Land South of Roman Road, Moulton Chapel, PE12 0XQ

Revised proposal:

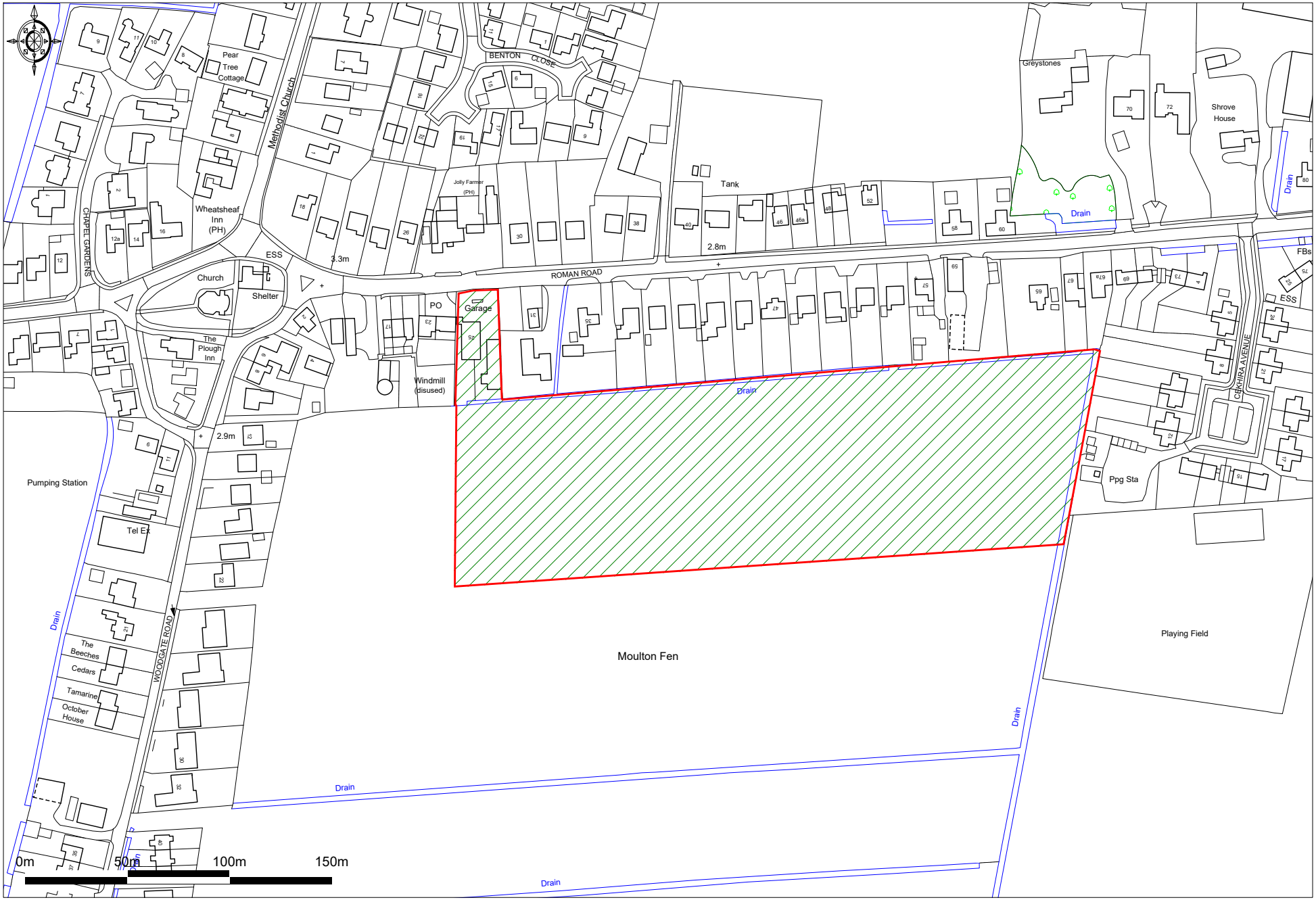
Proposed development of up to 58 houses with main access from the site of M. Chapel Motors (garage buildings to be removed)

Please note: This report was first submitted to support application H13-1280-16 for 78 houses over a larger site. Its conclusions still apply to a smaller site of up to 58 houses.

FLOOD RISK ASSESSMENT

Land South of Roman Road, Moulton Chapel, PE12 0XQ

REVISED SITE



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Promap®

Site Plan Scale 1:2500 Print@A4,

matrix planning

South Holland
Drainage Board

Marsh Reeves
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Holbeach
SPALDING
Lincs
PE12 7PA

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e: dominic@wlma.org.uk
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Our Ref: DM-PAB-1280-16-01-DM
Your Ref:

Please Contact: Dom Morris

5th January 2017

Jon Sharpe
LCC
Municipal Buildings
West Street
Boston
Lincolnshire
PE21 8QR

PREVIOUS ADVICE ON LARGER SITE

Dear Jon

OUTLINE PLANNING APPLICATION – H13-1280-16

PROPOSED DEMOLITION OF GARAGE BUILDINGS AND RESIDENTIAL DEVELOPMENT OF UP TO 78 DWELLINGS INCLUDING VEHICULAR ACCESS.

