OD, approximately 500mm above the present level.

The risk of flooding from IDB drains can be considered low, because the recommended floor level of the southern barn will be 1.35 metres above the predicted design level at the pumping station.

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. Welland and Deepings IDB have advised that the 1 in 100 year predicted level at the pumping station next to the site is unlikely to exceed 2.00m OD in a 1 in 100 year event. It can be assumed that the IDB will continue to monitor predicted water levels in the drain and carry out improvements to the system over the next 100 years to retain the present standard.

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

Although the all 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.

Recommendations

In any area where there is a risk of flooding, although the risk at this site is low, it is preferable to construct new buildings with two stories with all sleeping accommodation on the first floor, in order that the first floor can provide a safe refuge if any flooding were to occur.

However the development proposed is a conversion of a single storey barn for residential use. Therefore it is only possible to site sleeping accommodation on the ground floor. The South East Lincolnshire Advice Matrix advises that this will be safe as long as the finished ground floor level is above the predicted flood level for a 1 in 1000 year event in 2115.

Therefore all finished ground floor levels in the proposed conversion should be at a minimum level of 3.35m OD. This will involve raising the southern part of the barn by approximately 500mm. The northern section of the barn conversion is at a level of 3.70m OD and consideration should be given to placing all sleeping accommodation at this higher level.

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

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

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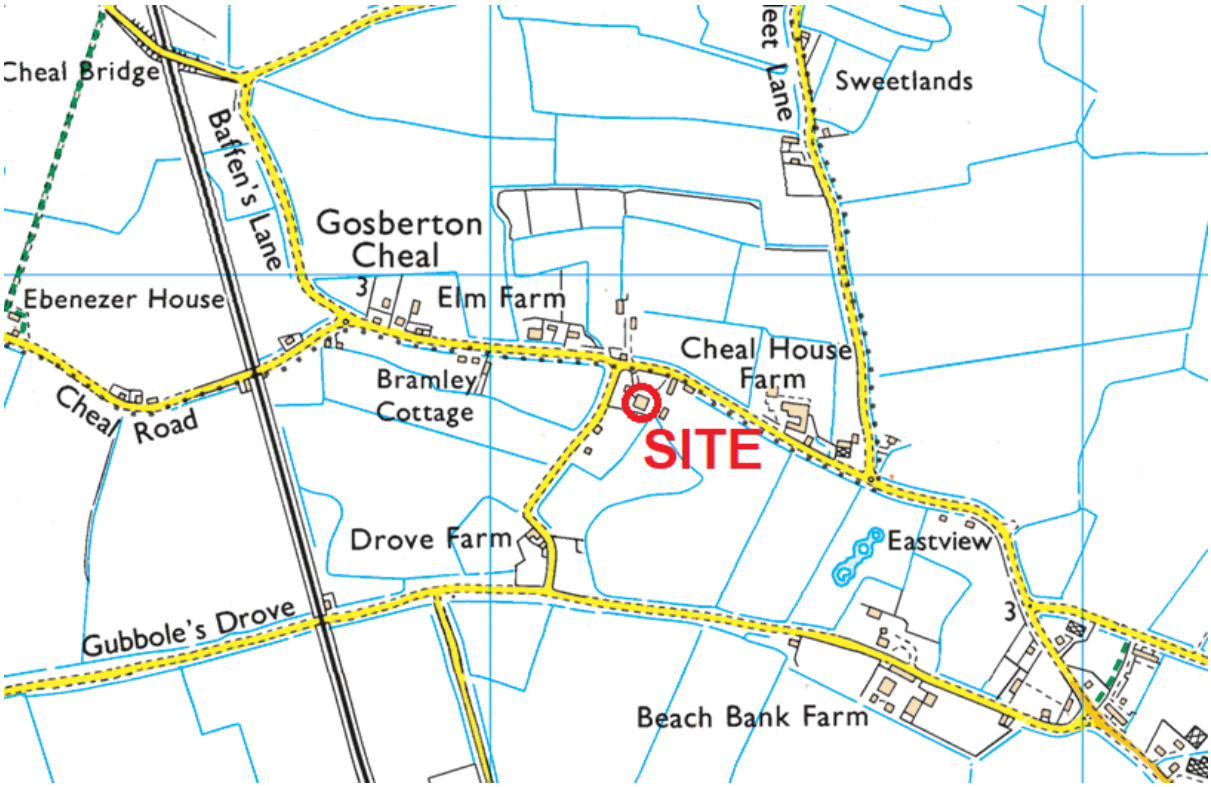
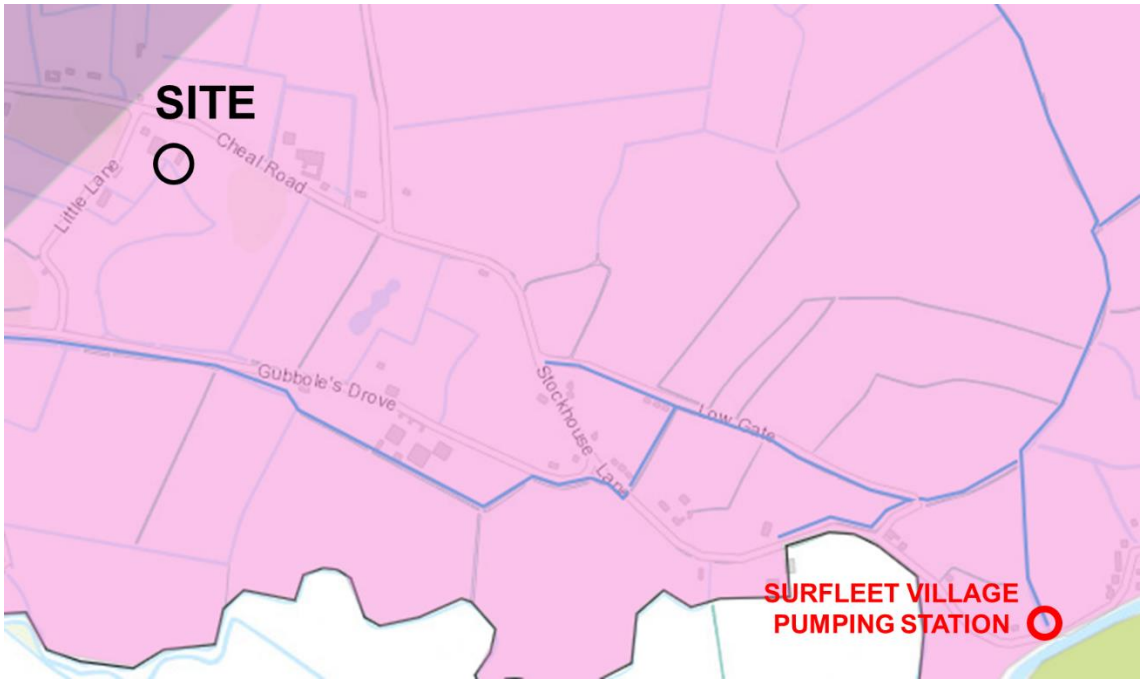
5th September 2018

