

Flood Risk Assessment

**Proposed Residential Development
at 47 Low Lane, Holbeach PE12 7PW**

**Erection of four detached two-storey dwellings,
detached garage and demolition
of existing bungalow.**

01 October 2021

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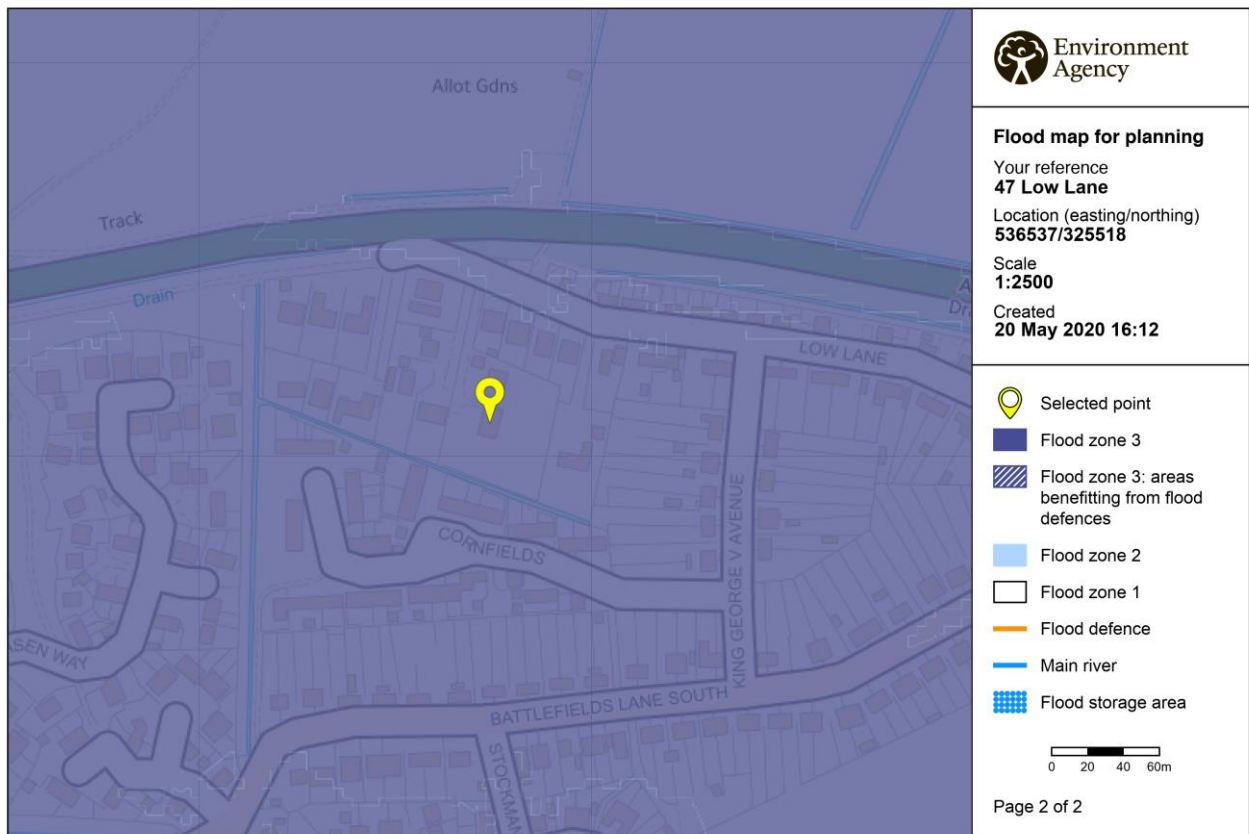
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1.0 Introduction

This report has been produced in support of a Planning Application for residential development by way of the erection of four detached dwellings, a detached garage, including the demolition of the existing bungalow at land known as 47, Low Lane, Holbeach Lincolnshire PE12 7PW.

The site, as situated, is located within Flood Zone 3, of the Environment Agency's (EA) Flood Map for Planning. The Maps do not take into account any flood defences. See Map below.

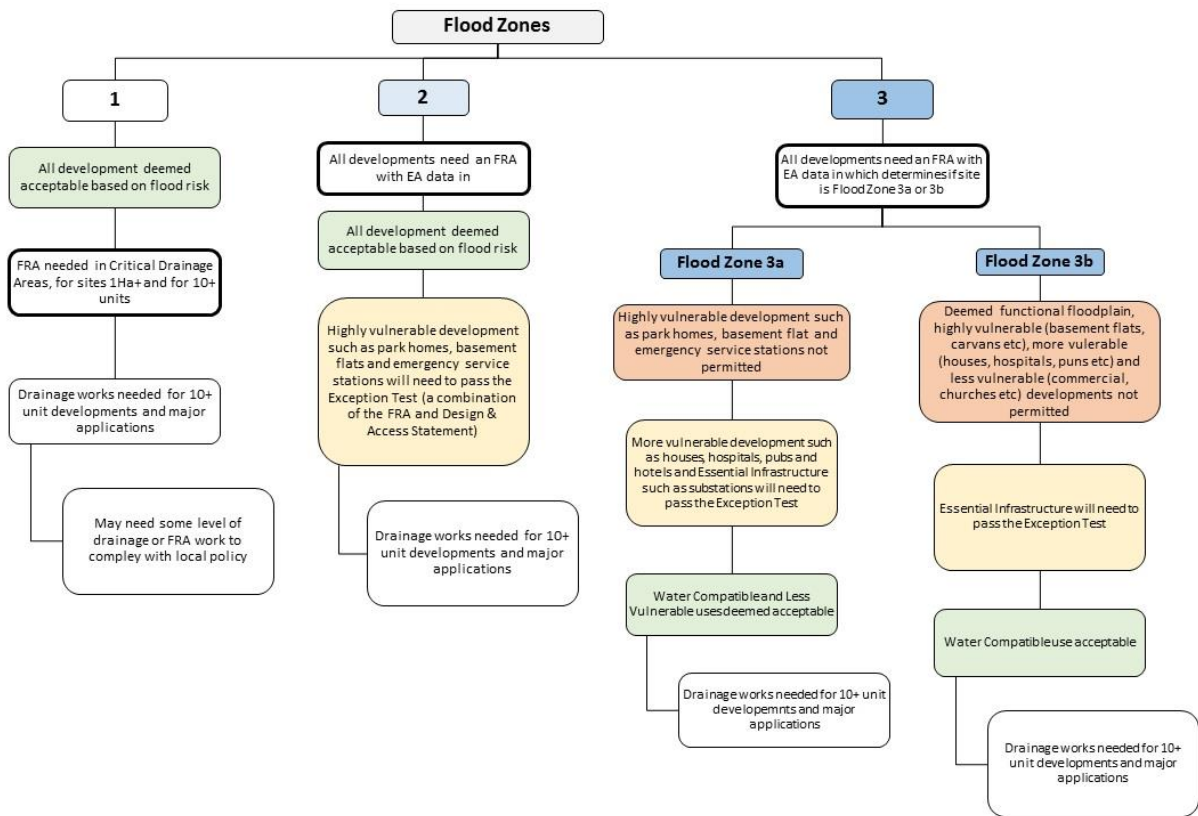


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Environment Agency Flood Map for Planning.

The purpose of the report is to assess flood risk and drainage in accordance with the National Planning Policy Framework (NPPF) in support of the planning application for the residential development at the proposed site. The requirement for an FRA is based primarily upon the flood zone classification (Zone 3a) affecting the site (See Flood Zone Flow Chart).

Within the South Holland District, the functional floodplain comprises of the designated flood storage areas of the Crowland and Cowbit Washes and the Surfleet Reservoir, designated flood zone 3b. The site is outside of any functional floodplain but is within flood zone classification 3a.



Flood Zone Flow Chart.

Applying the flood risk vulnerability classification in Table 2 of the Technical Guidance to the National Planning Policy Framework, a development consisting of residential development 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	✓*

Flood risk vulnerability and flood zone compatibility matrix taken from The Technical Guidance to the National Planning Policy Framework

The sequential test, together with the exception test, will therefore need to be applied to the proposed development.

The proposed development forms part of the same parcel of land on which Full Planning Permission was granted for the erection of four detached houses and two detached garages including demolition of the existing bungalow on the 25 February 2021, SHDC ref H09-0801-20. A Flood Risk Assessment was submitted in connection with this application and the agreed conclusions were that finished ground floor levels should be set a minimum of 3.5m AOD Newlyn including flood resilient construction to a height of 300mm above finished ground floor level.

2.0 Site Description

General:

The site is located in the northern district of the settlement of Holbeach south of the A17 and within the defined settlement boundary. It covers an area of around 0.34 ha. The development brief proposes to construct four detached dwellings, three of which will have integral garages, and one with a detached garage. It is proposed to demolish the existing detached bungalow to accommodate the new development

The approximate site centre is 536524 E 325510 N. A site location plan is shown below.



Site Location Plan

The site is bounded on all sides by residential development and a riparian drainage channel runs along the southern boundary, approximately 25% of which is piped, the remaining being open. An existing permeable private driveway provides access onto the Public Highway.

The British Geological Survey (BGS) geological map indicates the site is underlain by superficial Terrington Bed deposits comprising marine alluvium, salt marsh tidal creek and river deposits (sandy silty sand and clay). The Terrington beds are in turn underlain by the Jurassic Age West Walton Formation comprising silty mudstones and calcareous mudstones with minor nodular limestones. Near surface soils comprise mainly silt with very little sand. It should be noted that the BGS data is a guide and is no substitute for intrusive investigation.

Topographical Survey Data (See Appendix A) shows the site is relatively flat with elevations between 2.93m to 3.57m AOD Newlyn with an averaged elevation of 3.10m AOD Newlyn.