APPLICANT:

GRID REF: 529571-318144

Thank you for your consultation regarding the above proposal, details of which I have subsequently viewed on the SHDC website. The Board would like to make the following observations/comments:

- The Board would consider a discharge rate of 5litres a second entering their drainage system for the proposed development subject to a full site survey being carried out. From the proposed site through to the Board's Woodgate Drain.

- Consent will be required from the adjacent landowners of the riparian watercourses, as they will have a responsibility to maintain their section of watercourse, which the additional volume of surface water will flow through to enter the Board's drainage system. The Board may also consider adopting this riparian watercourse subject to the landowner's agreement, and the applicant producing a suitable proposal.

- If consent is granted, the applicant will have to pay a Surface Water Development Contribution which is currently £7.474 a square metre for the impermeable surface created by the proposed development. Because the proposed discharge flow rate is restricted to 5litres a second, the overall payment will be reduced to 20% of the total fee. However if there is an overflow fitted then this would be classed as an unrestricted discharge and the full amount will be payable. The applicant will have to apply to the Board for their consent for the proposed additional

ISO 9001 REGISTERED FIRM

Mr D R Worth (Chairman) Mr S A R Markillie (Vice-Chairman)

Mr P J Camamile (Chief Executive)

ISO 14001 REGISTERED FIRM

Cert No. GB11990 Mr K L J Vines (District Engineer) Mr A D Price (Operations Manager) Cert No. GB11991

DEFENDERS OF THE LOWLAND ENVIRONMENT

surface water discharge entering the drainage system. An application form is attached for the applicant's attention, there is a £100 application fee payable on return of the application form.

- The outfall level from the proposed flow control inspection chamber would need to be designed, to allow for the water level in the Board's Woodgate Drain for a 1:100year plus climate change (2085) rainfall event, which is 1.37m ODN. The level is taken from the Board's model which was undertaken in 2010. The climate change scenario may not therefore be to current standards. The length of new surface water storage dyke would need to be shallow and wide so as not to conflict with the water table, and allow for a suitable storage capacity for a 1:100year plus climate change rainfall event. As the nearest Board's Drain is some 530metres from the site, an assessment must be made of the head loss through the private drainage system to ensure the outfall level is no lower than the anticipated water level. As this would impede the flow rate of 5litres a second discharging into the drainage system (Riparian watercourse), which may cause a problem to the proposed development.

- The proposed storage dyke may need to be wider than proposed in the FRA. As the water level during a 1:100year rainfall event plus climate change may cause the drainage system to back up in to the development, before it's able to fill the dyke. Depending on the size and levels of the pipe work on the proposed development which enter the dyke.

- Suitable access strips need to be left, to be able to maintain the riparian watercourses. So they can be maintained efficiently.

- Consideration needs to be made for the maintenance of the proposed SuDS, soakaways, french drains, storage dyke, etc. Access too and around them, an area to remove any deposits from the dyke with sufficient room for improvements if necessary. No trees or vegetation should be planted around the dyke, which would cause access to maintain it, difficult. The Board would prefer the future maintenance of the SuDS to be in the hands of an Authority rather than a management company.

- If the applicant intends to alter any watercourses, then under Section 23 of the Land Drainage Act they will have to apply to the Drainage Board for consent. See application form attached there is a £50 application fee payable on return of the application.

