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Client: Care Management Group

Flood Risk Assessment for the
Proposed Development at 54
Spalding Road, Holbeach

December 2019

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1 Background and Scope of Appraisal

Flooding is a major issue in the United Kingdom. The impacts can be devastating in terms of the cost of repairs, replacement of damaged property and loss of business. The objectives of the Flood Risk Assessment (FRA) are therefore to establish the following:

- whether a proposed development is likely to be affected by current or future flooding from any source
- whether the development will increase flood risk elsewhere within the floodplain
- whether the measures proposed to address these effects and risks are appropriate
- whether the site will pass the second element of the Exception Test (where applicable).

Herrington Consulting has been commissioned by Care Management Group to prepare a Flood Risk Assessment (FRA) for the proposed development at **54 Spalding Road, Holbeach, PE12 7HG**.

This appraisal has been undertaken in accordance with the requirements of the National Planning Policy Framework (2019) and the National Planning Practice Guidance Suite (March 2014) that has been published by the Department for Communities and Local Government. The *Flood Risk and Coastal Change* planning practice guidance included within the Suite represents the most contemporary technical guidance on preparing FRAs. In addition, reference has also been made to Local Planning Policy.

To ensure that due account is taken of industry best practice, this FRA has been carried out in line with the CIRIA Report C624 'Development and flood risk - guidance for the construction industry'.

2 Development Description and Planning Context

2.1 Site Location and Existing Development

The site is located at OS coordinates 535350, 324954, off Spalding Road in Holbeach. The site covers an area of approximately 0.08 hectares and currently comprises a detached residential dwelling and a garage. The location of the site in relation to the surrounding area is shown in Figure 2.1.

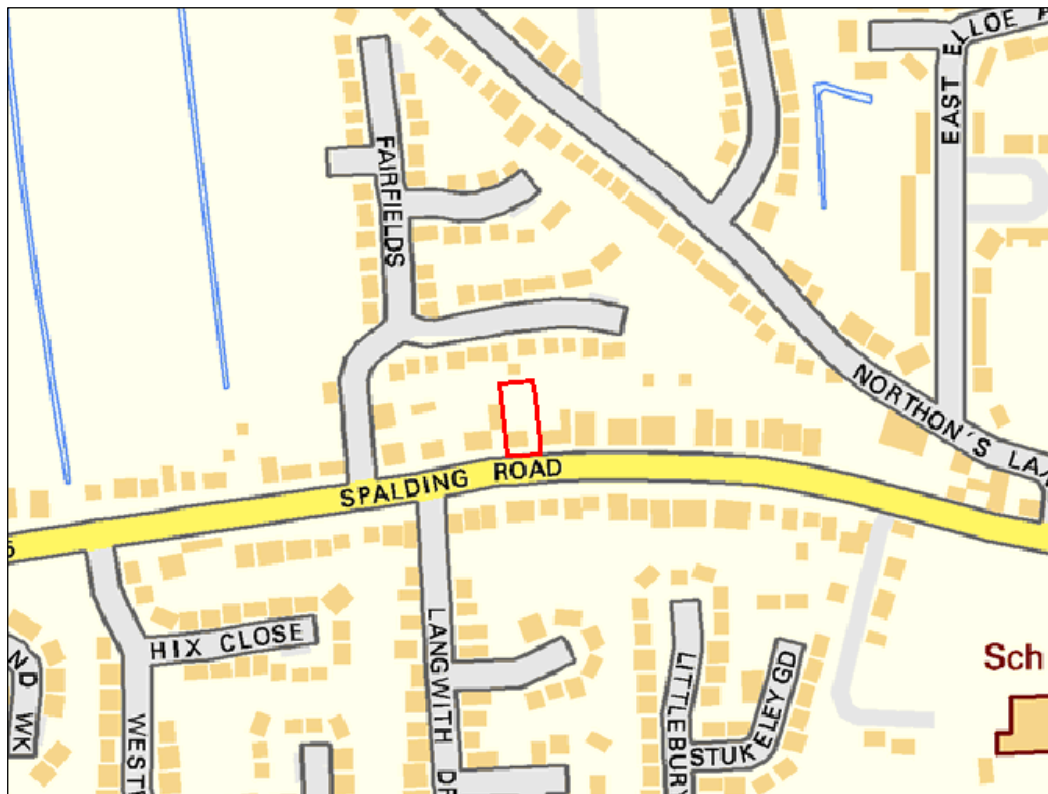


Figure 2.1 – Location map (Contains Ordnance Survey data © Crown copyright and database right 2019).

The site plan included in Appendix A.1 of this report provides more detail in relation to the site location and layout.

2.2 Proposed Development

The proposals for development comprise an extension to an existing garage to provide a 1-bedroom ancillary dwelling to the existing property.



Figure 2.2 – Existing and proposed site layout.

Drawings of the proposed scheme are included in Appendix A.1 of this report.

2.3

The Sequential Test

The National Planning Policy Framework (NPPF) requires the Sequential Test to be applied at all stages of the planning process and generally the starting point is the Environment Agency's flood zone maps. These maps and the associated information are intended for guidance, and cannot provide details for individual properties. They do not take into account other considerations such as existing flood defences, alternative flooding mechanisms and detailed site based surveys. They do, however, provide high level information on the type and likelihood of flood risk in any particular area of the country. The flood zones are classified as follows:

Zone 1 – Low probability of flooding – This zone is assessed as having less than a 1 in 1000 annual probability of river or sea flooding in any one year.