Watercourses:

The Welland is one of four main river watercourses that flows through the South Holland District, the others being the Nene, the Glen and the South Forty Foot Drain draining the low-lying fens and ultimately discharging to the wash estuary and is tidally influenced downstream of Spalding. All watercourses in the region drain into the wash located approximately 10 km to the north east of the site.

The site is located within the South Holland Internal Drainage Board District (SHIDB) and lies within the catchment area of the Holbeach River (Appendix B). SHIDB are responsible for the operation and maintenance of the arterial fluvial system.

The Environment Agency have provided details of their latest tidal breach/overtopping hazard mapping for the area (Appendix C). These provide modelled flood extents based on the modelled overtopping and the maximum composite flood extents from the series of simulated breaches in the flood defences along the Lincolnshire coastline.

The overtopping scenario model and the breach scenario model are two discrete EA models, constructed as part of the Northern Area Tidal Hazard Mapping Study and are considered the best available information on tidal flood risk to the area.

The EA mapping was used by Royal Haskoning DHV to produce the South Holland Flood Mapping. (see report 2016 Update of South Holland Strategic Flood Risk Assessment - Modelling and Mapping) dated 28 February 2017.

One important distinction between the two scenarios is that the overtopping scenario is representative of the actual flood risk to the site (as the probability and consequences are clearly assessed) whereas it is a point of debate as to whether a breach scenario is realistic to assess in respect of third party impacts, as this is the residual (hypothetical rather than an actual) flood risk, and the probability of flood defence failure combined with such a flood event is considered extremely small.

Further information relating to the definition of actual risk and residual risk is contained in The Environment Agency Flood Zone Factsheet Three (Appendix D), the relevant extract reads as follows:

“The FRA should assess all sources of flooding and provide sufficient information on the characteristics of flooding at the site, such as frequency, depth, velocity, speed of onset, and duration. As a minimum the FRA needs to assess the flood risk on site by comparing our modelled flood levels with a GPS verified topographical survey of the site to determine the anticipated flood depths during the 5% (1 in 20), 1% / 0.5% (1 in 100 / 200) (design) and 0.1% (1 in 1000) (extreme) events including allowances for climate change. Climate change allowances can be found on our website. If the area is protected by defences then the FRA should consider both the actual flood risk to the site through overtopping of the defences, and the residual risk posed by the defences being breached.”

As with the majority of the Fens, the land is reclaimed from the sea. The area relies upon a network of drainage channels, and pumping stations, managed by South Holland Internal Drainage Board and flood defence embankments, the majority of which are managed by the Environment Agency with a very small percentage being the responsibility of private land owners. The area is renowned for being largely agricultural and horticulture, the network of drainage supports this land use. The nearest surface water drainage channel runs along the entire southern boundary of the site, 75% of which is open the remaining 25% being piped discharging into a network of watercourses all of which are managed by South Holland Internal Drainage Board.

The existing standard of drainage for the South Holland Internal Drainage Board is 1 in 50 years return period, compatible with the Department of the Environment, Food and Rural Affairs (DEFRA) target level of service for rural drainage and flood defence works. Freeboard of 900mm is provided to the lowest land levels.

Current maintenance standards within the South Holland Internal Drainage Board and of the Environment Agency defences are generally very good.

During the operation and maintenance of its pumping stations, associated structures and channel systems, particularly those that could affect property, the Board seeks to maintain a general standard capable of providing flood protection to its district. A routine maintenance programme is in place to ensure that the Boards assets are commensurate with the standard of protection that is sought. However, bank slips, blocked culverts etc. may occur from time to time and these matters are usually dealt with promptly.

Existing Flood Alleviation Measures:

The site is within a defended floodplain, as defined in Appendix 1 of the Environment Agency's 'Policy for the Protection of Floodplains' and is considered to be passive until such time as a flood greater than that for which the defences were designed occurs. The likelihood of flooding due to overtopping or failure of a flood defence embankment is considered to be small.

The development site within the South Holland Internal Drainage Board area is protected by the Wash tidal defences to the Holbeach Marsh frontage with embankment levels of a minimum of 7.00m AOD.

The site and the surrounding land, drains by gravity to a network of South Holland Internal Drainage Board watercourses, finally discharging via the Holbeach River Tidal Sluice into the tidal River Welland (Appendix B).

Potential Sources of Flooding:

Six potential sources of flooding have been identified as a result of this assessment:

- a) local blockages to riparian drains;
- b) local blockages to IDB main drain system;
- c) storm return period of 1 in 50 years being exceeded;
- d) failure of Holbeach River Outfall Sluice;
- e) overtopping of defences of the Wash Tidal Defences;
- f) breaching of defences of the Wash Tidal Defences.

The probability of flooding from source a) is low, as the existing riparian drain adjoining the development site southern boundary flows into SHIDB drain P01, then into a piped section beneath Battlefields Lane South where it emerges into an open SHIDB watercourse P01. This continues in an easterly direction to flow into Holbeach River P21 which flows by gravity out into the river Welland near Fosdyke, via Holbeach Sluice, and out into The Wash.

The probability of flooding from source b) is also low due to the maintenance standards already achieved and managed by the IDB.

The probability of flooding from c) is also low due to the South Holland IDB main drain design standard incorporating a minimum 900mm freeboard to the lowest land level which provides adequate storage in events greater than 1 in 50 years.

Previous historic rainfall events of 1968 and 1978, estimated to be greater than 1 in 100 year events, caused no flooding to any residential properties at the time. The Boards policy is to provide a standard of drainage which satisfies NPPF requirements of a 1 in 100 year return period for fluvial protection inclusive of the effects of climate change and developments to the arterial system enables a flexible approach to be adopted and meet the criteria for "sustainable urban drainage".

Failure of Holbeach River Outfall Sluice may occur due to long term mechanical breakdown or power supply disruption. However, in these circumstances, if conditions were such as to put properties and land at risk of flooding, the Internal Drainage Board would take emergency action to maintain the drainage level of service by utilising temporary pumping equipment. The probability of such an occurrence is also considered to be low.

The flood embankments to the Wash tidal defences provide a 1 in 200 year return period level of protection. The 1 in 200 year tidal event to the Holbeach Marsh frontage inclusive of climate change to 2115 is estimated to be 7.20m AOD against existing embankment levels of a minimum of 7.00m AOD. The tidal surge event of 5th/6th December 2013 reached 6.17m AOD.

There is a low risk during such an event for wave and wind action to cause overtopping and/or breaching of the first line defences. However, the site is further protected by second line defences with embankment levels of 6.00m AOD. The EA have confirmed (Appendix E) that the site is not affected by overtopping of their defences currently or in the year 2115 for 1 in 200-year return period, this is defined as an actual risk

More recent Tidal Hazard Mapping included in the Council's Updated Strategic Flood Risk Assessment shows the site could be affected by floodwaters as a result of a breach occurring to The Wash tidal defences in 2115, this is defined as a residual risk.

The Environment Agency has recently published The Wash Shoreline Management Plan 2 from Gibraltar Point to Old Hunstanton. The summary of the plan between Gibraltar Point and Wolferton Creek is as follows:

“The intent of management for this Policy Development Zone (PDZ) is to sustain flood defence for the communities and their hinterland on the low lying areas around The Wash. This includes an increase of management as needed to sustain the current level of flood risk in the face of climate change.”

3.0 Consulted Reports and References

National Planning Policy Framework (NPPF):

The NPPF July 2021 and the guidance on Site Specific Flood Risk Assessment at Paragraph: 003, Reference ID: 7-030-20140306 of the Planning Practice Guidance (NPPG) Flood risk and coastal change, published by the Ministry of Housing, Communities and Local Government, March 2014, is the key guidance referred to.

The Environment Agency is a statutory consultee for all planning applications and will give comment and recommendations to the planning authority for any proposed developments in the flood zones and affecting main rivers. Under the Flood Water Management Act 2010, Lincolnshire County Council is the Lead Local Flood Authority (LLFA) and has a responsibility of managing flood risk from ordinary watercourses. A flood risk assessment, in accordance with NPPF, is required to accompany a planning application as the site is within Flood Zone 3.

The non-statutory technical standards for sustainable drainage systems, published by the Department for Environment, Food and Rural Affairs, March 2015, are used in conjunction with NPPF and PPG. This document provides additional guidance with reference to flood risk assessments, peak flow and volume control, structural integrity, design, and construction of drainage within a proposed site and has been considered as part of this study.

South East Lincolnshire Local Plan 2011-2036:

This document states that strategic flood risk in the context of the local plan has been considered within the South East Lincolnshire Strategic Flood Risk Assessment.

South East Lincolnshire Strategic Flood Risk Assessment (SFRA) (March 2017):

The Strategic Flood Risk Assessment, completed in March 2017 as an update to the original 2010 report, predicts flood depths from the present day through to 2115 for both the 1% fluvial/0.5% tidal and the 0.1% event probability.

DEFRA/Environment Agency:

Flood and Coastal Defence R&D Programme, Flood Risks to People, Phase 2, FD2321/TR1, The Flood Risks to People Methodology.

DEFRA/Environment Agency:

Flood and Coastal Defence R&D Programme, Flood Risk Assessment Guidance, for New Development, Phase 2, Framework and Guidance for Assessing and Managing, Flood Risk for New Development – An Overview, R&D Technical Report FD2320/TR1.

DEFRA/Environment Agency:

Flood and Coastal Defence R&D Programme, Flood Risk Assessment Guidance, for New Development, Phase 2, Framework and Guidance for Assessing and Managing, Flood Risk for New Development – Full Documentation and Tools, R&D Technical Report FD2320/TR2.

Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control, Purpose Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. Suresh Surendran and Geoff Gibbs (Environment Agency), Steven Wade and Helen Udale-Clarke (HR Wallingford) May 2008.

Environment Agency, Flood Zone 3 Fact Sheet, East Anglia (East).

