PROPOSED REPLACEMENT BUILDING
AT 25 THE RESERVOIR, SURFLEET SEAS END, PE11 4DJ
FLOOD RISK ASSESSMENT



View of existing property from alongside river

S M Hemmings B Sc C Eng MICE MIWEM,

40 Celta Road

Peterborough

PE2 9JD

This flood risk assessment has been prepared solely to support the planning application for a replacement building at 25 The Reservoir, Surfleet Reservoir. 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 for which it was originally commissioned.

Introduction

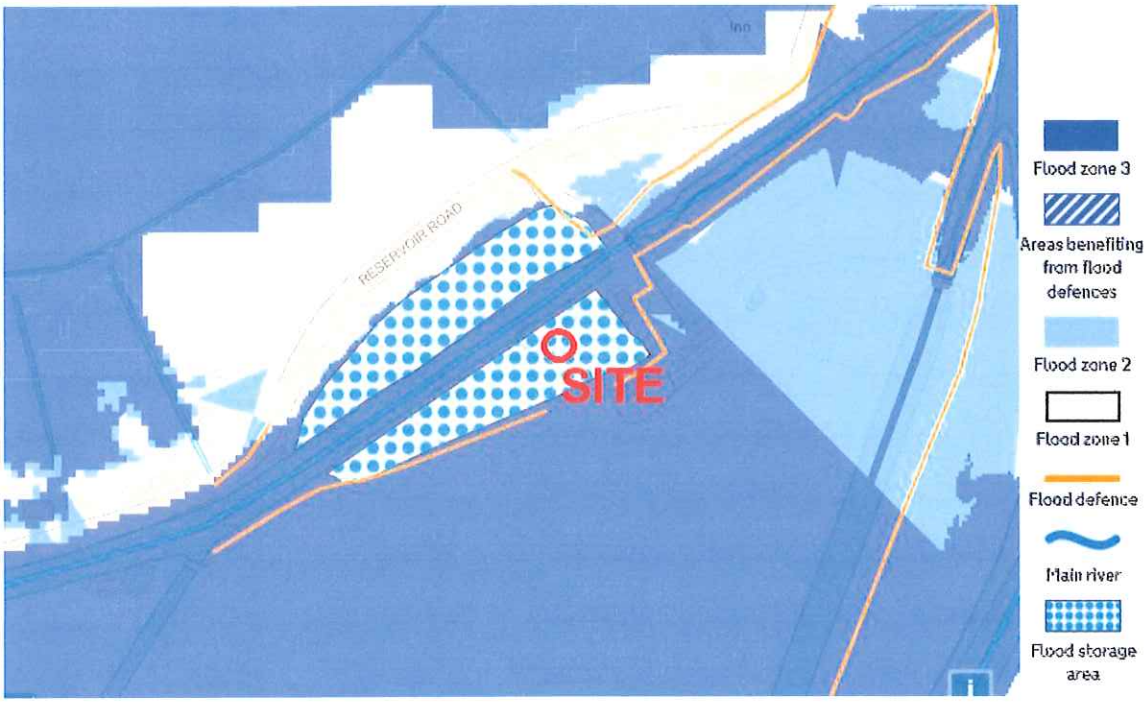
The prospective owners of the existing building at 25, The Reservoir, Surfleet Reservoir, Spalding, PE11 4DJ propose to demolish the existing building and to construct a new two storey building. The site is situated on the south bank of the River Glen approximately 90 metres west of the Sluices and Bridge over the river and is approximately 7.2km north of Spalding.

All of the site 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 site is in Flood Zone 3(b) and is designated in the above map as a flood storage area.

Application Site

The site is located 90 metres from the sluice at Surfleet Reservoir and the tidal section of the River Welland. The National Grid Reference of the site is 527910 329190.

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

As the area is within the functional flood plain then the proposed development is designated to be within Flood Zone 3(b) using the definitions in Table 1 of the Technical Guidance.