Zone 2 – Medium probability of flooding – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any one year.

Zone 3a – High probability of flooding - This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding or 1 in 200 or greater annual probability of sea flooding in any one year.

Zone 3b – The Functional Floodplain – This zone comprises land where water has to flow or be stored in times of flood and can be defined as land which would flood during an event having an annual probability of 1 in 20 or greater. This zone can also represent areas that are designed to flood in an extreme event as part of a flood alleviation or flood storage scheme.

The location of the site is shown on the Environment Agency's flood zone map in Figure 2.3 and the information provided by this map has been interrogated and summarised in Table 2.2 below.

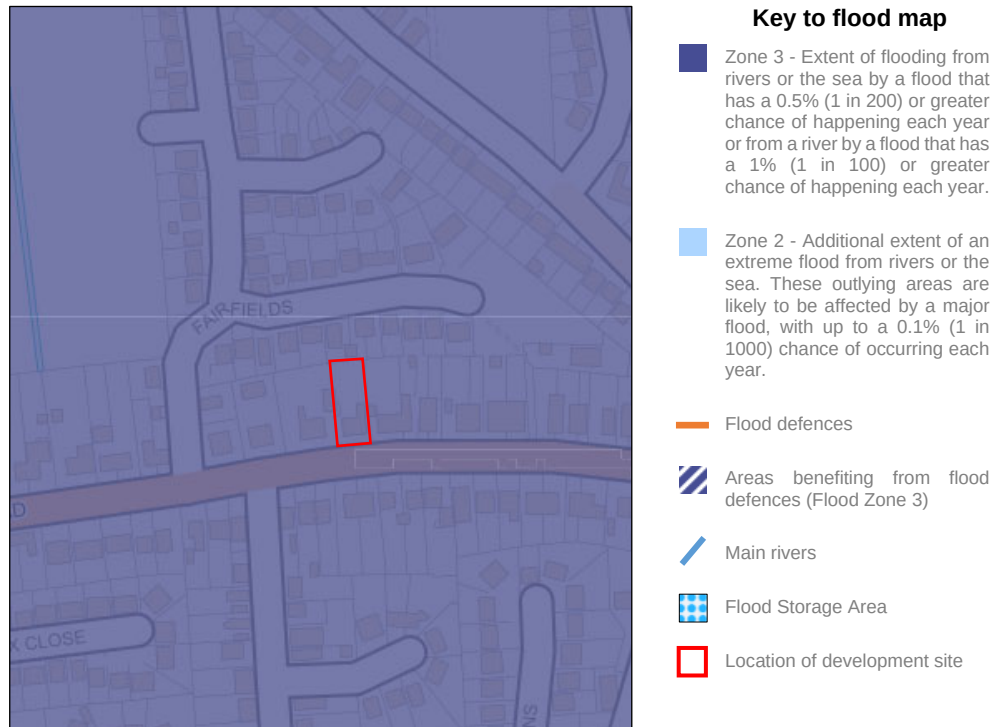


Figure 2.3 – Flood zone map showing the location of the development site (© Environment Agency)

The above mapping shows the development site is located within Flood Zone 3 and identifies that the site does not benefit from existing flood defences that have been constructed in the last 5 years. This mapping does not distinguish between high risk areas and the functional floodplain, i.e. Zones 3a and 3b. This is an important differentiation that needs to be made by the FRA because the NPPF states that no development, other than essential transport and utilities infrastructure, should be located within the functional floodplain.

The functional floodplain is defined by the NPPF as land where water has to flow or be stored in times of flood during events that have a probability of occurrence of 1 in 20 (5%) or greater in any one year. The Planning Practice Guidance goes on to further clarify this by adding the following definition:

The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood, should provide a starting point for consideration and discussions to identify the functional floodplain. Areas which would naturally flood with an annual exceedance probability of 1 in 20 (5%) or greater, but which are prevented from doing so by existing infrastructure or solid buildings will not normally be defined as functional floodplain.

Based on information provided by the Environment Agency and that derived as part of this appraisal, the following functional floodplain test is applied:

Do predicted flood levels show that the site will be affected by an event having a return period of 1 in 20 years or less?	X
Is the site defended by flood defence infrastructure that prevents flooding for events having a return period of 1 in 20 years or greater?	✓
Does the site provide a flood storage or floodwater conveyance function?	X
Does the site contain areas that are 'intended' to provide transmission and storage of water from other sources?	X
Is site within the functional floodplain (Zone 3b)?	No

Table 2.1 – Functional floodplain test.

The flood zone mapping and associated information has been summarised in Table 2.2 below.

Flood Zone (percentage of site within zone)		Source of flooding	Benefiting from existing flood defences*
Zone 1	0%		
Zone 2	0%		
Zone 3a	100%	River (Fluvial)	No
Zone 3b	0%		
(*) The flood zone maps only recognise defences constructed within the last 5 years			

Table 2.2 – Flood zone classification.

The NPPF states that the Local Planning Authority (LPA) should apply the sequential approach as part of the identification of land for development in areas at risk from flooding. The overarching objective of the Sequential Test is to ensure that lower risk sites are developed before sites in higher risk areas. When applying the Sequential Test, it is also necessary to ensure that the subject site is compared to only those sites that are available for development and are similar in size.