4.0 The Development in Relation to Flood Risk Vulnerability

The site is located within a defended zone of the tidal River Welland. The River Welland is located over 8km to the north west of the site at its closest point. The River Welland benefits from flood defences to control the spread of flood water and to confine it to the storage area. It is noted from the records provided within the SFRA that the site is defended to a standard that avoids flooding of the site during 2017 at the 1% annual flood probability level.

The site is considered to be defended from tidal flooding by the Wash tidal defences to the Holbeach Marsh frontage. Defence embankment levels are noted to be at 7.00m AOD minimum, well above the current site topography which has an average elevation of 3.10m AOD.

The site is notably defended by two lines of flood defences against tidal flooding. The first line has a minimum height of 7.00m AOD, with the 1 in 200 year tidal event predicted to reach 7.20m AOD, therefore overtopping defences by 0.2m. However, the second line of defences has embankments of 6.00m AOD which would contain such an overtopping event within a wider envelope with the depth much reduced. It is considered therefore that the site is well defended against such flooding.

Correspondence was received from the EA dated 29 June 2020 and is included in Appendix C. This included the following information:

The Flood Map – showing the area at risk of flooding (assuming no defences exist) for a flood with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial flooding;

History of Flooding – indicated that the EA have no records;

Tidal Defence Information – detailing that the site is protected by earth embankments, in a fair condition, that reduce the risk of flooding to a 0.67% (1 in 150) chance of occurring in any year;

Modelled Hazard Mapping – showing maximum values of flood depth, velocity and hazard rating resulting from breaching of defences for the 0.5% and the 0.1% event.

Table 2 of The Technical Guidance to National Planning Policy Framework has been used to assess the Flood Risk Vulnerability classification for the designated use of the site. The proposed residential use of the site is classed as 'more vulnerable'. The site falls within Flood Zone 3a, therefore the Sequential Test together with the Exception Test will need to be applied to the proposed 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. The greater part of the area around Holbeach, is in Flood Zone 3 not allowing for sea defences.

Large parts of the South Holland district lie within Flood Zone 3. For this reason, it is therefore necessary to use the refined flood risk information (Hazard and Depth maps) to assist with the application of the Sequential Test.

Referring to the publication 'Flood Risk Assessment Guidance for New Development Phase 2. Framework and Guidance for Assessing and Managing Flood Risk for New Development. Full Documentation and tools. R and D Technical Report FD2320/TR2', which referenced in the SELSFRA, the guidance states:

"Applying the Sequential Test

A risk-based, sequential approach should be adopted when developing development plans or determining planning applications. For example: If there are two sites, both of which do not flood in present day conditions, but one floods with an allowance for climate change, preference should be given to the site that does not flood with an allowance for climate change (assuming all other considerations are equal)."

Paragraph: 041 Reference ID: 7-041-20140306 Revision date: 06 03 2014 The Guidance and Support Flood Risk and Coastal change document published by Ministry of Housing, Communities and Local Government states:

"What is "residual risk"?"

"Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions."

The risk-based Sequential Test will use the actual fluvial and tidal risk to the site, i.e. from overtopping of the flood defences, including allowing for climate change. The residual risk, i.e. a failure or breach of the sea defences, will be used in applying the exception test.

As stated in Section Two - Site Description, the important distinction between the two scenarios is that the overtopping scenario is representative of the actual flood risk to the site (as the probability and consequences are clearly assessed) whereas it is a point of debate as to whether a breach scenario is realistic to assess in respect of third party impacts, as this is the residual (hypothetical rather than an actual) flood risk and the probability of flood defence failure combined with such a flood event is considered extremely small.

Residual risks therefore are those remaining after applying the sequential approach against which mitigating actions are taken to manage the risk. The Technical guide stresses: *"... it is the responsibility of those planning development to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be safely managed."*

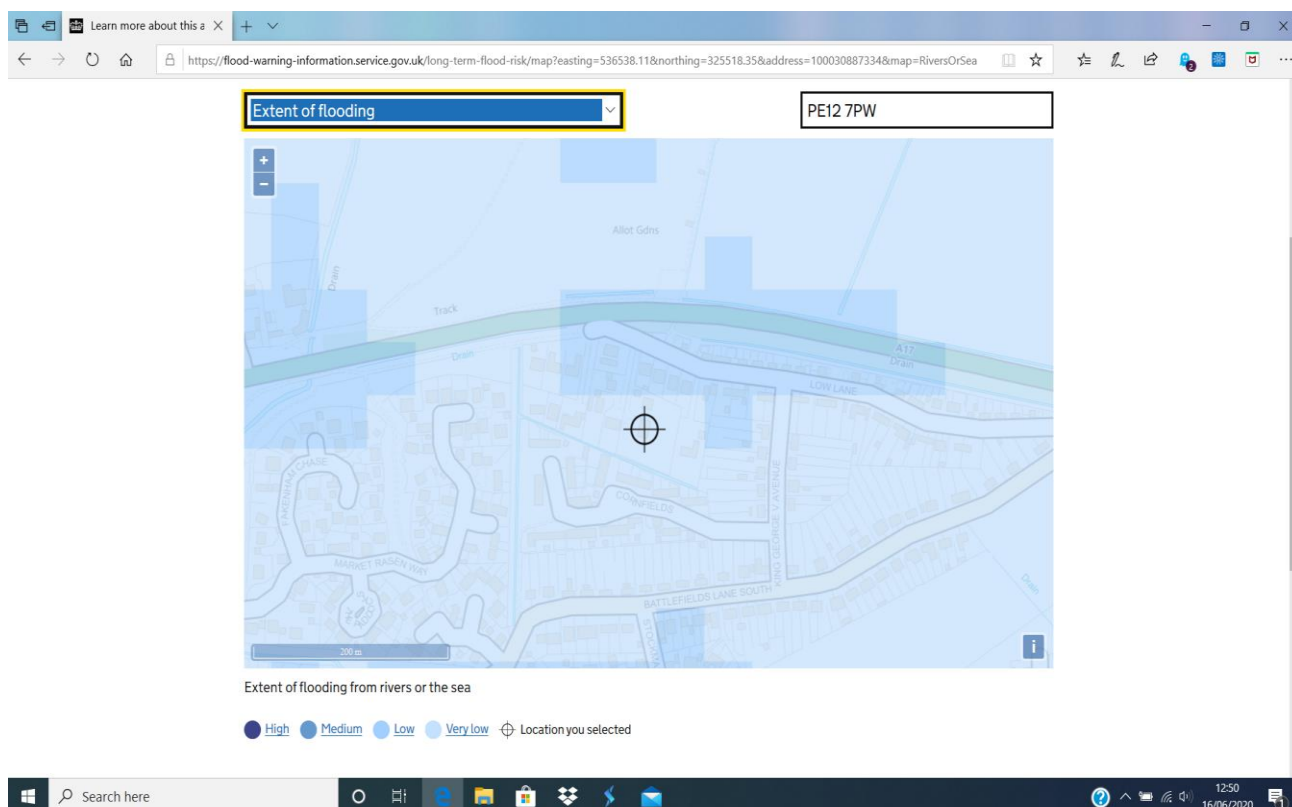
The South Holland Strategic Flood Risk Assessment maps 5, 12 & 13 (Appendix F), show the 'actual' flood risk across the district for a range of timescales based on the 1 in 100 (1%) annual probability fluvial event and a 1 in 200 (0.5%) annual probability tidal event. These are the most up to date actual flood risk maps available.

Map 5 shows the flood risk under current conditions. Areas at high probability of flooding are confined to land immediately behind the Wash coastline and primarily along the north-west boundary of the Holbeach area is shown as unaffected.

Map 12 shows the flood risk projected to the year 2055. This indicates more extensive flooding along the Wash coastline and on the western part of the District but Holbeach remains a significant distance from any impacted area (a minimum of approximately 8km).

Map 13 depicts the actual flood risk projected to the year 2115. This shows extensive flooding of the district, particularly inland along the Wash coastline and along the floodplain of the River Welland. Flooding extends towards Holbeach from the north-west as far as the A151 link road whilst Holbeach remains unaffected.

The long-term EA flood risk maps, as shown below, also indicate that the site is at very low risk of flooding from rivers and sea.



<https://flood-warning-information.service.gov.uk/long-term-flood-risk>

The Sequential Test is therefore considered to be met.

The Exception Test:

Residential developments are classified by the NPPF as 'More Vulnerable' and appropriate in Flood Zone 3a subject to satisfying the Exception Test.

For the development of residential dwellings, classed as 'More Vulnerable' and within Flood Zone 3a, an exception test is required. The exception test, defined in section 160 of the NPPF requires that the development satisfies two criteria:

- a) It should be demonstrated that the development would provide wider sustainability benefits to the community that outweigh flood risk, and;
- b) It should be demonstrated that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible will reduce flood risk overall.

In answer to the exception test criterium 'a', it is considered that the close link to the area of Holbeach and adjacency to typical settlement development provides facilities for the development that would be unavailable in less adjoining locations. In addition, the proposed development will provide support for local facilities to perpetuate their existence, such as local shops, community venues, public services, etc. It is therefore considered that the proposed development is sustainable when considered in the context of alternative locations.

It is considered in answer to criterium 'b', this site-specific flood risk assessment aims to identify the flood risk to the proposed development and ensure that sufficient measures are put in place to enable the safe and timely evacuation of residents in dwellings that have potential flood risk. The flood risk assessment that follows will therefore put in place a strategy and plan to ensure safe occupation of the proposed dwellings. It is considered that the proposed development is a significant distance from both the tidal and fluvial flooding sources and significant warning time would be available.

5.0 Flood Risk Assessment

Fluvial and Tidal Flood Risk:

The development site is located within Flood Zone 3a as per the Environment Agency Flood Map for Planning, that is, land assessed as having a 1% (1 in 100) or greater annual probability of river flooding or a 0.5% (1 in 200) or greater annual probability of flooding from the sea without the benefit of flood defences.