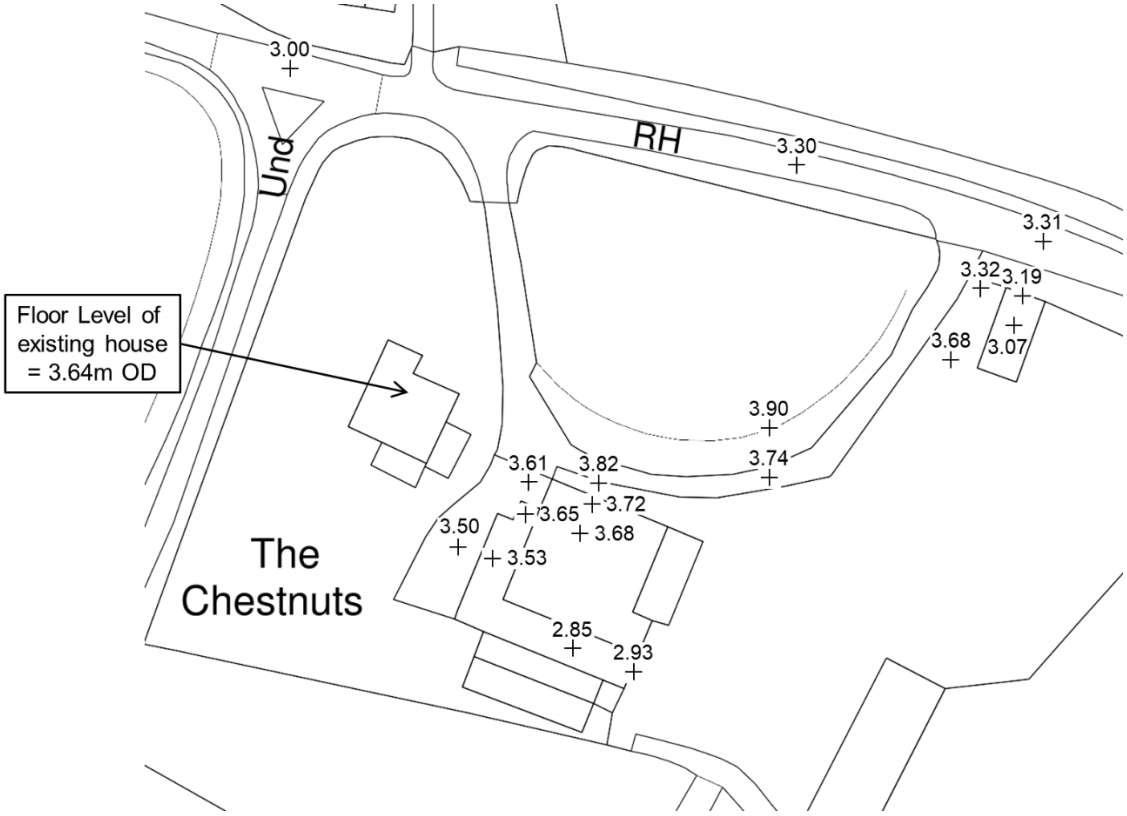
LOCATION PLAN



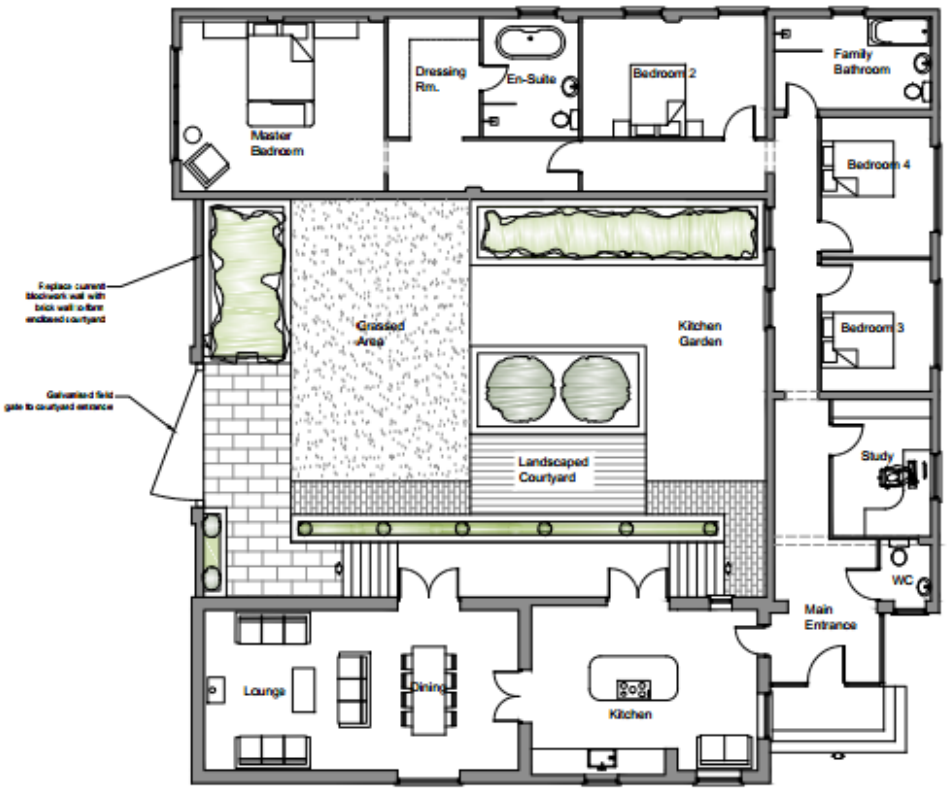
PLAN OF IDB DRAINS



PLAN SHOWING SITE LEVELS



PROPOSED PLAN OF DEVELOPMENT



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%	

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

The FRA has identified two 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 the River Glen
3) Flooding from IDB Watercourses

1) Flooding from the tidal 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

The SFRA predicts a maximum any residual flooding on any part of the site in a 1 in 200 year event in 2115. The risk of flooding from the tidal River Welland is extremely low due to the reasons set out on page 7 of this report.

An increase of 100mm in maximum tidal levels is only likely to increase the maximum flood depths by around 10mm at the location of the development site, and is unlikely to significantly change the predicted flood depths indicated on the maps in the SFRA.

The precaution of recommending that the proposed new building should have a minimum ground floor level of 3.35m OD should still ensure that the risk of flooding to the building is extremely low in a 1 in 200 year event in 2115.

2) Flooding from the River Glen

Fluvial flooding from the River Glen 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 Glen will not be increased by the increase in flows projected in the new climate change allowances. 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 Bourne and Surfleet Reservoir and the maximum levels will not increase significantly.

3) Flooding from IDB drains

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.

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 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 3.35m OD, is satisfactory.