This requires a comprehensive knowledge of development sites within the district and is generally applied as part of the Local Development Framework (LDF) process. However, when applying the Sequential Test to sites that have not been assessed as part of the LDF it is necessary to apply a bespoke test, and the Flood Risk Assessment can help to provide additional evidence to better quantify the true risk of flooding, enabling an informed judgement to be made.

In this instance, a Sequential Test has not been undertaken as part of this assessment. Notwithstanding this, the proposals comprise a change of use of the existing garage and an extension to the garage to create an ancillary dwelling. Neither of these changes would typically

require the Sequential Test to be applied and therefore, it is concluded that the requirements of the Sequential Test can be met.

The second level of appraisal is through the application of the more detailed and refined flood risk information contained within the Strategic Flood Risk Assessments (SFRA). Such a document has been prepared for the South Holland District Council and this has been referenced as part of this site-specific FRA.

The most detailed stage at which the sequential approach can be applied is at a site based level. Careful consideration of the site's topography and development uses can provide opportunities to locate more vulnerable buildings on the higher parts of the site and placing less vulnerable elements such as car parking or recreational use in the areas exposed to higher risk. This approach is examined later on in this FRA.

2.4 The Exception Test

According to the NPPF, if it is not possible, consistent with wider sustainability objectives, for the development to be located in areas at lower risk, the Exception Test may have to be applied. The application of the Exception Test will depend on the type and nature of the development, in line with the Flood Risk vulnerability classification set out in the NPPG. This has been summarised in Table 2.3 below.

Flood Risk Vulnerability Classification	Zone 1	Zone 2	Zone 3a	Zone 3b
Essential infrastructure – Essential transport infrastructure, strategic utility infrastructure, including electricity generating power stations	✓	✓	e	e
High vulnerability – Emergency services, basement dwellings, caravans and mobile homes intended for permanent residential use	✓	e	x	x
More vulnerable – Hospitals, residential care homes, buildings used for dwelling houses, halls of residence, pubs, hotels, non-residential uses for health services, nurseries and education	✓	✓	e	x
Less vulnerable – Shops, offices, restaurants, general industry, agriculture, sewerage treatment plants	✓	✓	✓	x
Water compatible development – Flood control infrastructure, sewerage infrastructure, docks, marinas, ship building, water-based recreation etc.	✓	✓	✓	✓
Key : ✓ Development is appropriate x Development should not be permitted e Exception Test required Shaded cell represents the classification of this development				

Table 2.3 – Flood risk vulnerability and flood zone compatibility.

From Table 2.3 above it can be seen that the development falls into a classification that requires the Exception Test to be applied. For the Exception Test to be passed it should be demonstrated that:

- A. the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- B. 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.

Both elements of the test will have to be passed for development to be allocated or permitted.

Demonstrating that the development provides wider sustainability benefits to the community that outweigh flood risk is outside the scope of this report, nevertheless, reference is made to the SFRA to establish the key risks associated with flooding to help demonstrate that this objective can be achieved. The key focus of this FRA is therefore to establish whether the site is likely to pass part B of the Exception Test.

3 Definition of Flood Hazard

3.1 Site Specific Information

Information from a wide range of sources has been referenced in order to appraise the true risk of flooding at this location. This section summarises the additional information collected as part of this FRA.

Site specific flood level data provided by the EA – The EA has been consulted as part of the development of this FRA and a copy of their response is included in Appendix A.2 of this report.

Information contained within the SFRA – This report has been prepared in accordance with the requirements outlined within the South East Lincolnshire Council (SELC) SFRA (2017). Reference has been made to the historic flood records contained within this document.

Information provided by Anglian Water – Anglian Water has provided the results of an asset location search for the site. The response is included in Appendix A.3.

Site specific topographic surveys – A site-specific topographic survey has been undertaken for the entire development site and Figure 3.1 below shows an extract of the survey for the area of proposed development. A copy of the full topographic survey can be found in Appendix A.1.