The primary risk of fluvial flooding to the site is from the River Welland, which flows to the north west of the site and is a Main River under the jurisdiction of the EA. A flood defence embankment is located along the River Welland to the west of the site that provides an initial line of defence to keep excess flows in channel. The River Welland is tidal within the area of influence of the proposed development site, however two levels of defences exist.

The first line of defences has a corresponding height of 7.00m AOD protecting against a water level of 7.200m AOD during the 2115 100 year plus climate change (1% annual exceedance probability plus climate change) event. This indicates that this first line of defence could be overtopped in this event. However further defences exist, providing a 6.00m AOD defence. It is considered that the likelihood of the flooding beyond these defences is unlikely.

The Strategic Flood Risk Assessment produced for South Holland District Council in 2017 shows that the development without defences would be subject to flooding, however when defended it benefits from protection up to and including the 1 in 100 return period (1% probability) fluvial event.

EA data (Section 3) states that the site is at risk of flooding (assuming no flood defences exist) for a flood with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial flooding.

The site is within flood warning and alert areas. It is classed to be within the flood alert data as *"far extent tidal flooding from the Wash between Gibraltar Point and Admiralty Point, and the Tidal River Witham, the Tidal River Welland and the Tidal River Nene"*.

Actual Risk Overtopping of Sea Defences 2115:

The Environment Agency have previously confirmed that the site is not affected by overtopping of the sea defences for both 0.5% and the 0.1% event to the year 2115 allowing for climate change, the actual risk (See Appendix E).

The Residual Risk Breach Hazard:

In a well defended area such as this, the fluvial and tidal risk in real terms is associated with failure by breach of the defence embankment. This could potentially result in a sudden surge of floodwater into the land lying behind the defences. In this case, depths and velocities of water may both be significant and an assessment of this is required.

The SELSFRA states, “The definition of flood hazard used in this hazard mapping follows the definition used by DEFRA and the Environment Agency which is translated in ‘Flood Risk Assessment Guidance for New Development Phase 2, R&D Technical Report FD2320/TR2’”. The classification is split into four categories, defined by the depth and velocity of flood waters and the related ability of people to evacuate the area once a flood occurs. Please refer to the table below for further information on flood hazard.

Danger to people for different combinations of depth and velocity.

Velocity (m/s)	Depth of flooding (m)										
	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00
0.00											
0.10											
0.25											
0.50											
1.00											
1.50											
2.00											
2.50											
3.00											
3.50											
4.00											
4.50											
5.00											

Key	Danger to some		Danger to most		Danger to all	
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Table 13.1 of R&D Technical Report FD2320/TR2

The above Table makes no allowance for the distance of the breach in the tidal defences to the area of the floodplain under consideration.

To assess the level of hazard presented by a breach relative to the distance to points on the flood plain, a simple assessment process contained in ‘R&D Technical Report FD2320 /TR2’ forms a relationship between distance from the breach and the head above crest level and the danger it presents to human life.

Please refer to the table below for further information on flood hazard:

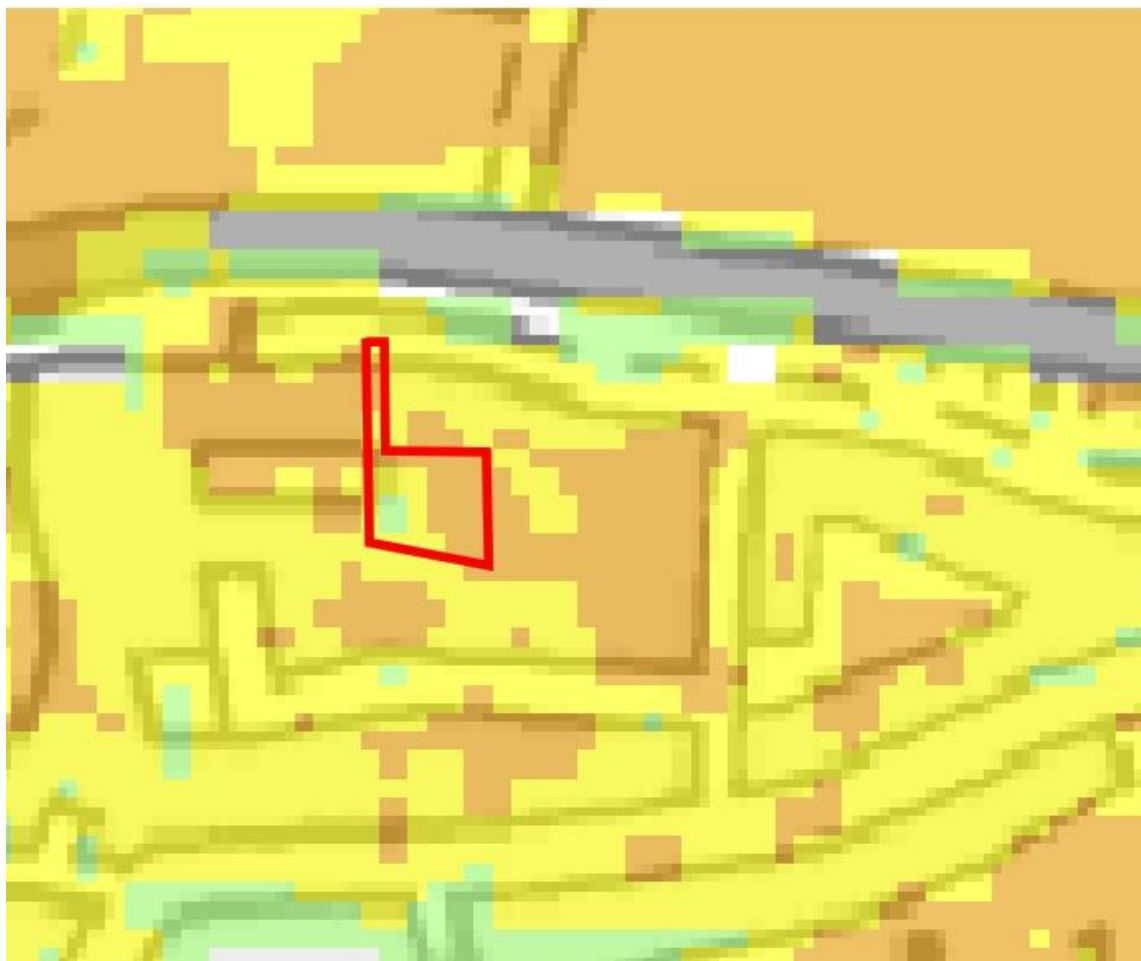
Distance (m)	Head above Flood plain (m)						
from Breach	0.5	1.0	2.0	3.0	4.0	5.0	6.0
100							
250							
500							
1000							
1500							
2000							
2500							
3000							
3500							
4000							
4500							
5000							

Key	Danger to some		Danger to most		Danger to all	
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Table 3: Danger to People from Breaching Relative to Distance from Floodplain

From the table above it is noted that the site is located approximately 8km from the nearest source of flooding (the Tidal River Welland) with a maximum head of water above floodplain of 4.10m (7.20m, the predicted 2115 0.5% tidal event, minus 3.10m, the average elevation of the site,) and as such the risk falls beyond the scope of this table, i.e. the risk is below the 'Danger to Some' level.

In addition, referring to the South Holland SFRA Hazard Mapping, the site is located within three flood zones namely low, danger to some and danger to all, see extract of map below.



Extract from South Holland SFRA Residual Hazard mapping

To arrive at a mean hazard rating for the site, reference is made to 'DEFRA/Environment Agency Flood and Coastal Defence R&D Programme Flood Risk Assessment Guidance for New Development Phase 2 Framework and Guidance for Assessing and Managing Flood Risk for New Development – Full Documentation and Tools R&D Technical Report FD2320/TR2'.

This guidance was followed in the formation of the SELSFRA and is referenced in the report 2016 Update of South Holland Strategic Flood Risk Assessment:

Modelling and Mapping Note 2016 Modelling and mapping Update Note:

Client:

South Holland District Council

Reference:

WATPB3271R001D01

Revision: 01/Final Date: 28 February 2017

Flood Hazard Rating (HR) and thresholds:

The 'hazard rating' expression based primarily, on consideration to the direct risks of people exposed to floodwaters is derived from the following formula:

$$HR = d \times (v + n) + DF$$

Where:

HR = (flood) hazard rating;

d = depth of flooding (m);

v = velocity of floodwaters (m/sec);

DF = debris factor (0, 0.5, 1 depending on probability that debris will lead to a hazard), and;

n = a constant of 0.5.

The floodwater reaching the site will have to travel over predominately pasture/arable land and some minor settlements so a DF of 0.5 seems most appropriate.

Depths	Pasture/Arable	Woodland	Urban
0 to 0.25 m	0	0	0
0.25 to 0.75 m	0	0.5	1
d>0.75 m and/or v>2	0.5	1	1

Table 3.1 Guidance on debris factors (DF) for different flood depths, velocities and dominant land uses. DEFRA/Environment Agency FD2321/TR2.

Inputting the data:

d max = 0.43m

v max = 0.3m/sec

n constant 0.5

DF = 0.5

$$0.43 \times (0.3 + 0.5) + 0.5 = 0.844$$

This falls between 0.75 and 1.25 which gives a Flood Hazard Rating for the site of Moderate, (Dangerous to Some).

As discussed earlier, flood defences to the tidal river corridor are present, with an initial line presenting capacity to contain some events, and the secondary line of defences that contain larger flood events. It is considered that these two lines of defences provide robust defence against tidal or fluvial flood sources.

It is noted that other residential development in the locality faces similar and higher levels of exposure, both older and recently approved applications.