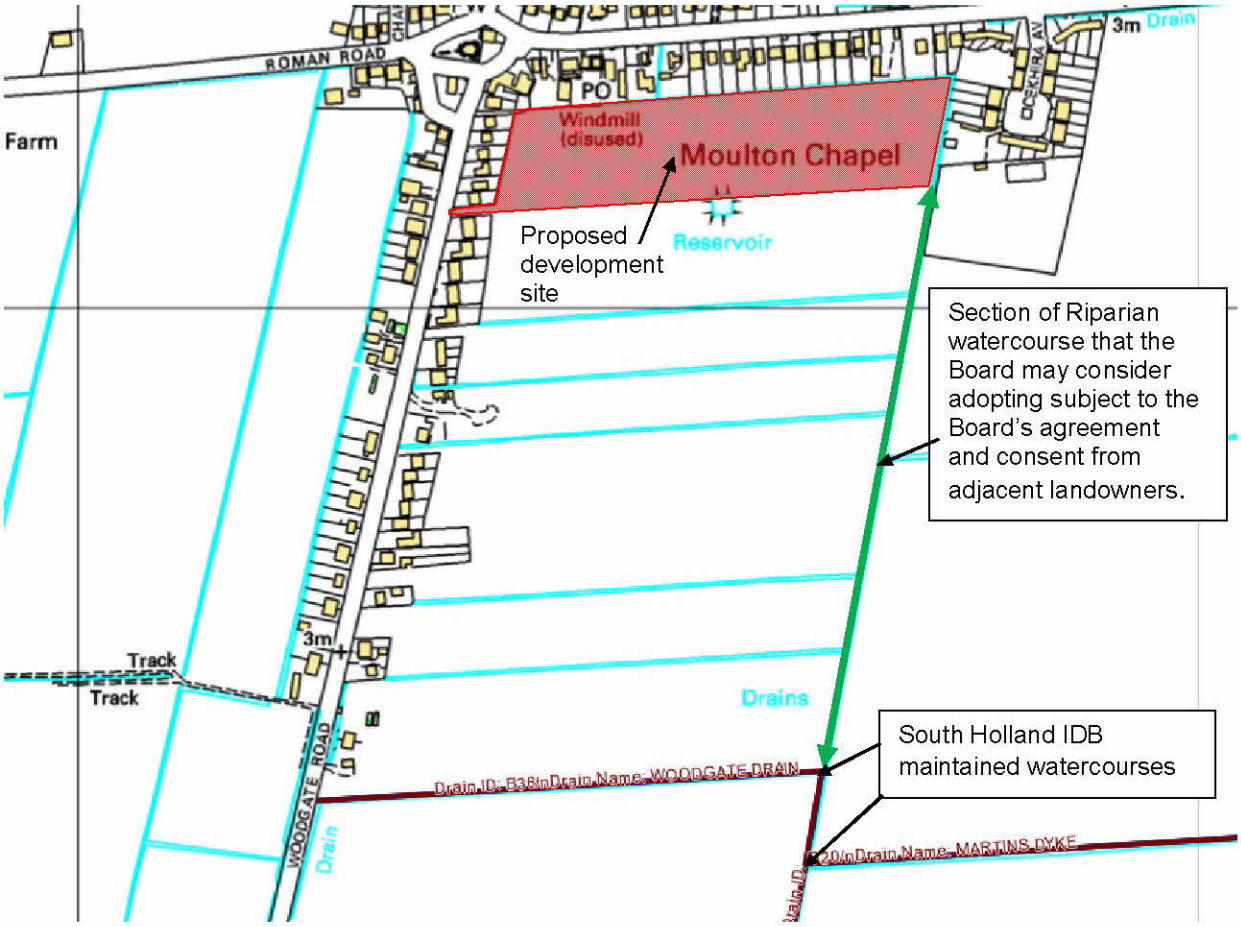
The Board do not object in principal to this outline planning application subject to the applicant confirming a definitive drainage plan and applying for relevant consent from the Board. The Board makes decisions on what flows we will accept entering our system and anything that affects the Board's Byelaws/Land Drainage Act. However, we understand it's the Local Lead Flood Authority that makes the ultimate decision on the sufficiency of the onsite SuDS and drainage for the proposed development.

I am sending SHDC, the agent, and the applicant a copy of this letter, so they are aware of the Board's comments.

Yours sincerely

D MORRIS
ASSISTANT ENGINEER

Cc: SHDC
Cc: Matrix Planning Ltd


ROMAN ROAD
Farm
PO
Windmill (disused)
Moulton Chapel
Reservoir
Proposed development site
3m Drain
Section of Riparian watercourse that the Board may consider adopting subject to the Board's agreement and consent from adjacent landowners.
Track
Track
3m
Drains
South Holland IDB maintained watercourses
WOODGATE ROAD
Drain
Drain ID: B36/n Drain Name: WOODGATE DRAIN
20/n Drain Name: MARTINS DYKE

PROPOSED RESIDENTIAL DEVELOPMENT AT ROMAN ROAD, MOULTON CHAPEL, SPALDING, PE12 0XQ.

FLOOD RISK ASSESSMENT

S M Hemmings B Sc C Eng MICE MIWEM,
69 Charlotte Way,
Peterborough,
PE3 9ER.

This flood risk assessment has been prepared solely to support the planning application for a residential development at Roman Road, Moulton Chapel. The author has made every effort to provide an accurate assessment of the flood risk but accepts no liability should the information be found to be incorrect or incomplete.