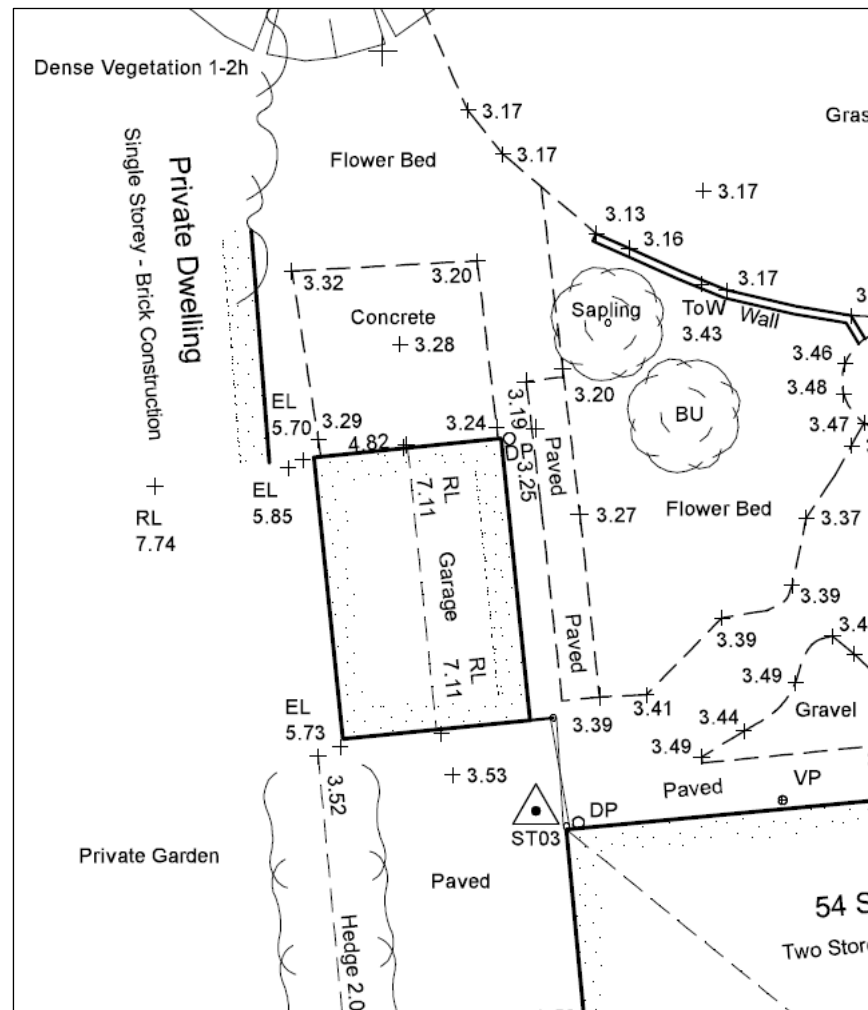


Figure 3.1 – Extract from the site-specific topographic survey.

From Figure 3.1 above, it is evident that the land levels in the area of proposed development vary between 3.20m and 3.32m AODN. The existing garage is situated slightly higher, with an internal floor level of 3.55m AODN. In general, the development site is located on higher ground with lower-lying areas further to the north and south of the development site.

Geology – Reference to the British Geological Survey map shows that the underlying solid geology in the location of the subject site is West Walton Formation (mudstone and siltstone). Overlying this are Tidal Flat Deposits (clay and silt).

Historic flooding – The EA has confirmed that they do not hold records of historic flooding in the area. No other information has been revealed through desktop study.

3.2 Potential Sources of Flooding

The main sources of flooding have been assessed as part of this appraisal. The specific issues relating to each one and its impact on this particular development are discussed below. Table 3.1 at the end of this section summarises the risks associated with each of the sources of flooding.

Flooding from Fluvial Sources (Rivers) – The development site is located within Flood Zone 3 as identified by the EA's 'Flood Map for Planning' (Figure 2.3). Reference to the mapping contained within the SFRA confirms that the dominant risk of flooding in this location is tidal, not fluvial, and therefore the risk of flooding from fluvial sources is not considered in any further detail.

Flooding from Tidal Sources (Rivers, the Sea and Estuaries) – As discussed above, the site is located within Flood Zone 3, in an area which is classified as being tidally-dominated by the SFRA. Both of these maps are used as a consultation tool by planners to highlight areas where more detailed investigation into the risk of flooding is required. Consequently, the risk of flooding from this source is examined in more detail in Section 5 of this FRA.

Flooding from Ordinary or Man-made Watercourses – Natural watercourses that have not been enmainained and man-made drainage systems such as irrigation drains, sewers or ditches could potentially cause flooding.

Inspection of OS mapping of the site and surrounding area identifies that there is a drainage network approximately 140m to the west of the site. The primary purpose of the drainage network is to drain the surrounding fields and reduce the groundwater level within the surrounding land, with pumps or tidal sluices being used to discharge flows to the sea.

Extreme rainfall, the failure of a pumping station or the tide-locking of the tidal outlet can prevent the system discharging, which may result in increased water levels in the network of drains and ditches. However, due to the large and relatively flat nature of the land that is drained, the consequence of such an event is likely to be water logging of the ground and shallow flooding in the lower-lying areas.

Further interrogation of aerial height data reveals that the development site is elevated approximately 0.5m above the lower-lying areas to the south and northwest. Consequently, the impact of such a flood event is considered to be relatively low, and significantly less than the impact from a coastal event, which is considered in more detail.

Flooding from Land (overland flow and surface water runoff) – Overland flooding typically occurs in natural valley bottoms as normally dry areas become covered in flowing water and in low spots where water may pond. This flooding mechanism can occur almost anywhere, but is likely to be of particular concern in any topographical low spot, or where the pathway for runoff is restricted by terrain or man-made obstructions.

The EA's 'Flood Risk from Surface Water' shows a majority of the site is identified as having a 'very low' risk of flooding from surface water (Figure 3.1). There is a small area within the garden which is shown to be have a 'low' risk of flooding from surface water.