It is considered that as this area is protected by two flood defences, the flood defences to the Wash that defend against tidal flooding and those to the River Welland that defend against tidal and fluvial events, the risk of flooding is low.

Referencing the South Holland SFRA Residual Peak Depth mapping for a 0.5% event in 2115, the development site falls within three depth zones, 0m to 0.25m, 0.25m to 0.5m and 0.5m to 1.0m. This gives a potential depth gradient across the site of 1.00m. However, referencing the topographical survey of the site (Appendix A), the elevation deviation of the terrain is no more than 0.57m when including a small section of the site, approximately four-square metres in area, currently comprising part of a rockery with an elevation of 3.57m AOD. If this small area is discounted then the elevational deviation of the site 0.33m.



Extract from South Holland SFRA Residual Peak Depth Mapping

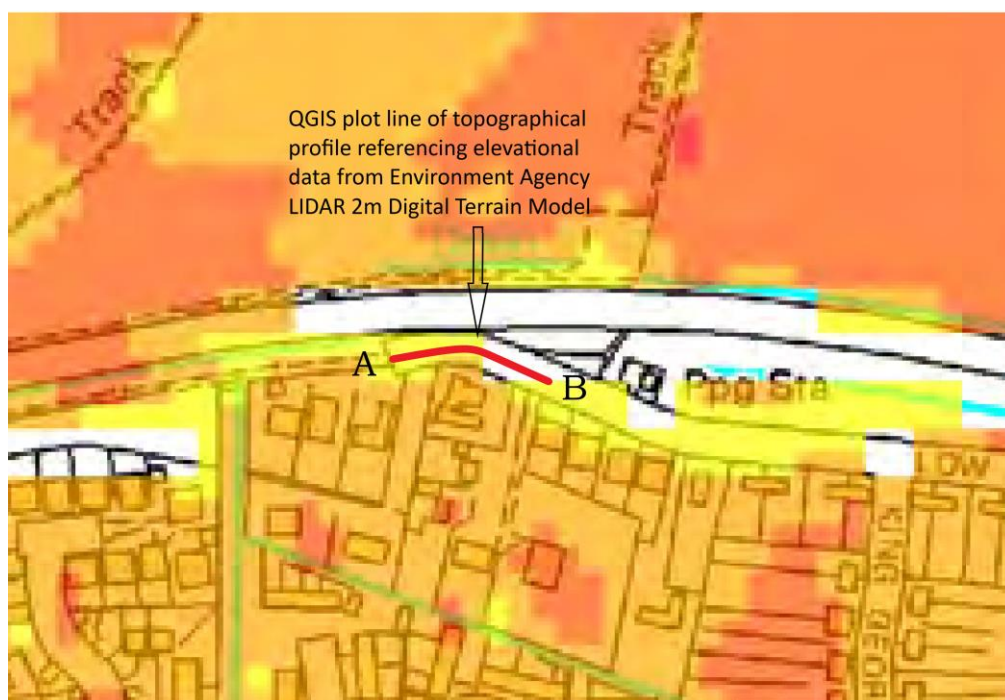
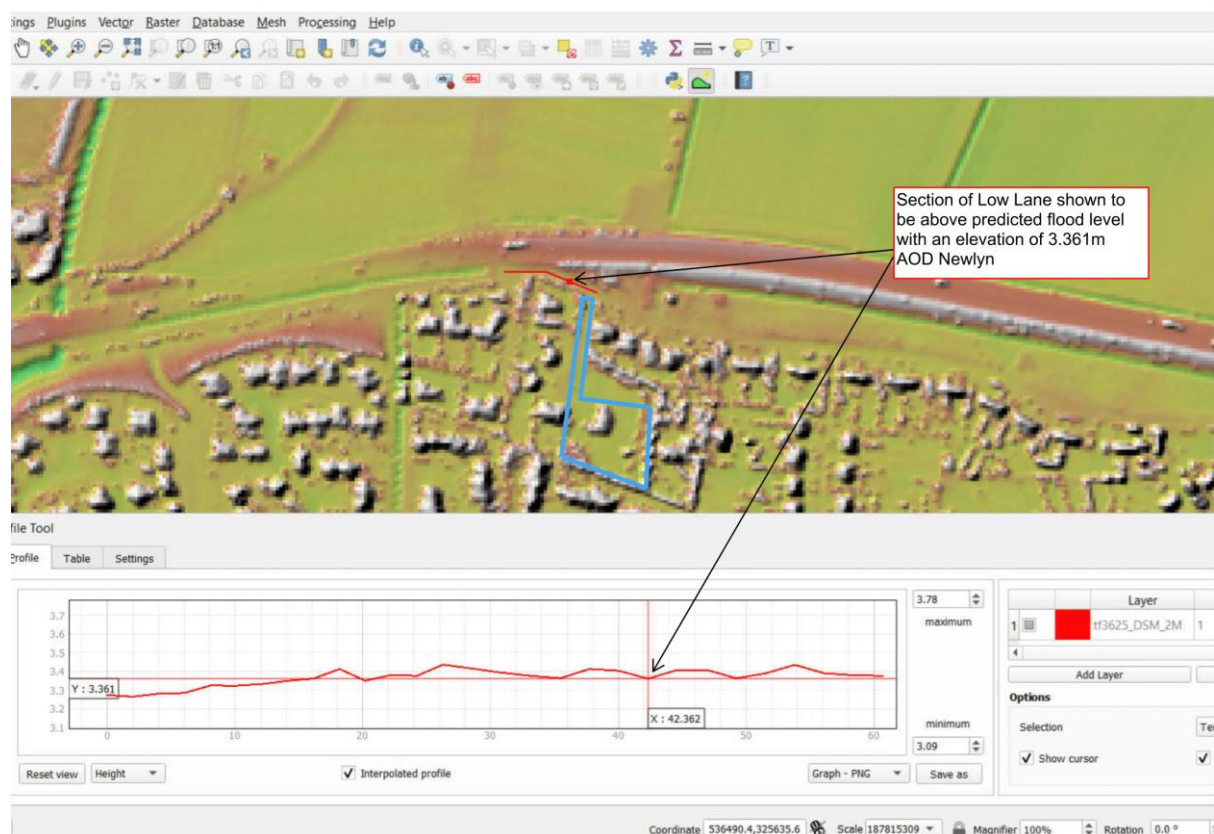
In preparing site specific flood risk assessment the guidance and support flood risk and coastal change document published by Ministry of Housing, Communities and Local Government recommends in paragraph 5d *“What is the expected depth and level for the design flood? See paragraph 055 of this guidance for information on what is meant by a “design flood”. If possible, flood levels should be presented in metres above Ordnance Datum (i.e.) the height above average sea level).”*

In order to determine the average flood depth for the site it will be necessary to ascertain the maximum predicated tidal flood level AOD for the 0.5% event in 2115.

The EA Northern Area Tidal Breach Depth mapping (Appendix C) shows the section of Low Lane, immediately north west of where the private drive to the site joins the public carriageway, outside the zone of residual flooding for the year 2115 for both the 0.5% (1 in 200) and 0.1% (1 in 1000) events but the site itself is shown to be inside the predicted zone of residual flooding for both the 0.5% (1 in 200) and 0.1% (1 in 1000) events.

The Topographic survey (Appendix A) has the elevation of this section of Low Lane as 3.43 metres AOD.

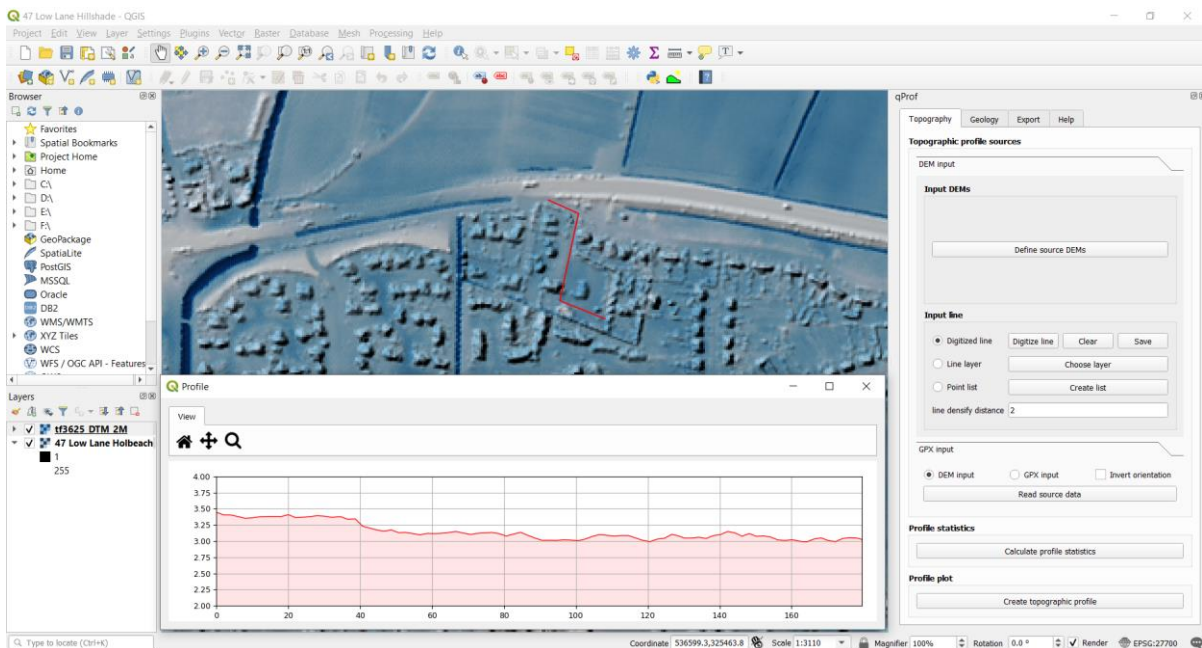
This is confirmed by the Topographic profile graph of the section of road using the Environment Agency LIDAR 2m DTM data where the elevation varies between 3.361m AOD Newlyn and 3.43m AOD Newlyn.