Introduction

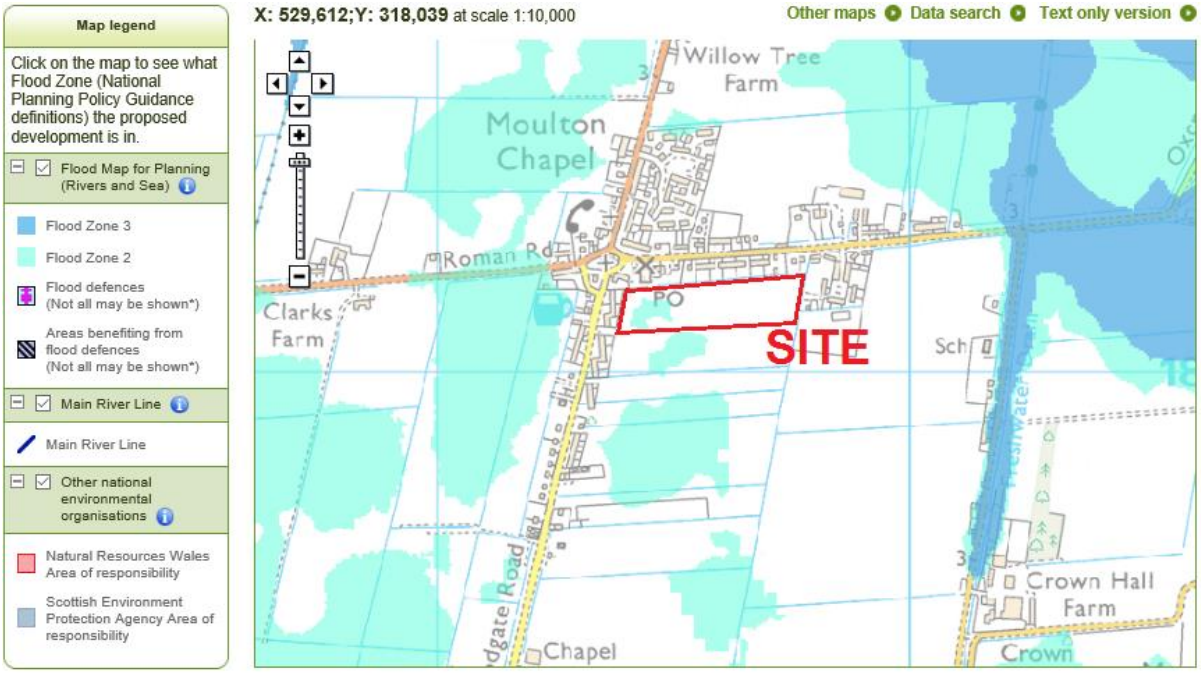
A Planning application is due to be submitted to South Holland District Council to construct a residential development with approximately 78 dwellings and associated access roads south of Roman Road, Moulton Chapel.

The site is in mainly within Flood Zone 1 as shown on the Environment Agency's Flood Zone map. The flood zone maps do not take into account existing flood defences.

For the Planning Application to be valid a flood risk assessment needs to be carried out to conform with the requirements of the Technical Guidance to the National Planning Policy Framework Development and Flood Risk. The site is within a defended area as specified in the South Holland District Council's Strategic Flood Risk Assessment and is located in the South Holland Internal Drainage Board District.

Environment Agency (EA) Flood Zones

The map below is taken from the Environment Agency website and shows the flood zones in the area.



It can be seen that approximately 80% of the proposed area of the development is within Flood Zone 1, with the remaining 20% on the western side categorised in flood zone 2.

Application Site

The development is located on the southern side of Moulton Chapel which is approximately 6km from the centre of Spalding. The National Grid Reference of the site is 529580 318150.

The location 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 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 from table 3 that “More vulnerable” development is appropriate in 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.

The greater part of the area around the outlying villages of Spalding is within flood zone 3 and as can be seen from the map on page 2 of this report, most of this development site is within flood zone 1. Therefore it can be concluded that this site is probably one of the best sites in the area if flood risk is taken as the main consideration.

The South Holland District Council Core Strategy states that there is a limited number of sites outside the town of Spalding available for residential development. Some greenfield land will need to be identified to enable the Council to meet the RSS and

Structure Plan requirement for 2021. Therefore there is a requirement for further land to be brought forward and used for residential development.

Strategic Flood Risk Assessment

The following information about the flood risk in the location of this development has been sourced from the maps and reports in the South Holland District Council's Strategic Flood Risk Assessment (SHDC SFRA).

Report Maps

Map 3 shows that the site is within flood zone 3.

Map 5 shows that the site is at low or medium risk, but reliant on flood defences for this standard.

Map 6 indicates the peak depth is zero for the present day 1% fluvial and 0.5% tidal event probability.

Map 7 indicates the peak velocity is zero for the present day 1% fluvial and 0.5% tidal event probability.

Map 12 indicates the actual risk is low or medium for the year 2055 1% fluvial and 0.5% tidal event probability.

Map 13 indicates the actual risk is low or medium for the year 2115 1% fluvial and 0.5% tidal event probability.

Map 16 shows that the site is not within a rapid inundation zone.

Flood Maps Table D1

The actual flood hazard for the present day and 2115 is as follows:

Depth of flooding..... zero

Extent of flooding..... low or medium, reliant on flood defences

Velocity ..... nil

The residual flood hazard for the present day and 2115 is as follows:

Depth of flooding..... zero

Extent of flooding..... low or medium, reliant on flood defences

Velocity ..... nil

Maximum flood level and bank levels in the River Welland

The maximum levels in the fluvial section of the River Welland 3.1 km west of the site between chainages 5.0 and 5.5km are as follows:

	2007	2115
Peak 1 in 200 year level	4.59	4.70
Peak 1 in 1000 year level	4.61	4.70

The lowest levels of the east bank, which are earth banks, of the River Welland are between 5.88m and 5.96m OD.