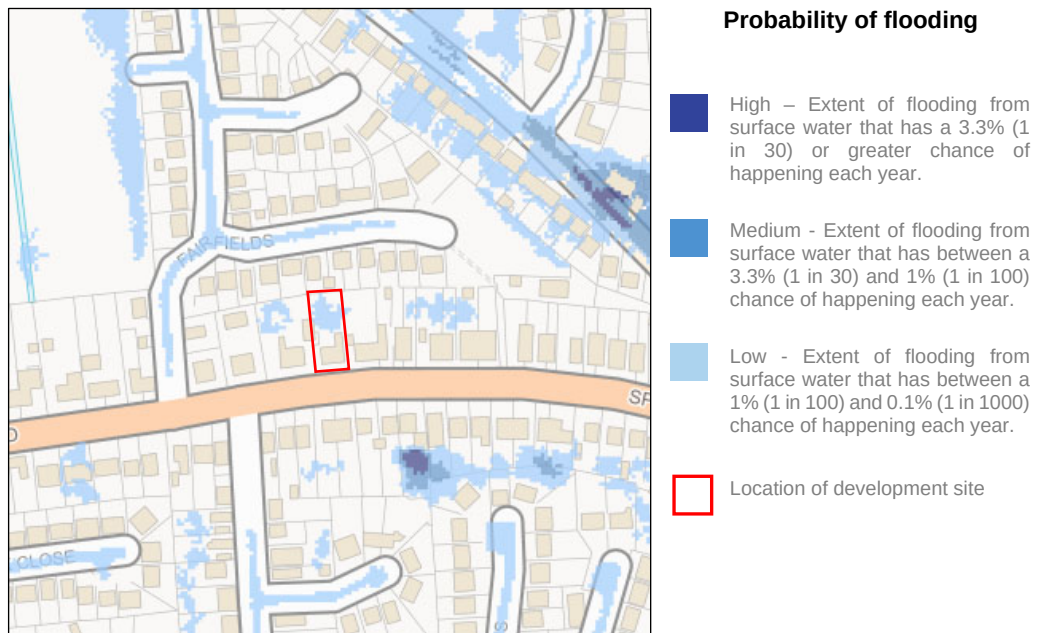


Figure 3.2 – Surface water flooding map showing the location of the development site
(© Environment Agency)

Inspection of the site-specific topographic survey identifies that land levels within the garden are lower than the existing house and garage. Aerial height data shows that the gardens along the rear of all of the properties along Spalding Road are lower than the buildings, and as such, surface water landing in this area could accumulate in the gardens following an extreme rainfall event. Reference to the more detailed mapping hosted by the EA shows that this area is only expected to flood during an extreme event with a return period of 1 in 1000 years, to a depth of less than 300mm.

As a result, the risk of flooding *to the site* from this source is considered to be 'moderate' and mitigation will be required. Reference to the scheme drawings identifies that the floor level of the development will be raised 500mm above the external ground level and therefore, the risk of internal flooding during an extreme rainfall event is considered to be low.

Flooding from Groundwater – Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in 'bournes' (streams that only flow for part of the year).

The underlying geology in this area is West Walton Formation overlain by tidal flat deposits, which are typically permeable and therefore, can be associated with groundwater emergence. Inspection of nearby borehole records identifies that the groundwater level is over 1.5m below ground and therefore, emergence is considered unlikely in this area. This is supported by the Defra Groundwater Flood Scoping Study (May 2004), which shows that no groundwater flooding events were recorded during the very wet periods of 2000/01 or 2002/03 and that the site itself is not located within an area where groundwater emergence is predicted. As the proposals do not include the construction of a basement, it is concluded that the risk of flooding from this source is low.

Flooding from Sewers – In urban areas, rainwater is typically drained into surface water sewers or sewers containing both surface and wastewater known as “combined sewers”. Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked, or has inadequate capacity; this will continue until the water drains away.

Inspection of asset location data provided by Anglian Water reveals that the sewers in this area are foul sewers only. The absence of combined sewers significantly reduces the risk of the sewer network surcharging as a result of an extreme rainfall event. It is only in the unlikely event that the foul sewers were to become blocked, that water could exit the sewer network.

However, inspection of aerial height data reveals that land levels within Spalding Road (further to the west of the development site) are lower. Consequently, water is likely to exit the sewer network at this location and then flow towards the lower-lying area to the north, away from site. This is supported by the SFRA which shows that there are no historic records of sewer flooding in this area. Consequently, the risk of flooding from this source is considered to be low.

Flooding from Reservoirs, Canals and other Artificial Sources – Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes, where water is retained above natural ground level. In addition, operational and redundant industrial processes including; mining, quarrying, sand and gravel extraction, may also increase the depth of floodwater in areas adjacent to these features.

The potential effects of flood risk management infrastructure and other structures also needs to be considered. For example; reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.

Inspection of the OS mapping for the area shows that there are no artificial sources of flooding within close proximity to the site. In addition, the EA's 'Flood Risk from Reservoirs' website shows that the site is not within an area considered to be at risk of flooding from reservoirs. Therefore, the risk of flooding from this source is considered to be *low*.

Flood Risk Summary - A summary of the overall risk of flooding from each source is provided in Table 3.1 below.

Source of flooding	Initial level of risk	Appraisal method applied at the initial flood risk assessment stage
Fluvial sources - Rivers	Low	OS mapping, EA's 'Flood Map for Planning' and mapping contained within the SFRA
Tidal sources – Rives, Sea, and Estuaries	Appraised further in Section 5	OS mapping and the EA's 'Flood Map for Planning'
Ordinary and man-made watercourses	Low	OS mapping and aerial height data
Overland flow	Low (with mitigation)	Environment Agency 'Flood Risk from Surface Water' map, aerial height data and OS mapping
Groundwater	Low	Defra Groundwater Flood Scoping Study, site-specific geological data, aerial height data, OS mapping and BGS Borehole survey records
Sewers	Low	Aerial height data, OS mapping, asset location data provided by Anglian Water and historic sewer records contained within the SFRA
Artificial sources	Low	OS mapping and Environment Agency 'Flood Risk from Reservoirs' flood map

Table 3.1 – Summary of flood sources and risks.