Topographic profile graph of section of Low Lane shown to be outside the zone of residual flooding for the year 2115 for both the 0.5% (1 in 200) and 0.1% (1 in 1000) events, based on Environment Agency LIDAR 2m Digital Terrain Model and the latest EA Flood Mapping, print date June 2020.

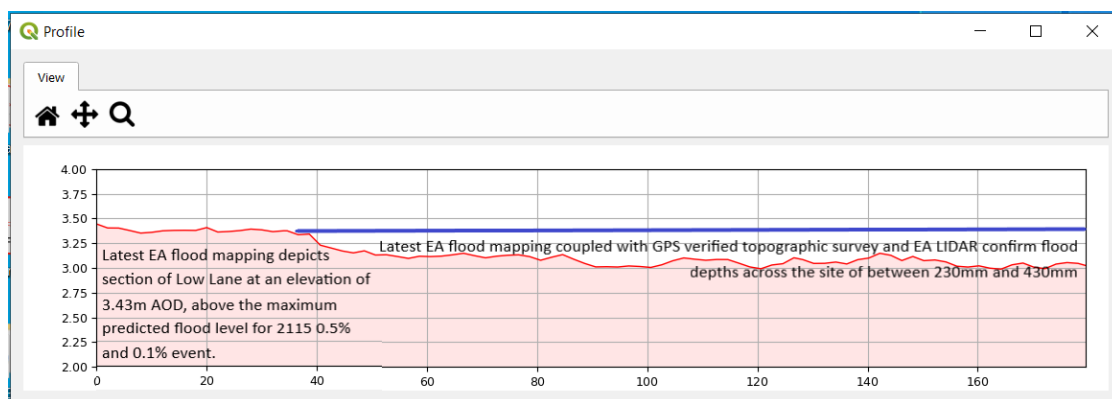
A detailed analysis of the topographical data contained in the latest LIDAR 2m Digital Terrain Models, issued by the Environment Agency, against the SFRA Flood Mapping for the settlement of Holbeach for a residual tidal breach 0.5% event for 2115, allowing for climate change, provides the necessary information to calculate the predicted maximum flood level AOD Newlyn. The resultant figure being between 3.361 and 3.43m AOD Newlyn.

It can therefore be concluded that the peak flood level for a residual tidal breach 0.5% event for 2115, allowing for climate change across the proposed site will not exceed 3.43 metres AOD.



Topographic profile graph, through part section of Low Lane and the site based on Environment Agency LIDAR 2m Digital Terrain Model.

It can demonstrated from the qProf topographic profile, taken from the EA LIDAR 2m DTM, beginning at the section of Low Lane shown in the Flood Risk depth maps shown to be above the predicted flood level for a 0.5 % and 0.1% Residual Tidal breach scenario of 2115 and the south eastern extremity of the development site, that the predicted flood depths across the site varies between 230mm and 430mm.



Topographic profile graph, through part section of Low Lane and the site based on Environment Agency LIDAR 2m Digital Terrain Model coupled with the latest EA Flood Depth Mapping for the year 2115 for both the 0.5% (1 in 200)and 0.1% (1 in 1000) events, print date June 2020 shows predicted flood depths of between 230mm and 430mm.

Using the average elevation of the site of 3.10m AOD Newlyn against the maximum predicted flood level of 3.43m AOD Newly, produces an average flood depth of 330mm.

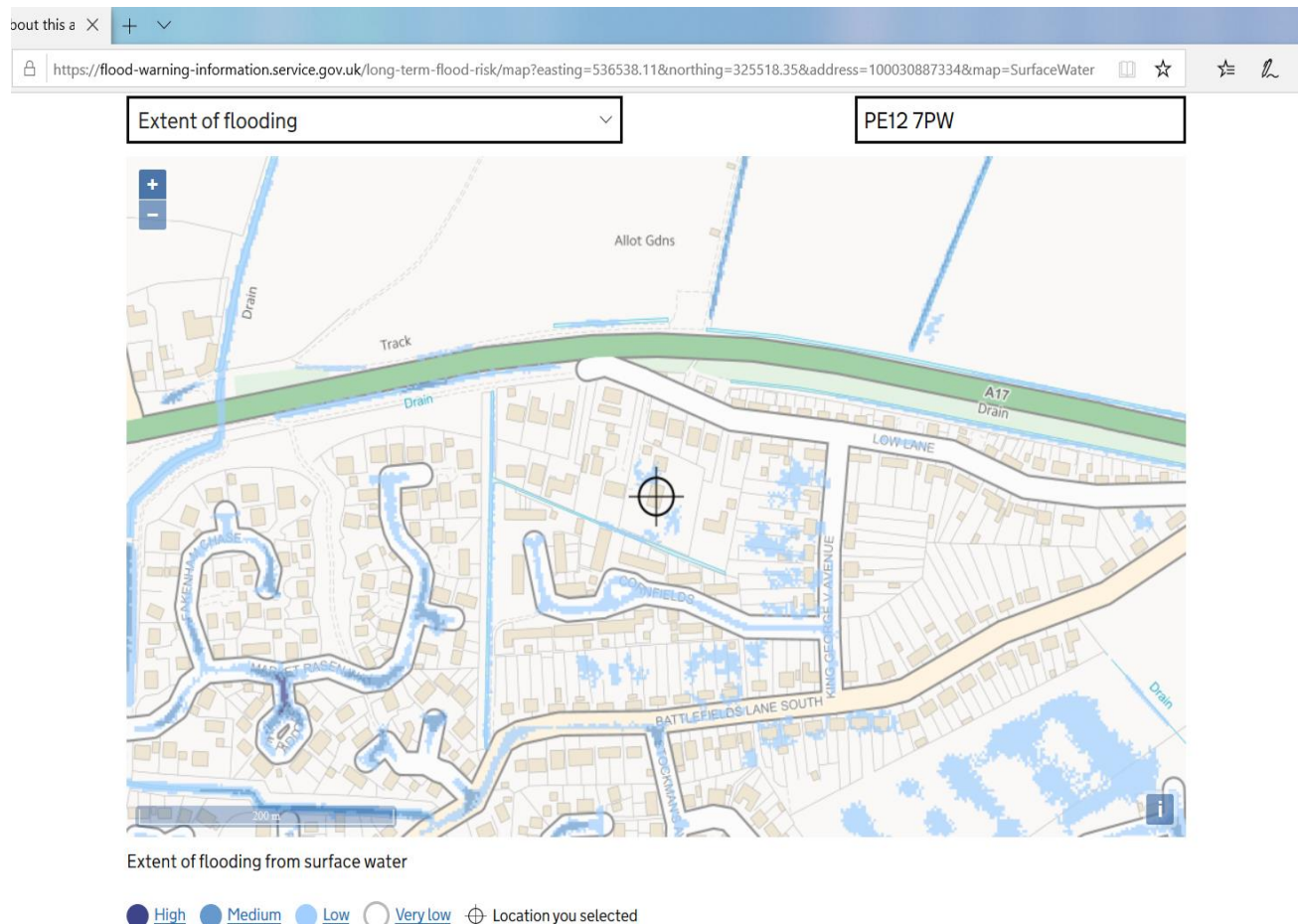
Setting the ground floor levels of the proposed dwellings at 3.50m AOD Newlyn would ensure protection against both the 0.5 % and 0.1% Residual Tidal breach scenario of 2115.

This would also meet the recommendations contained in the South East Lincs standing advice matrix where on non-major sites of more vulnerable development with predicted water depths of between 0.0m and 0.25m should be set 300mm above ground level and for predicted water depths of between 0.25 and 0.5m, floor levels should be set a minimum of 0.5metres above ground level, the relative ground levels of the site being 3.2m AOD and 3.0m AOD respectively.

This is also consistent with the ground floor level of the recently completed dwelling immediately north and adjacent to the proposed site and the ground floor levels of thirty-nine new dwellings located north of Low Lane completed within the past twenty-four months, both developments with ground floor levels set at 3.5m AOD Newlyn.

Pluvial Flood Risk:

EA mapping available online indicates that the site is at very low risk from surface water flooding. There are isolated areas where surface water ponding could occur in times of very extreme rainfall events. The topographical survey and the LIDAR EA DTM data indicates surface water flood depths to these areas in such an event is unlikely to exceed 30mm.