Maximum flood level and bank levels in the Coronation Channel

The maximum levels in the Coronation Channel 5.0km north west of the site at chainage 2.5km are as follows:

	2007	2115
Peak 1 in 200 year level	4.36	4.68
Peak 1 in 1000 year level	4.38	4.69

The lowest levels of the east bank, which are earth banks, are between 5.30m and 5.70m OD.

Information from the Environment Agency

The Environment Agency has provided predicted flood levels for the River Welland which are taken from the Welland Catchment Model produced in 2007.

	2007	2115
Peak 1 in 100 year flood level	4.61m OD	4.72m OD
Peak 1 in 1,000 year flood level	4.63m OD	4.72m OD

The above levels are very similar to the levels shown in the SHDC SFRA.

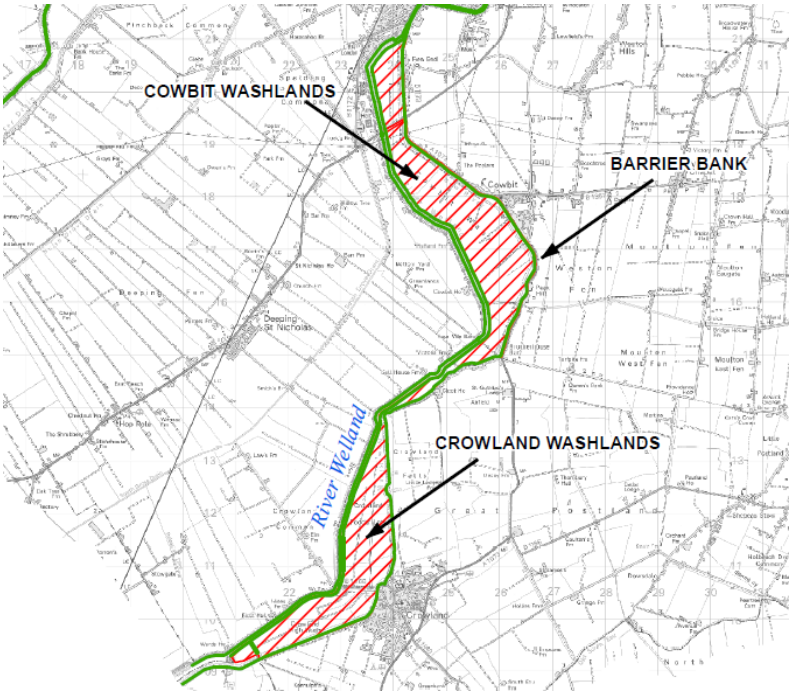
The Environment Agency has provided the following predicted fluvial flood flows measured in cumecs for the River Welland which are taken from the Welland Catchment Model produced in 2007.

	2007	2115
Peak 1 in 100 year flow	94.15	95.05
Peak 1 in 1,000 year flow	95.45	95.40

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 5.00m 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.



The development site is approximately 3.1km from the Barrier Bank, the south bank of the River Welland.

The major watercourses in the area are maintained by South Holland IDB, which has carried out improvement schemes so that IDB watercourses generally provide a standard of 1 in 100 years with a freeboard of 300mm in urban areas.

Existing Ground Levels and Proposed Levels of Buildings

The level of the northern part of the field varies between 2.54m OD and 2.67m OD. There are one or two higher and lower levels recorded but generally the development site can be considered to be at an approximate level of 2.60m OD.

The level of Roman Road is slightly higher and falls from a level of 3.15m OD near the junction with Woodgate Road north west of the site to 2.75m OD at the north east side of the site. The level of Roman Road north of the proposed access is 2.80m OD.

A full topographical study has been carried out and the drawing showing all of the results will be submitted with the planning application. A sample of the levels has been reproduced on a smaller plan which is shown on page 12 of this report.

Potential Sources of Flooding

The potential sources of flooding to the site are:-

1. Failure or Overtopping of tidal River Welland
2. Failure or overtopping of fluvial defences of the River Welland
3. Overtopping or Breaching of the Coronation Channel
4. High water levels in IDB drainage channels.
5. Localised flooding in the area.

1. **Failure or overtopping of tidal defences**

The tidal section of the River Welland starts north of the sluices near the confluence of the Coronation Channel and the River Welland on the northern side of Spalding, which is approximately 7.5km north of the development site.

The east bank of the River at this location is higher than the predicted maximum tide levels for the present day, but along some lengths with climate change bank levels are lower than the predicted tidal levels and banks could be overtopped and possibly breaches could occur in a 1 in 200 year event in 2115. However flood water would tend to flow eastwards towards Weston rather than southwards towards Cowbit, and the predicted maps for residual flooding in the SFRA confirm this by showing no flooding within 2 – 3km north of Moulton Chapel in the 1 in 200 year map for 2115.

Therefore raising floor levels of the proposed dwelling by approximately 300mm would provide adequate mitigation for this risk which is extremely low.

2. **Failure or overtopping of the Barrier Bank**

The Barrier Bank is the eastern bank of the Crowland Washes, and is 3,1 km west of the site. 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 around 5.00m OD.