3.3 Existing Flood Risk Management Measures

As part of their response, the EA has confirmed that the development site benefits from existing defence infrastructure which provides a 1 in 150 years standard of protection. The defences are in fair condition and are inspected regularly by the EA.

4 Climate Change

When the impact of climate change is considered it is generally accepted that the standard of protection provided by current defences will reduce with time. The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential changes in the future and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary: for the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall of the type responsible for the recent UK flooding could be expected.

These effects will tend to increase the size of flood zones associated with rivers, and the amount of flooding experienced from other inland sources. The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels. It will also increase the extent of the area at risk should sea defences fail. Changes in wave heights due to increased water depths, as well as possible changes in the frequency, duration and severity of storm events are also predicted.

Planning Horizon

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on the extreme flood level that is commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite state that residential development should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. The development that is the subject of this FRA is classified as residential.

4.1 Extreme Sea Level

Global sea levels will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west. The accompanying Planning Practice Guidance Suite to the NPPF provides allowances for the regional rates of relative sea level rise and these are shown in Table 4.1.

Administrative Region	Net Sea Level Rise (mm/yr) Relative to 1990			
	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115
East of England, East Midlands, London, SE England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South West	3.5	8.0	11.5	14.5
NW England, NE England (north of Flamborough Head)	2.5	7.0	10.0	13.0

Table 4.1 – Recommended contingency allowances for net sea level rise

From these values it can be seen that the extreme flood level at the site is likely to change with time and this change is not linear.

The EA has provided tidal water levels for the South Humber, East Coast and The Wash and inspection of the location map for the tidal levels identifies that Fosdyke Bridge (Welland Tidal) is the closest tidal level to the site. It is recognised that since the data has been prepared in 2017, the extreme sea level predictions have been updated as part of the 2018 coastal flood boundary conditions. However, comparison of the two sets of data identifies that the tidal water level for the 1 in 200 year flood event provided by the EA is only 1mm higher than the latest estimate of extreme sea levels. Consequently, the EA's data has been referenced and used to calculate the 1 in 200 year flood level at this location for a number of steps between the current day and the year 2115 and these values are shown in Table 4.2 below.

Year	1 in 200 year extreme water level (m AODN)
Current day (year 2014)	5.99
2025	6.03
2055	6.29
2085	6.65
2115	7.10

Table 4.2 – Climate change impacts on extreme water levels at location Fosdyke Bridge (Welland Tidal).

The lifetime of the development is assumed to be 100 years and therefore, the extreme sea level is taken as 7.10m AODN.

5 Probability and Consequence of Flooding

5.1 Risk of Flooding from Tidal Sources

When appraising the risk of flooding to new development it is necessary to assess the impact of the 'design flood event' to establish depths, velocities and the rate of rise of floodwater under such conditions. Flood conditions can be predicted for a range of return periods and these are expressed in either years or as a probability, i.e. the probability that the event will occur in any given year, or Annual Exceedance Probability (AEP). The design flood event is taken as the 1 in 200 year (0.5% AEP) event for sea or tidal flooding, including an appropriate allowance for climate change (refer to Section 4.1).

The EA has been consulted to request modelled flood level information and a copy of the response is included in Appendix A.2. The information provided confirms that the development site currently benefits from the protection of coastal flood defences (refer to Section 3.3). The site would continue to remain dry even in the event that the existing defences were to fail (i.e. due to a breach) during a tidal storm event with a return period of 1 in 200 years under current day conditions.

Notwithstanding this, the NPPF requires the impacts of climate change to be taken into consideration over the lifetime of the development. As extreme sea levels are expected to rise due to climate change (section 4.1), the standard of protection of the existing defence is expected to decline into the future. No information has been provided by the EA to confirm whether the defences would continue to provide sufficient protection to the development site in 100 years' time. In the absence of this data, it has not been possible to quantify the actual risk of flooding to the site under design flood conditions. However, the EA has provided the results of modelling for a 1 in 200 year event, in the year 2115, which does consider the impact of waves overtopping the defences, alongside a breach in the defences (Figure 5.1).