<https://flood-warning-information.service.gov.uk/long-term-flood-risk>

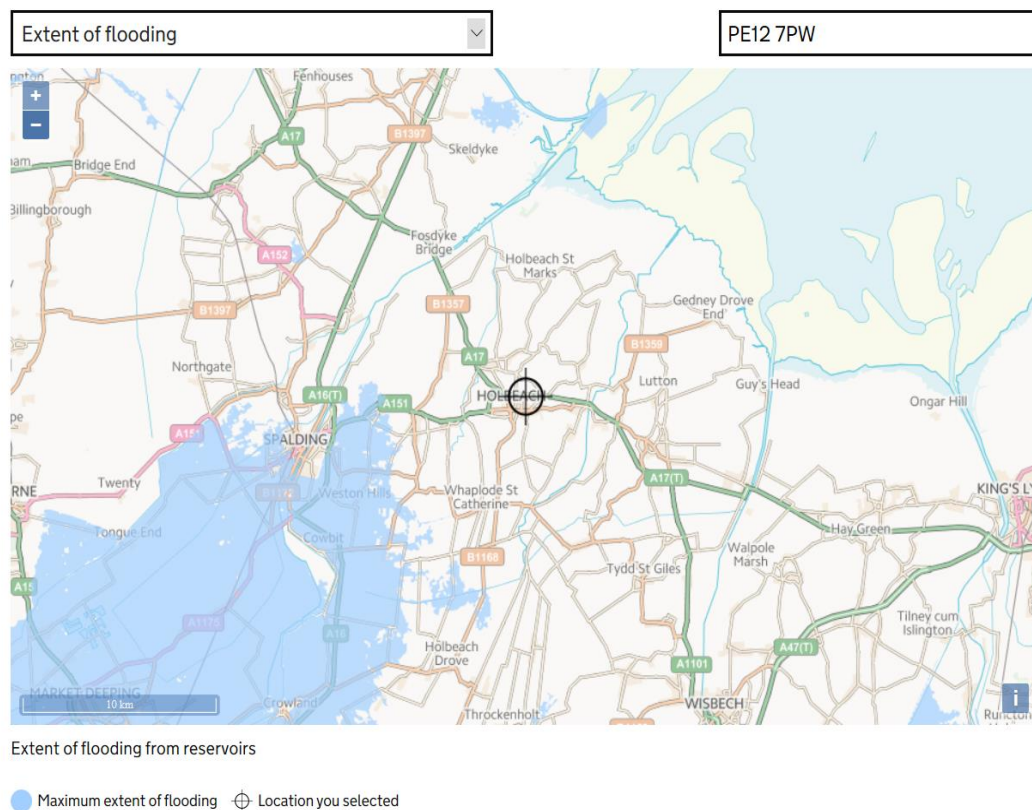
Flooding from Foul Water Sewers:

There are no records of flooding from public foul water sewers.

Reservoir Flooding:

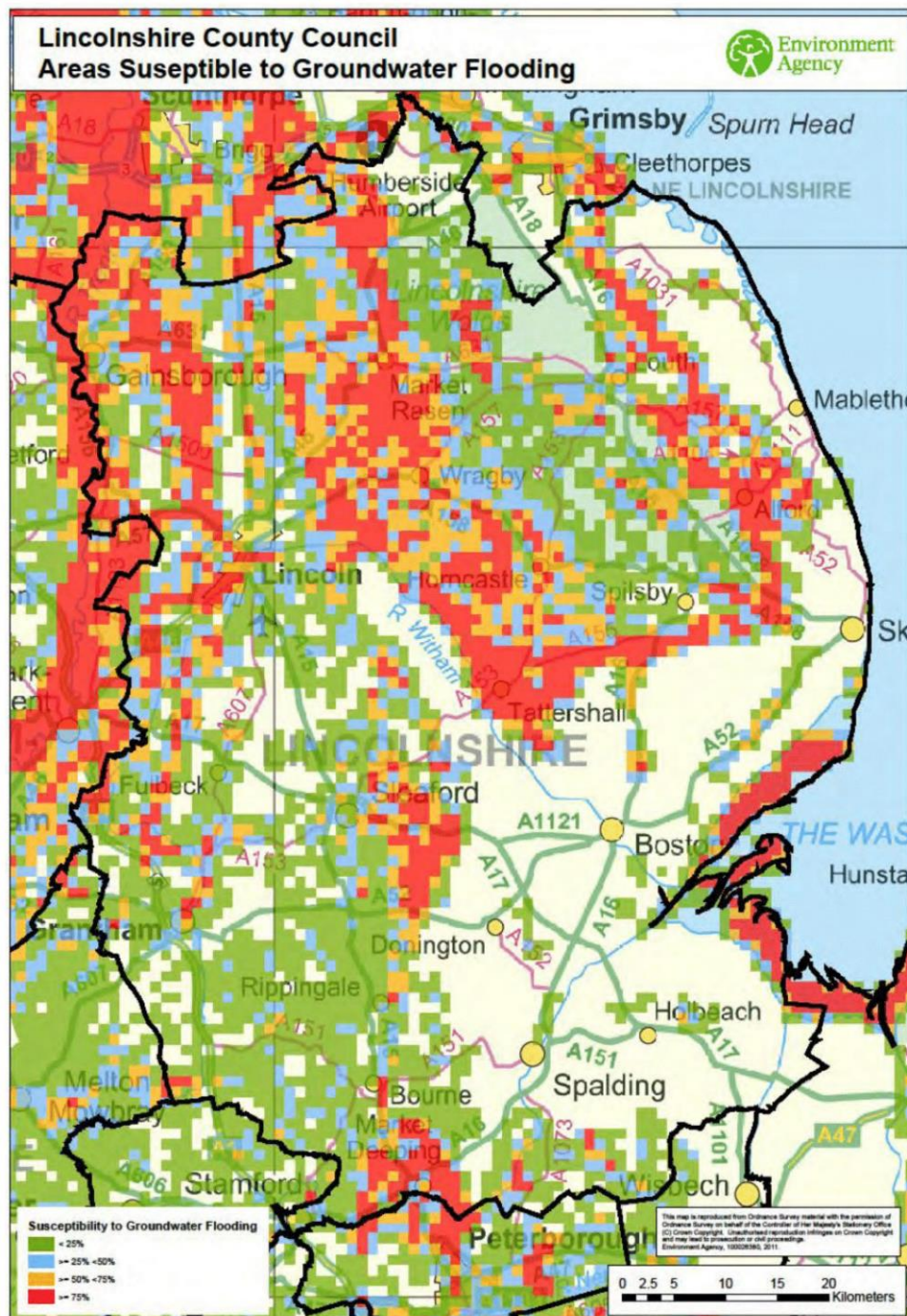
The site is not at risk from reservoir flooding.

<https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?easting=536538.11&northing=325518.35&address=100030887334&map=RiversOrSea>



<https://flood-warning-information.service.gov.uk/long-term-flood-risk>

Groundwater Flooding:
The site is not at risk from ground water flooding.



Map showing Areas Susceptible to Ground Water Flooding.

6.0 Mitigation

The proposed development is considered appropriate for the Zone 3a classification. It is acknowledged by the EA that the flood zone classification may give a misleading picture in that if there were no flood defences, water would spread out across these large Fenland floodplains. Defences are present however, and the site is not affected by overtopping of the sea defences for both 0.5% and the 0.1% event to the year 2115 allowing for climate change, the actual risk. In practical terms therefore, the risk of flooding is associated with the unlikely scenario of a flood defence embankment breach defined as a residual risk.

The proposed mitigation measures to manage this risk are four-fold; raising finished floor levels above the predicted peak flood level, providing safe refuge at first floor level, the application of flood resilient constructions techniques, and the application of advanced flood warning and emergency evacuation procedures.

The planning application for the site is for a detailed application. This gives the opportunity to ensure that, as buildings are designed, their layout and use of materials are resilient and resistant to flooding. The following principles will be applied:

(1) Finished ground floor levels will be set a minimum of 3.5m AOD Newlyn. This is above the predicted residual breach fluvial/tidal flood level for both the 0.5% event and the 0.1% event in the year 2115 allowing for climate change.

(2) All properties are two storey therefore safe refuge will be provided at first floor level.

(3) Flood resilient construction shall be incorporated in the buildings to a height 300mm above the finished ground floor level. For information on resilient materials, designers should refer to the Communities and Local Government document 'Improving the flood performance of new buildings – Flood resilient construction';

Services, wherever possible, will be located above the 1% (1 in 100 year) plus climate change peak flood level.

(4) Flood Warning and Evacuation:

Measures will be put in place to ensure that any potential flood events are communicated to the occupiers at the earliest opportunity and safe routes for evacuation are included (Appendix G and H). Similarly, all future occupiers will be provided with the necessary information to ensure that they register for flood warnings and work with the emergency planners on their evacuation procedure as part of the emergency plan for the area. Information is available at www.lincolnshire.gov.uk/lincolnshireprepared/about-us.

7.0 Climate Change

Effects on Predictions of Flood Risk in FRA:

This FRA has identified the main source of flooding where the new climate change recommendations could affect the predictions of flood levels in 2115. At the development site these are a breach of the Wash Tidal Sea Defences.

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

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

It can be seen that the revised 2016 guidance increases the maximum allowance for sea rise in 2115 by 100mm.

Referencing the Environmental Agencies guidance at:

<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#history>

latest update 27 July 2021 2020.

The annual sea rise due to climate change is given in the latest guidance issued by the EA date 27 July 2021. The recommended contingency allowances are stated in Table 3.

Table 3 Peak sea level allowance for each epoch in (mm) per year with cumulative sea level rise for each epoch in brackets (use 1981 to 2000 baseline)						
Area of England) (Use River Basin	Allowance	2000 to 2035	2036 to 2065	2066 to 2095	2096 to 2115	Cumulative Rise 2000 to 2125 (m)
Anglian	Higher Central	5.8 (203mm)	8.7 (261mm)	11.6 (348mm)	13 (390mm)	1.20m
Anglian	Upper End	7 (245mm)	11.3 (339mm)	15.8 (474mm)	18.1 (543mm)	1.6m

Environment Agency 2018 Coastal Flood Boundary Extreme Sea Levels for West Lighthouse for a 1 in 200 event 6.21 m ODN.

Higher Central:

Base year 2018 to 2035 @ 5.8mm/year (17 years x 5.8mm) = 99mm

2036 to 2065 @ 8.7mm/year (30 years x 8.7) = 261mm

2066 to 2095 @ 11.6mm/year (30 years x 11.6) = 348mm

2096 to 2125 @ 13mm/year (29 years x 13) = 377mm

Overall total = 1085mm

Peak tide levels Present Day (2018) at West Lighthouse 0.5% (1 in 200) = 6.21m ODN and for year 2125 = 7.29m ODN.

Upper End:

Base year 2018 — 2035 @ 7mm/year (17 years x 7mm) = 119mm

2036 — 2055 @ 11.3mm/year (30 years x 11.3) = 339mm

2066 — 2095 @ 15.8mm/year (30 years x 15.8) = 474mm

2096 to 2125 @ 18.1mm/year (29 years x 18.1) = 525mm

Overall total = 1457mm

Peak tide levels Present Day (2018) at West Lighthouse 0.5% (1 in 200) = 6.21m ODN and for year 2125 = 7.667 ODN.