If a breach occurred in the Barrier Bank in this scenario then flood water would flow eastwards towards the development site. However the maps showing flood depths in a 1 in 100 year event in 2115 in the SFRA indicate that the extent of any flooding that did occur would be at least 2.0km from the site.

Therefore raising floor levels of the proposed dwelling by approximately 300mm would provide adequate mitigation for this risk which is extremely low.

3. **Overtopping or breaching in the Coronation Channel**

The SFRA states that the maximum design water level in the Coronation Channel is 4.69m OD. The minimum crest level of the east bank of the Channel is 5.14m OD, which gives a minimum freeboard of 450mm. However, generally there is a freeboard of 600 mm along this bank of the Channel.

If the Channel were to breach water could flow south eastwards towards the site. However, it would be retained for a short time by the A16 which is higher than the surrounding land. The SFRA indicates that with a serious breach water would not reach the site in a 1 in 100 year event.

As the site is 5.0 km from the Coronation Channel the risk that flood water from this source could reach the development site is extremely low. The map of residual flood

depths in a 1 in 100 year event in 2115 in the SFRA indicates that showing no flooding is predicted to occur within 2 – 3 km north of Moulton Chapel.

Therefore raising floor levels of the proposed dwelling by approximately 300mm would provide adequate mitigation for this risk which is extremely low.

4. High Water Levels in IDB drains

Although the whole of this area is below high tide level and levels in the rivers, the retained water levels in the drainage channels ensure that the risk of flooding is extremely low. South Holland IDB maintains a system of sluices, pumping stations, and drainage channels which convey surface water into the River Nene, the Wash and the River Welland and control water levels throughout the South Holland IDB area.

The development site is located south of the village of Moulton Chapel which is in the catchment area of Wisemans Pumping Station. The nearest IDB drainage channel is approximately 530 metres south of the south eastern corner of the development site. The IDB drain flows 1.8km southwards where it discharges into the South Holland Main Drain approximately 600 metres west of Wiseman's Pumping Station. The South Holland IDB have stated that the predicted maximum level in the Board's Woodgate Drain for a 1:100 year event with climate change is 1.37m OD.

The channels maintained by South Holland IDB in urban areas are classified as high priority watercourses and as such receive a higher maintenance priority.

There are possibilities of failure of pumping stations and outfall sluices, but these are mitigated by the high level of maintenance given to these structures by the IDB. If a failure did occur the IDB would immediately be warned of the problem by their telemetry system and take action to repair the fault or to bring in temporary pumps to reduce the risk of any flooding in the area. Similarly any failures of culverts or other blockages would be dealt with immediately.

IDB systems are designed to provide a freeboard of between 600mm and 1000mm to all land in a 1 in 10 year return period rainfall event. South Holland IDB watercourses generally state that their watercourses provide a standard of 1 in 100 years with a freeboard of 300mm in urban areas. In an extreme event water levels will rise but this will be a slow process and it would be at least 24 hours before levels were high enough to begin to flood low land in the area, and after this the level of the flood water would need to rise another 1.0 metre before the development site would be affected.

Therefore the risk of flooding from IDB drainage channels can be considered to be extremely low.

5. Localised Flooding in the area of the development

An initial design of a suitable surface water disposal system has been carried out and this is detailed in the Drainage Strategy accompanying the planning application. The

strategy details a proposed attenuation scheme which will discharge into the dyke on the eastern side of the development.

If any part of the scheme fails to operate satisfactorily then it is possible that surface water could accumulate in areas of the development. However the mitigation of raising the ground floor levels of houses by approximately 300mm will provide adequate mitigation to the houses. As has been shown above the site is level so any flood water from this source would not accumulate in a particular section of the development, or flood any of the surrounding properties.

Therefore the risk of flooding from this source can be considered remote.

Extent of known Flooding

During the preparation of this assessment, no evidence was discovered of the existing house or garden or any of the adjoining properties having been flooded in the past.

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 12 to 15). It is concluded that no extra mitigation measures are necessary to comply with the new guidance on climate change.

Conclusions

The Environment Agency flood zone map shows at least 80% of the site being in flood zone 1, which is defined as land having a less than 1 in 1000 annual probability of river or sea flooding.

The remaining part of the site, which is at the same level as the land in flood zone 1, is in flood zone 2 which is defined as land having between 1 in 100 and 1 in 1000 annual probability of river flooding or between1 in 200 and 1 in 1000 annual probability of tidal flooding.

The maps in the SHDC SFRA do not predict any flooding will occur within 2.0 km of Moulton Chapel in a 1 in 100 year fluvial or a 1 in 200 year tidal event in 2115.

The earth banks which constitute the Barrier Bank which are the defences of the River Welland west of the site have adequate freeboards for the present day and in 2115.

The risk of flooding from IDB watercourses in a 1 in 100 year event with climate change is low as the predicted maximum water level is approximately 1.2 metres below the ground level on the site.

The Environment Agency have stated that their policy is to continue to maintain fluvial and tidal banks in the future with at least a 1 in 200 year standard of service.

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

If any flooding were to occur it would happen very slowly and residents would have adequate time to prepare themselves for the event.