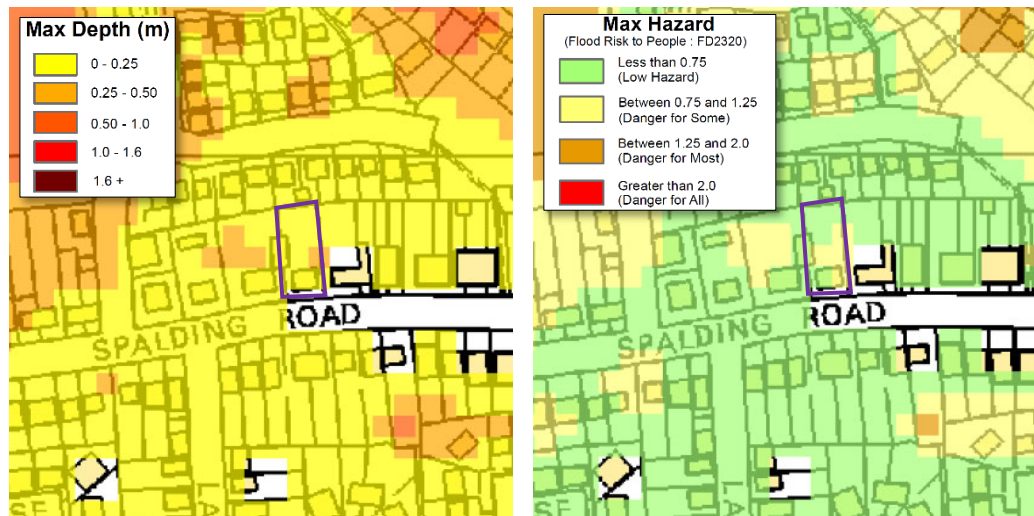


Figure 5.1 – Maximum depth (left) and hazard rating (right) for a 1 in 200 year return period tidal storm event in the year 2115, considering wave overtopping and a breach of the defences. Site boundary delineated in purple.

The EA's model assumes that the coastal defences are not improved in the future in line with sea level rise. Consequently, flooding is shown to occur in locations where the crest is lower than the extreme sea level (due to sea level rise), as a result of water overflowing the defences. It should therefore be recognised that the maps may overestimate the risk of flooding at the site if the defences are improved at a later date.

The modelling also includes the impact of a breach in the sea defences. The maps show the worst-case flood depth and hazard at any location based on the results of a number of individual breaches at several locations along the coastline. The occurrence of a breach is classified as a *residual risk* of flooding, as it relies on a failure of the defences which otherwise provide a high standard of protection to the site. In conclusion, the maps are likely to overestimate the *actual* risk of flooding to the development site.

Flood levels have not been provided for this scenario, however, from Figure 5.1 it can be seen that the depth of flooding in the area of the proposed development ranges between '0m to 0.25m'. This relates to a 'low' hazard rating.

Whilst the NPPF requires that the risk of flooding under the 'design flood event' is appraised as part of the FRA, the South East Lincolnshire SFRA (2017) states that for proposals which are single storey, flood mitigation measures should be assessed against the 1 in 1000 year return period flood event for the year 2115. The development falls into this category. Reference to the information provided by the EA shows that under this scenario the maximum predicted depth of flooding in the area of where the development is proposed to be located increases to 0.5m. The hazard rating under this scenario is classified as 'moderate'.

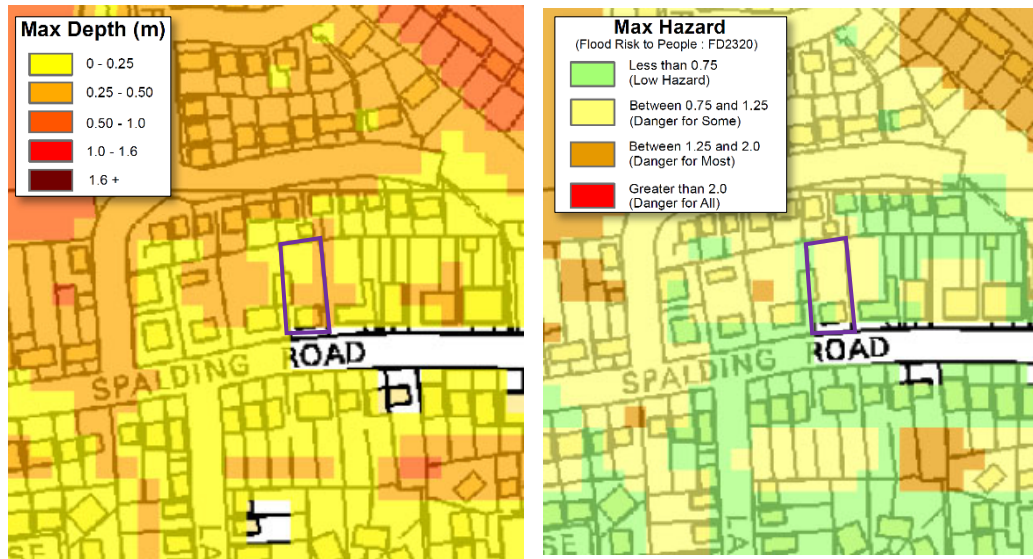


Figure 5.2 – Maximum depth (left) and hazard rating (right) for a **1 in 1000 year return period** tidal storm event in the year 2115, considering wave overtopping and a breach of the defences

The results of the scenario shown in Figure 5.2 have therefore been referenced to determine the required flood mitigation for this development (discussed in the following sections of this report), in accordance with the requirements of the SFRA.

5.2

Residual Risk of Flooding

When assessing residual risk it is necessary to consider the impacts of a flood event that exceeds the design event, or in the case of areas that are already defended to an adequate standard, the impact of a failure of these defences. However, as identifies above, the results presented in Figures 5.1 and 5.2 above already account for the potential impact of a failure in the defence infrastructure. As a result, the recommendations made by this FRA are based on the residual risk scenario.

6 Offsite Impacts and Other Considerations

6.1 Displacement of Floodwater

The construction of a new building within the floodplain has the potential to displace water and to increase the risk elsewhere by raising flood levels. A compensatory flood storage scheme can be used to mitigate this impact, ensuring the volume of water displaced is minimised.