The current Hazard Mapping has a Base year 2006 — 2115

Table 3 Peak sea level allowance for each epoch in (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)					
Area of England) (Use River Basin maps	1990 to 2025	2026 to 2050	2051 to 2080	2081 to 2115	Cumulative Rise 1990 to 2115 (m)
East, Midlands, London, South East	4 (140mm)	8.5 (212.5mm)	12 (360mm)	15 (525mm)	1.24m

Base year 2006 — 2025 @ 4mm/year (29 years x 4mm) = 96mm

2026 — 2050 @ 85mm/year (30 years x 8.7) = 212.5mm

2051 — 2080 @ 11.6mm/year (30 years x 12) = 360mm

2091 — 2115 @ 15mm/year (24 years x 15) = 525mm

Overall total = 1194mm

Peak tide levels Present Day (2006) at West Lighthouse 0.5% (1 in 200) = 6.01m ODN and for year 2115 (Higher Central) = 7.204 ODN.

This will not have the effect of increasing the predicted residual flood level at the site for a 1 in 200 year breach event in the year 2115 compared to 2125 by the maximum of 86mm, the increase at the site will probably be only between 10mm and 25mm. It is unlikely that this increase will significantly change the Flood Risk Maps issued by The Environment Agency.

The latest update to Flood Risk Assessments climate change allowances produced by the Association of SuDS Authorities states:

“UK Climate projections report.

On 17th December 2019 our guidance for developers and planners on how to account for climate change in their flood risk assessments was updated – ‘Flood risk assessments: climate change allowances’. The main changes include:

Updated sea level rise allowances to reflect latest climate change projections (UKCP18), which have replaced previous projections (UKCP09);

Improved clarity and usability of the guidance. This has been informed by a user feedback event in summer 2017, plus general feedback and questions we’ve had since 2016 when it was originally published;

Amendments to reflect changes in policy since the National Planning Policy Framework was updated in 2018.

“The update sea level allowances are broadly similar to the previous allowance, although now a range of sea level rise allowances is provided so a range of sea level rise scenarios can be assessed. When UKCP18 was published in November 2018 the Environment Agency shared an interim approach for planners and developers to ensure their development accounted for the upper end of sea level rise projections in UKCP18, as appropriate. On this basis, and because the updated allowances are broadly similar to previous allowances, developments approved using previous climate change allowances and guidance should be considered to be robust in the context of UKCP18”.

It is therefore concluded that the findings of this flood risk assessment are robust for climate change events to the year 2125.

8.0 Conclusion & Recommendations

The proposals comprise the construction of four residential dwellings together with one detached garages and the demolition of the existing bungalow.

The site is located in Environment Agency Flood Zone 3a, namely an area with a high probability of fluvial and tidal flooding. However, it is stated by the EA that the assessment of flood risk in the Fenlands can give a misleading picture, since the area is protected by flood embankments for the 1% AEP event, and as such it is the tidal breach scenario that presents a very small residual risk.

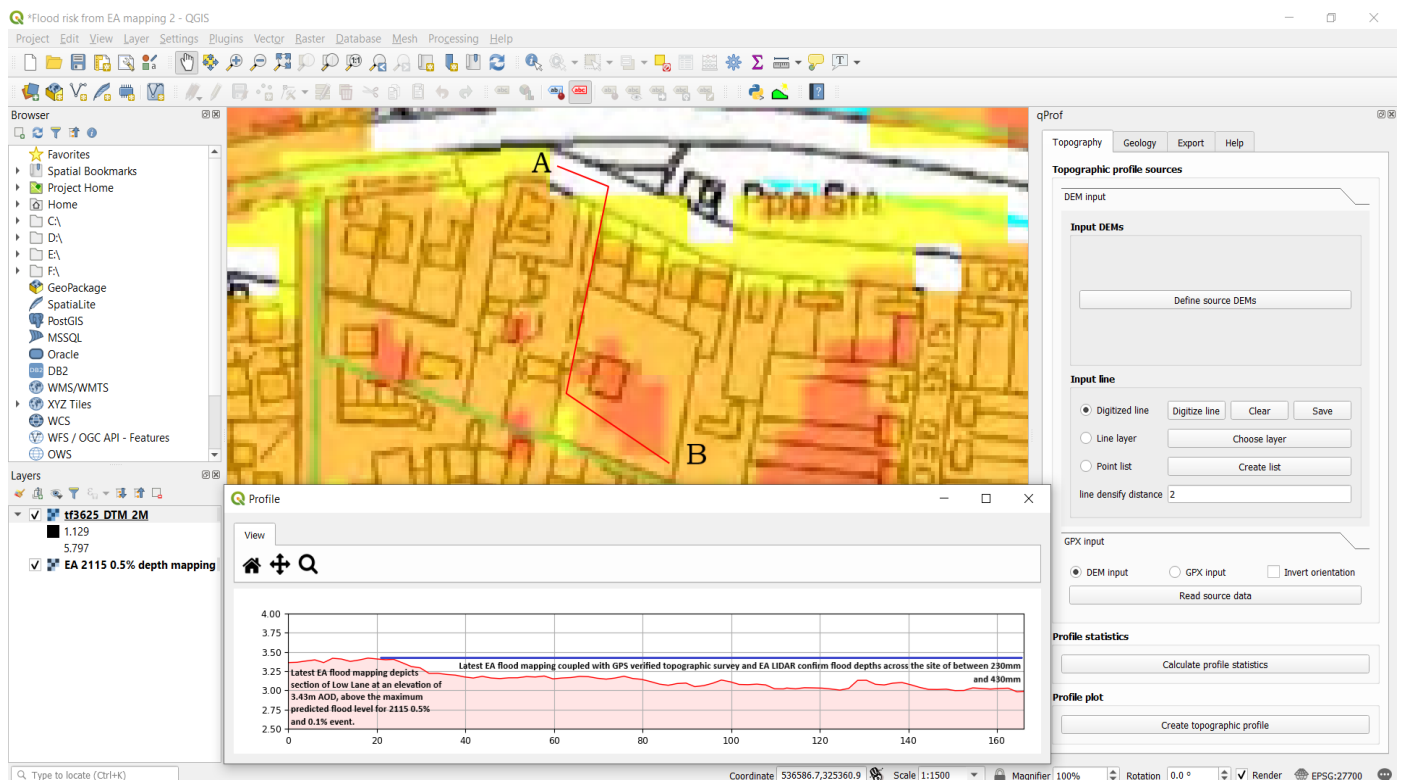
The site is outside the zone of an actual risk for the 1% Fluvial or 0.5% Tidal flooding event up to the year 2115 as shown on the SFR maps for an actual event i.e. overtopping of the flood defences.

In the report ‘2016 Update of South Holland Strategic Flood Risk Assessment Modelling and Mapping Note’ dated 28 February 2017 and referencing ‘Table 7 Comparison of 2010 and 2016 Mapped Outputs’, it is confirmed that the actual risk maps were not retained, however they remain the most up to date actual fluvial and tidal flood risk maps available. Since Holbeach is outside the predicted flood zone for an actual flood risk for the 1% fluvial or 0.5% tidal flooding event up to the year 2115, whilst large areas of the district are within this flood zone, the Sequential Test is met.

The residential aspects of the site are classed as 'more vulnerable' to flooding, as outlined in 'Planning Practice Guide – Flood Risk and Coastal Change'.

Development of 'more vulnerable' uses is compatible with Flood Zone 3a, but requires the completion of the Exception Test.

An assessment of flood risk to the development site determined that there is potentially an extremely small residual risk of flooding from a breach of the flood defence embankments. Also the flood risk assessment has concluded that by combining the SELSFRA mapping with the latest EA flood mapping and reading this against the data contained in the GPS verified topographic survey and the EA LIDAR 2m DTM, for a 0.5% tidal event and a 0.1% tidal event for the year 2115, the maximum predicted flood level is 3.43m AOD Newlyn.



Topographic profile graph, through part section of Low Lane and the site based on Environment Agency LIDAR 2m Digital Terrain Model coupled with the latest EA Flood Depth Mapping for the year 2115 for both the 0.5% (1 in 200)and 0.1% (1 in 1000) events, print date June 2020 shows predicted flood depths of between 230mm and 430mm.

Proposed mitigation for these risks includes raising of finished ground floor levels to 3.5m AOD Newlyn, which is above the predicted flood level for a Residual 0.5 % event and a 0.1% event to the year 2115, allowing for climate change to the year 2125

The development will incorporate flood resilient building techniques, flood resilient construction shall be incorporated in the buildings to a height 300mm above finished ground floor level. In the event of flooding, safe refuge will be provided at first floor level and future occupiers will be provided with an emergency plan for safe evacuation depending on prevailing conditions.

In addition to direct and indirect flood warnings, the Environment Agency operates a 24 hour a day Floodline Service providing advice and information on flooding, contact telephone number 0845 9881188 and the occupiers of the new property should register with the Floodline Warnings Direct Service to receive future flood warnings. <https://www.gov.uk/sign-up-for-flood-warnings>

Surface water run-off from the roofs of the proposed dwellings and detached garage should be discharged into soakaway crates. The infiltration system together with associated drainage should be designed to BRE Digest 365 and meet the requirements of Part H of Building Regulations. The access road should be constructed with a permeable block paving and gravel driveways with a suitable base to allow the surface water to permeate into the ground. Water butts of at least 120 litres internal capacity shall be installed to the rear of all properties to intercept rainwater discharging from the roofs of the dwellings. This will reduce the risk of flooding and the demand for water by recycling and to increase the level of sustainability of the development.