Recommendations

In any area at risk of flooding it is preferable that new dwellings should be of two story construction with all bedrooms at first floor level. This is to provide a refuge for residents if the building becomes flooded after a major breach of the tidal bank, and ensure there is no danger to residents when they are asleep

It is recommended that the ground floor level of the proposed dwellings should be 2.90m OD which is approximately 300mm above the existing ground level of the site. It is also recommended that road levels should not exceed 2.70m OD and the public open space should be lowered by 150mm to a level of 2.45m OD.

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

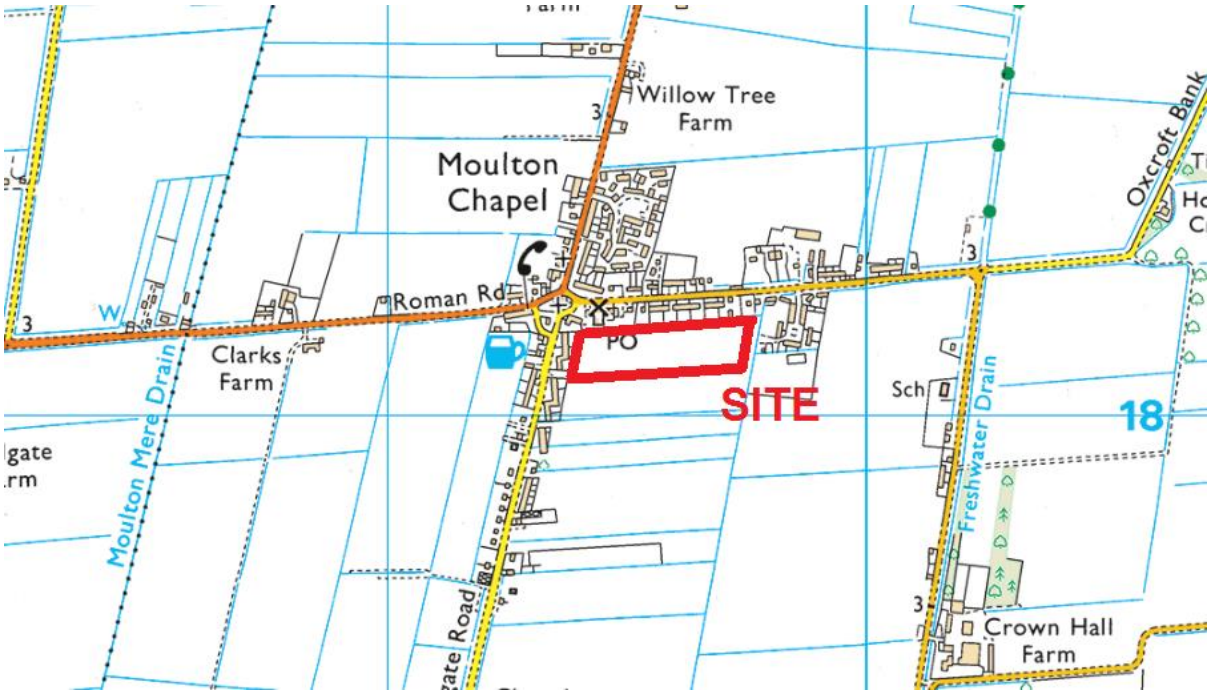
Rainwater from the roofs of the houses and from the roads should be discharged into attenuation which will reduce the flow into the dyke on the east side of the development. Details of the initial design for surface water disposal is shown in the Drainage Strategy which will accompany the planning application.

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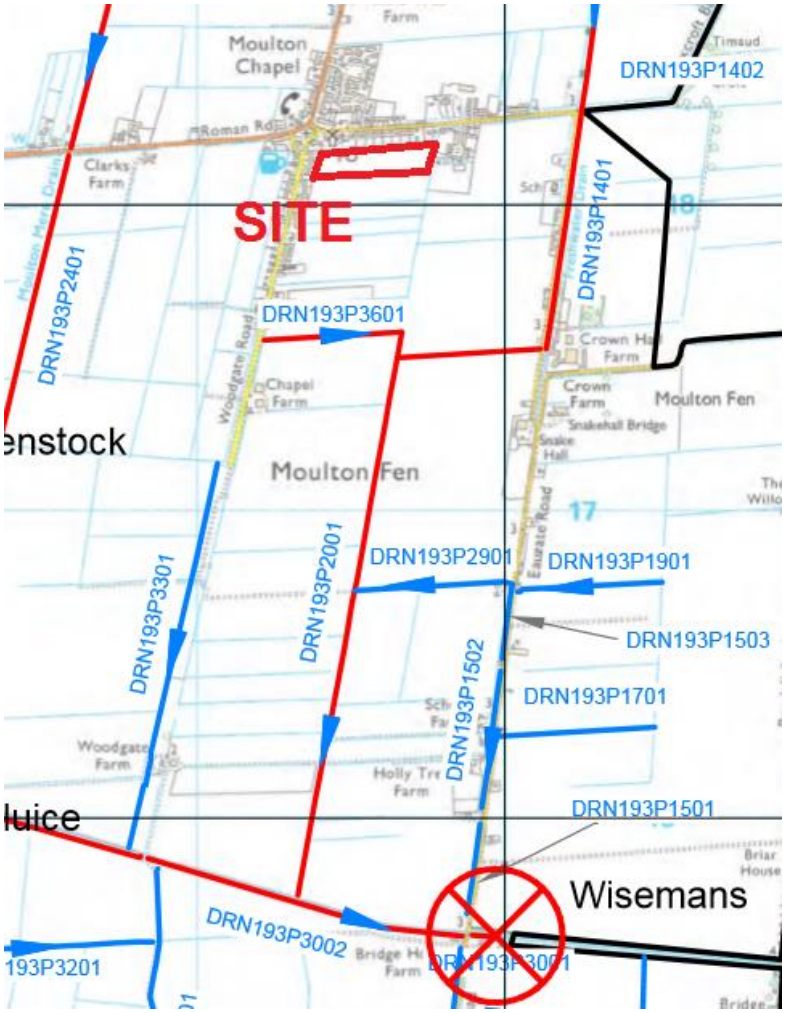
stuart.hemmings@btinternet.com