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

In general the Practice Guidance to the National Planning Policy Framework Development and Flood Risk states that development in waterside areas such as the buildings alongside the River Glen at Surfleet Reservoir are not appropriate as they are located in Zone 3b, where only essential infrastructure is allowed. However as this building is a replacement of an existing building the principle of development has been established at this location.

The guidance requires the developer to demonstrate that the development will be safe for the planned life of the development, and measures for managing the development at the end of its planned life.

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 proposed development is a replacement for an existing building, and as such cannot be located anywhere else except at the location of the existing building. Surfleet Reservoir is a unique location in the South Holland area where residential buildings have been allowed to develop next to the river.

The guidance gives the following advice where an alternative location is not possible, which can be also applied to developments such as these:

When applying the Sequential Test, a pragmatic approach on the availability of alternatives should be taken. For example, in considering planning applications for extensions to existing business premises it might be impractical to suggest that there are more suitable alternative locations for that development elsewhere. For nationally or regionally important infrastructure the area of search to which the Sequential Test could be applied will be wider than the local planning authority boundary.

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

The following information about the flood risk to the proposed development has been gained from the tables that can be found in the South Holland District Council Strategic Flood Risk Assessment issued in January 2010:

1. **The maximum flood level in the fluvial section of the River Glen is as follows:**

Year	2007	2115
1 in 100 year	4.09	4.90
1 in 1,000 year	4.12	4.96

2. **The extreme tide levels in the section of the River Welland at chainage 16.1km is shown in the report as follows:**

	2007	2055	2115
1 in 200 year	5.99	6.32	7.13
1 in 1,000 year	6.32	6.65	7.46

The bank levels of the west bank of the tidal River Welland north and south of the River Glen outfall are at a level of approximately 7.50m OD and above, but the bank level at 16.1km, the River Glen outfall is shown to be 7.05m OD.

Information from the Environment Agency

The Environment Agency has provided predicted flood levels for the River Glen which are taken from the Welland Strategic Catchment Model produced in 2016.

	2016	2016 with 20% climate change allowance
Peak 1 in 100 year	4.17m OD	4.78m OD
Peak 1 in 1,000 year	4.30m OD	4.83m OD

The Environment Agency has provided the following predicted fluvial flood flows measured in cumecs for the River Glen which are taken from the Welland Strategic Catchment Model produced in 2016.

	2016	2016 with 20% climate change allowance
Peak 1 in 100 year flow	65.92	77.20
Peak 1 in 1,000 year flow	76.89	85.97

The Environment Agency state:-

- The predicted water levels are in channel levels and therefore may not represent the flood level on the flood plain, particularly where the channel is embanked or has raised defences.
- The allowance for climate change in the 2016 model was 20%.

The Environment Agency advice also included the following information on the operation of the Surfleet Reservoir and the Sluice:

Surfleet Reservoir was constructed in order to store floodwater from the River Glen until high tides on the River Welland had passed. The structure that controls water levels for the Surfleet Reservoir is the Surfleet Sluice. It is manually controlled and river level is generally kept to 2.70-2.80m AOD. When high flows are registered upstream at Kate's Bridge, the sluice at Surfleet is opened as early as possible in order to pass the flood waters safely through at an early low tide. We have been able to protect the chalets within Surfleet Reservoir most of the time, but there are times when the river flow and high tides coincide and the chalets may flood. The nature of

how the reservoir works means we cannot protect these properties all of the time. The frequency of flooding will increase with climate change.

Existing Flood Alleviation Measures

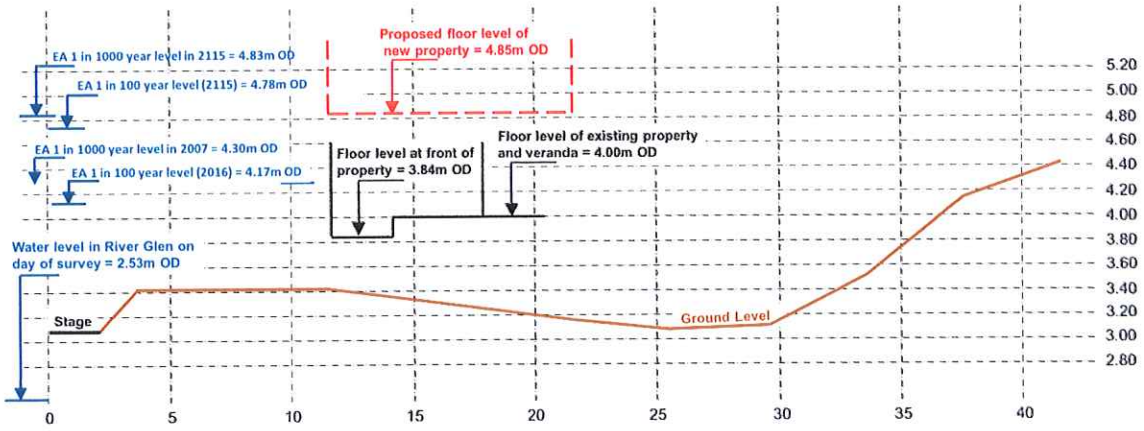
The site is within a defended flood plain, as defined in Appendix 1 of the Environment Agency's "Policy and Practice for the Protection of Flood Plains", which is considered to be passive until such time that a flood greater than the defences can withstand occurs. The likelihood of flooding occurring due to overtopping or failures of the defences is considered to be very low.

The site is located approximately 90 metres 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 on the north bank of the River Glen which is maintained by the Environment Agency.

Site Levels

Ground levels on the site have been surveyed and the levels taken are shown on page 12 of this report. These have been used to draw the cross section north to south across the site which is shown below.



The above cross section is shown on a full page on sheet 13 of this report.

The level of the River Glen on 12th June 2019 was 2.530m OD and the ground level of the site is approximately 3.40m OD. The floor level of the existing building, which has sleeping accommodation on the ground floor, is 3.84m OD at the front of the property and 4.00m OD at the rear. The ground floor level of the proposed building with all sleeping accommodation on the first floor is recommended to be 4.85m OD.

The section shows these levels along with the predicted flood levels in the River Glen.

Potential Sources of Flooding

The following sources of flooding have been identified:

1. Overtopping of the tidal River Welland.
2. Flooding from the River Glen.

1. **Overtopping of the River Welland.**

The River Welland is tidal in the section adjacent to the River Glen outfall sluice. The SFRA states that the defences are adequate to withstand a 1 in 200 year (0.5%) probability event for present day. In the future in 2115 some of the banks would be overtopped with a 0.5% probability event.

The predicted extreme tide level in 2055 in the SFRA is 6.32m OD. This is increased to 6.40m when taking the latest climate change guidelines into account. The lowest bank level of 7.05m OD is at Surfleet outfall sluice at 16.1km. The average level of the banks in this section is 7.50m OD. Therefore there is a minimum freeboard of 600mm in a 1 in 200 year event in 2055.

It is reasonable to assume that within the next 100 years the tidal defences will be raised to continue to provide a 1 in 200 year level of protection to this area.

The development site would not be affected by any flooding that may occur due to a failure of the west bank of the tidal Welland north or south of the site. This is because the Surfleet Reservoir area is within raised river banks which will protect the site from this method of flooding

2. **Flooding from the River Glen.**

Using the Environment Agency information, the maximum predicted level in the River Glen at this location just upstream of the outfall sluice is 4.17m OD for a 1 in 100 year event at the present time. However predictions for the year 2115 (allowing 20% increase in flows for climate change) state that the maximum 1 in 100 level will increase to 4.78m OD.

Therefore if the building has a finished floor level of 4.85m OD it will be above the 1 in 1000 year flood level in 2115. There is further consideration of this and climate change later in this FRA.