6th December 2016

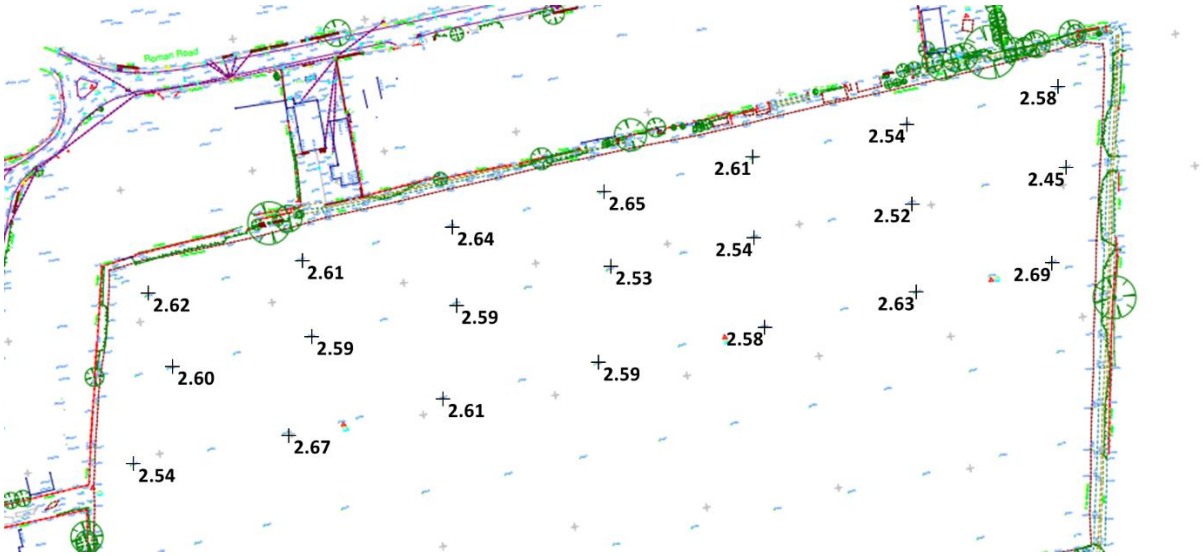
LOCATION PLAN



PLAN OF AREA SHOWING IDB WATERCOURSES



PLAN SHOWING SITE LEVELS



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

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 FRA has identified three sources of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115 at the development site:

1) Flooding from the tidal River Welland
2) Flooding from River Welland or Coronation Channel
3) Flooding from IDB drainage system

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

The contingency allowance in metres for the years 2055 and 2115 using 1990 as a baseline in the SFRA compared with the guidelines is as follows

Year	SFRA	2013 guidance	Revised 2016 guidance
2055	0.33	0.395	0.412
2115	1.14	1.205	1.24

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

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

As the proposed ground floor levels of the properties are 300mm above the average ground level of the site then the risk of flooding from a 1 in 200 year tidal event is extremely low.

2) Flooding from the Coronation ChannelFluvial watercourses

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

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

3) Flooding from IDB watercourses

IDB's have been using an allowance of 20% for climate change over the past few years in their assessments and modelling of their systems. Generally IDB's are happy that their systems provide a 1 in 100 year standard to most urban areas at the present time.

South Holland IDB, and all IDB's, are aware that climate change will affect the operations of pumping stations, sluices and drainage channels. Pumping stations and sluices only have a 30 year life and will need to be refurbished or rebuilt within this timespan. It is assumed that South Holland IDB will continue to review the modelling they have already carried out and when the Board consider these refurbishments adequate arrangements will be made to incorporate the latest climate change projections in order that the Board continues to provide the same standard of service as the present day.

Therefore it is considered that the mitigation proposed for the development, with the recommendation that the floor levels should be a minimum level of 2.90m OD is satisfactory.