Extent of known Flooding

There is some history of flooding of properties at this location due to high levels in the River Glen. These properties are believed to have been older properties with floor levels below 4.00m OD. Discussions with owners of other properties on the south side of the River confirm that there have been no instances of flooding of these properties in the last thirty years.

Probabilities and Trends of Flooding

The probability of this development flooding from Environment Agency main river is very low. The ground floor level of the proposed building would be above the predicted 1 in 1000 year level in 2115. In an extreme event any effect on this location would not be sudden and there would be warnings from the Environment Agency at least 24 hours before any event occurred, and there would be adequate 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 high water levels in the River Glen.

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). The proposed mitigation measures will be set out in the conclusions of this report.

Previous Planning Permissions

Two planning applications for similar replacement dwellings at Surfleet Reservoir have been approved by South Holland District Council in 2018.

a) Planning Application No H17-0674-18 approved on 26th September 2018.

This application was for a replacement for a similar building damaged by fire. There were no conditions on this planning application with regard to floor levels.

b) Planning Application No H17-1029-18 approved on 14th November 2018.

The relevant conditions on this permission are reproduced below:

The development hereby permitted shall be carried out in accordance with the measures set out in the Flood Risk Assessment (prepared by S M Hemmings, dated 8th October 2018) forming part of this planning application, unless otherwise agreed in writing by the Local Planning Authority, in particular the following measures shall be fully implemented before the property is first occupied:

Finished floor levels shall be set no lower than 4.85m AOD; and

Flood resistance and resilient measures shall be incorporated up to 600mm above finished floor levels.

Summary of Risk of Flooding to the Site

The major risk of flooding at this site is from high levels in the River Glen following heavy rainfall in the catchment. The site is 90 metres from the sluice that opens to discharge the River Glen into the tidal section of the River Welland. Flow out of the sluice is not possible during the period of high tide in the River Welland and therefore levels in the River Glen will rise during this period. However as soon as discharge is possible into the tidal River Welland levels will immediately fall.

The information provided by the Environment Agency has indicated that the maximum predicted level in a 1 in 100 year event would be 4.17m OD at the present time. The maximum predicted level in a 1 in 1000 year event in 2115 is 4.78m OD.

There is a possibility that the EA could carry out a scheme to reduce the risk of flooding from the River Glen in the next 100 years. However any proposals will need to take into account that any bank raising would increase the flood risk to existing properties at Surfleet Reservoir, and therefore a scheme for improvement would need to look at flood storage rather than bank raising.

Therefore it would be reasonable to construct the dwelling with a floor level of 4.85m OD.

Conclusions

Although the site is in flood zone 3(b) functional flood plain it will not be at risk of flooding from a 1 in 1000 year event in 2115.

Although the frequency of high river levels may increase it is unlikely that higher flood levels than the 1 in 1000 year flood levels with climate change that are predicted by the Environment Agency will occur because the River Glen is an embanked watercourse for much of it length between Bourne and Surfleet and water will overflow long lengths of bank if these river levels occur which will prevent the river levels rising further.

Any flooding that does occur will happen very slowly and give residents of the building adequate time to escape to higher land.

There is a safe safety route from the site onto the bank to the north which is at a level of 6.50m OD.

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

Recommendations

In any area at risk of flooding it is 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 if high water levels occur in the River Glen, and ensure there is no danger to residents when they are asleep.

The safety of the occupants of the building will be provided by raising the floor level of the building above the 1 in 1000 year flood level for the life of the building.

The ground floor level of the proposed building should be at a minimum level of 4.85m OD.

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

If a flood warning is received from the Environment Agency nobody should remain in the building during the hours of darkness. Ideally all occupants should leave the building and not return until river levels are falling.

A flood warning and evacuation plan should be prepared for the property before the building is occupied. This should be approved by the Environment Agency and the SHDC.

When a warning is received there is a safe means of escape by proceeding to the track on the bank south of the property which is eastwards along the track behind the building and onto the road which is higher than any design flood level in the River Glen.

The new building should be designed incorporating flood resistant/resilient techniques to allow it to be refurbished after being flooding to a depth of approximately 600mm. All electrics and heating pipes should be distributed at ceiling level rather than at floor level. Materials used for the floor and walls should be able to withstand flooding for a period of at least three days. If possible the design of the kitchen should allow for as many electrical appliances as possible to be at least 600mm above floor level.

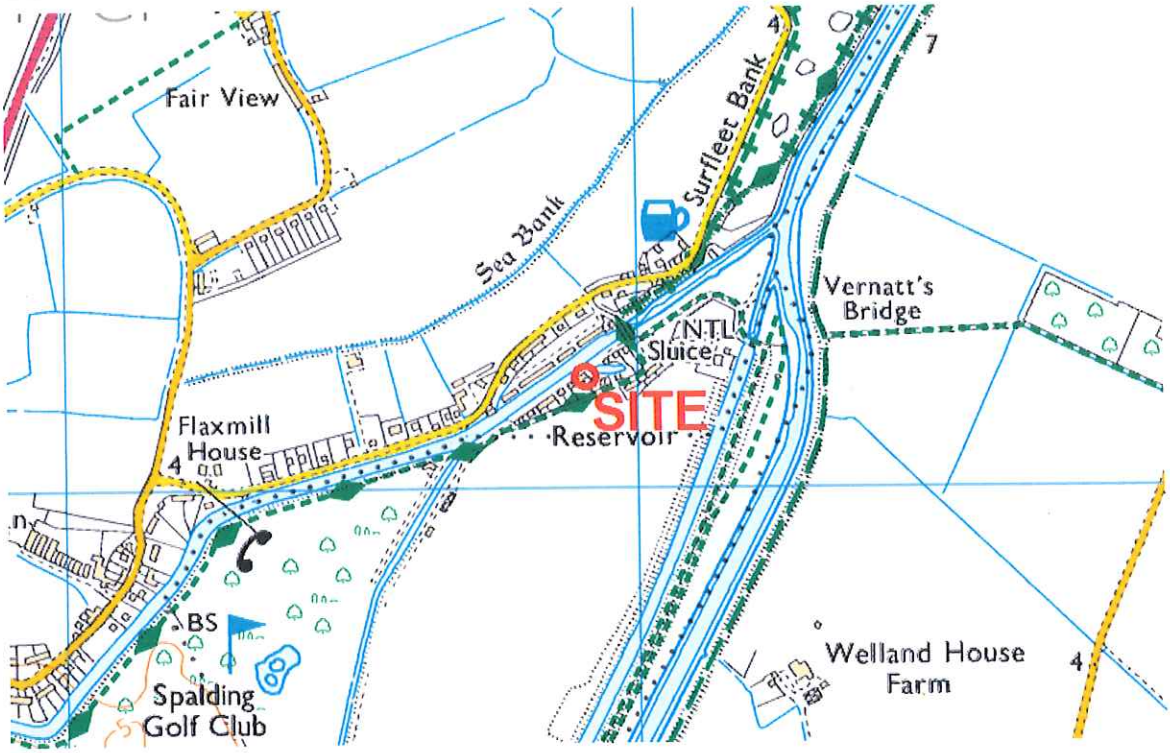
On site surface water drainage will be discharged into soakaways and these should be designed to BRE Digest 365 and approved under Building regulations.

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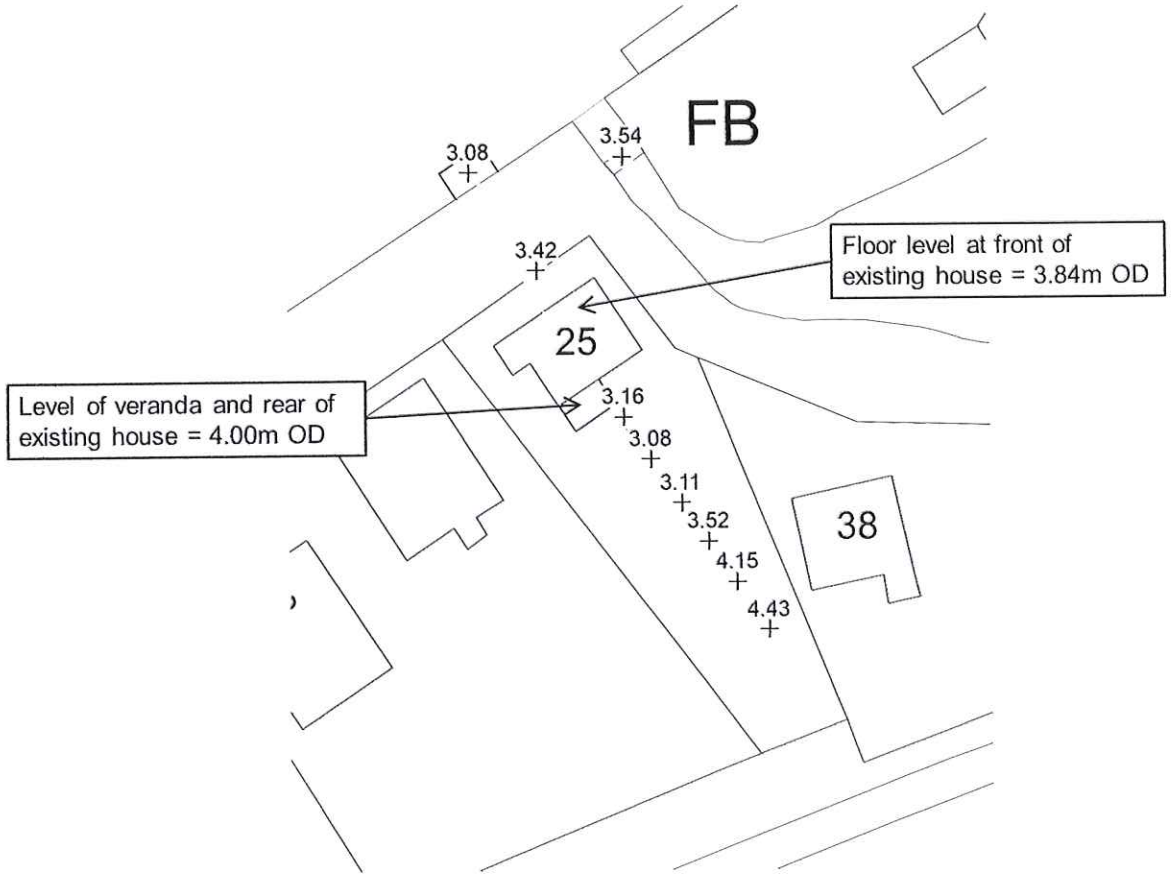
stuart.hemmings@btinternet.com

4th July 2019

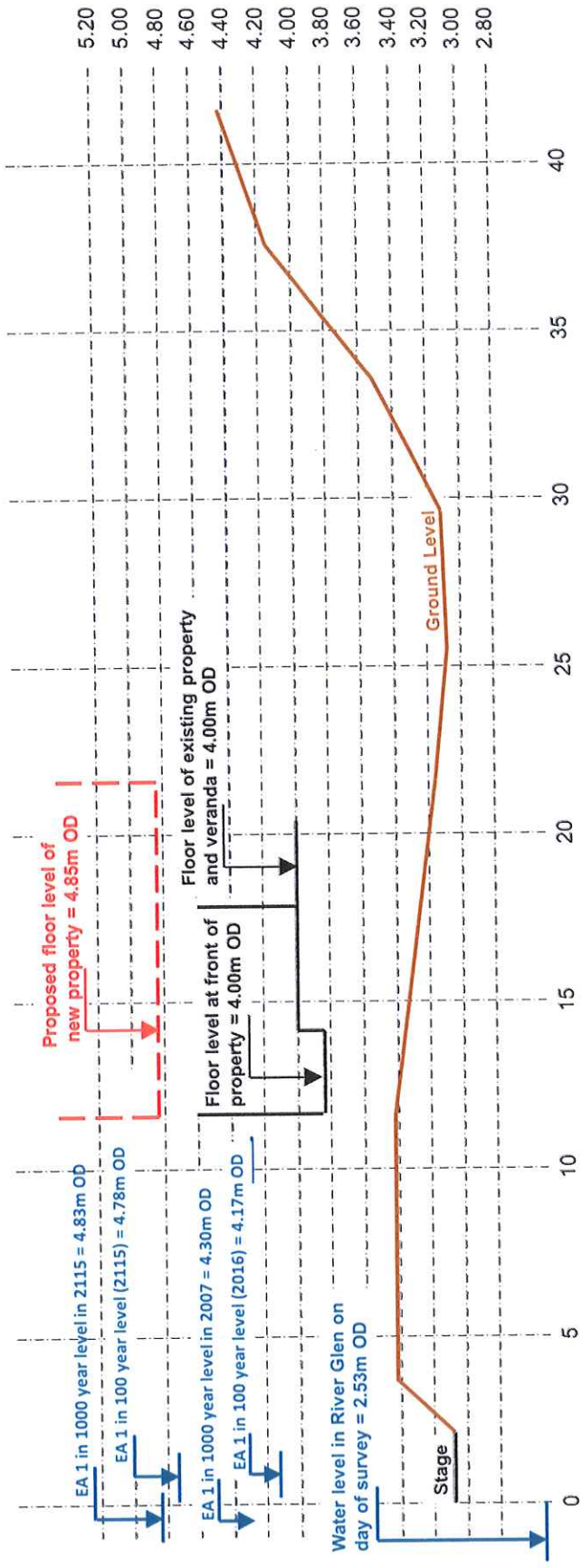
LOCATION PLAN



PLAN SHOWING SITE LEVELS



SECTION NORTH SOUTH ACROSS SITE



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
- South East Lincolnshire SFRA (March 2017)

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's

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(b) 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%

South East Lincolnshire SFRA (March 2017)

The SE Lincs SFRA States that all FRA's should refer to the revised guidance issued by the EA in 2016.

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

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

As the maximum life of the proposed building is 50 years then the increase in maximum tide levels can be taken to be 412mm. This is an increase of 82mm in the maximum tide level, which is now predicted to be 6.402m OD. This is below all of the tidal flood defence levels in this area.

2) Flooding from the River Glen

As the development is in flood zone 3 and is classed as more vulnerable, the advice is that the higher central climate change allowance, which is 20% for a proposed life of 50 years, should be considered. After considering the effects of this increase the upper end allowance, which is 35%, should be considered to assess the effect of this.

The river flows provided by the Environment Agency (see page 6) can be extended as shown below to assess the possible increased flows in 2115 with both a 35% and 65% increase.

		With 20% allowance	With 35% allowance
Peak 1 in 100 year flow	33.76	40.5	45.6
Peak 1 in 1,000 year flow	40.21	48.25	54.3

These figures seem to be very high for use in fenland rivers with a percentage of pumped inflows from IDB systems, and at first it can be concluded that the overall impact on river systems such as the fluvial River Glen could be very large.

The River Glen flows for approximately 25km through fenland between the A15 south of Bourne to the Surfleet Sluice. The gradient of the river is very low, and therefore in order for additional flows to pass down the river the gradient must increase. However if the river is full at the upstream end increasing gradients will increase water levels, which in turn will overflow the banks. Therefore the increased flows projected in the guidance are unlikely to occur in practice in a fenland river such as the River Glen.

In practice what would happen in the River Glen if there were large increases in flow would be that extensive flooding would occur in the upper reaches of the catchment.

Therefore it is considered that the mitigation proposed for the development is satisfactory.