However, where development is proposed in tidal floodplains such as is the case here, it is generally accepted by the EA that raising the ground or building on the floodplain is unlikely to impact on maximum tidal levels.

6.2 Public Safety and Access

The NPPF states that safe access and escape should be available to/from new developments located within areas at risk of flooding. The Practice Guide goes on to state that access routes should enable occupants to safely access and exit their dwellings during design flood conditions and that vehicular access should be available to allow the emergency services to safely reach the development.

This FRA has indicated that the subject could be flooded to a depth of 0.25m under design flood conditions, increasing to a maximum of 0.5m under the 1 in 1000 year return period event (including an allowance for climate change). As such, access/egress to/from the proposed dwelling could be affected at the peak of the flood event. However, reference to the hazard mapping provided by the EA confirms that safe access is available to/from to an area outside the predicted flood extents in an easterly direction along Spalding Road.

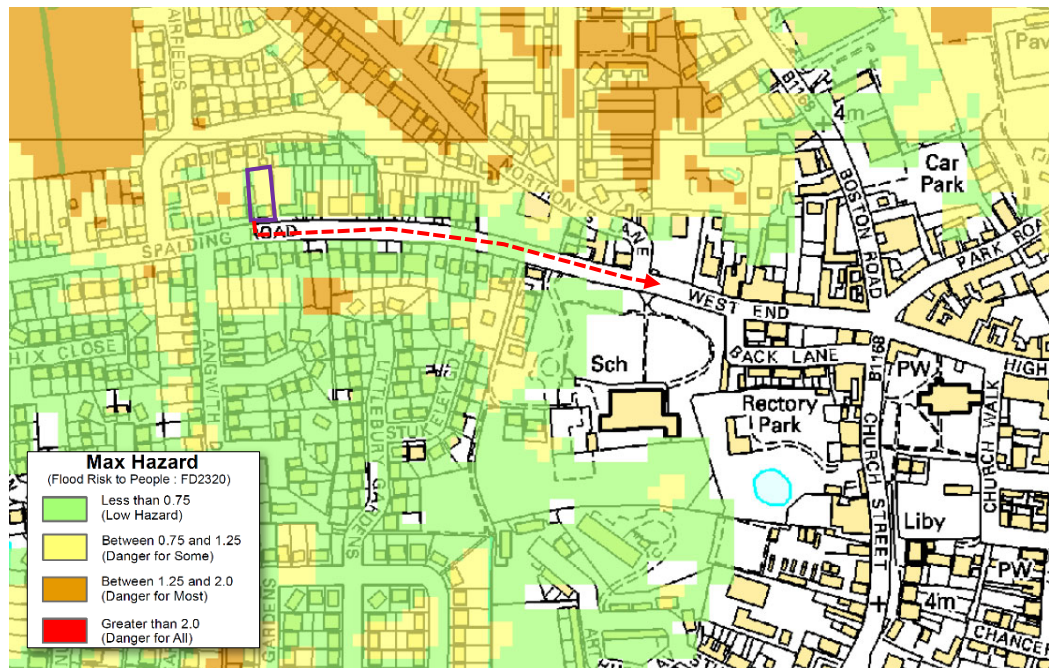


Figure 6.1 – Maximum hazard rating (ZUK0) for a 1 in 1000 year return period tidal storm event in the year 2115, considering wave overtopping and a breach of the defences. Site boundary delineated in purple. Safe access route indicated by red dashed arrow.

Furthermore, the finished floor level of the proposed development will be raised above the flood level and therefore residents will be able to seek safe dry refuge within their dwelling if necessary. It should also be recognised that the proposed building forms ancillary accommodation to the main 2 storey dwelling, which provides an alternative option for safe refuge.

In consideration of the above, occupants of the dwelling should sign up to the EA's Early Flood Warning service to enable them to evacuate the site prior to the onset of flooding. In the unlikely event that there is insufficient time to evacuate, residents should remain within their dwelling or relocate to the main 2 storey dwelling.

6.3 Proximity to Watercourse and Flood Defence Structures

Under the Water Resources Act 1991 and Land Drainage Byelaws, any proposals for development in close proximity to a 'main river' would need to take into account the EA's requirement for an 8m buffer zone between the river bank and any permanent construction such as buildings or car parking etc. This buffer zone increases to 16m for tidal waterbodies and sea defence infrastructure.

The development site is located more than 16m from the nearest watercourse or defence infrastructure and as such will not compromise any of the EA's maintenance or access requirements.

7 Flood Mitigation Measures

The key objectives of flood risk mitigation are:

- to reduce the risk of the development being flooded.
- to ensure continued operation and safety during flood events
- to ensure that the flood risk downstream of the site is not increased by increased runoff
- to ensure that the development does not have an adverse impact on flood risk elsewhere

The South Lincolnshire Council SFRA provides advice on the appropriateness of development within flood risk areas, including recommendations for development in areas at risk of flooding. The LPA, in conjunction with the EA, has produced Standing Advice which specifies the mitigation measures which are required to be incorporated into development at risk of flooding. These measures are dependent on the type of development and the modelled flood hazard rating. For sites located in a tidal flood risk area, the hazard classification is defined by the EA's flood mapping (referred to in Section 5 of this report). The following sections outline each mitigation measure required by the LPA;

Finished Floor Levels - The standing advice states that for development classified as 'more vulnerable' which does not fall into the definition of 'major development', the finished floor levels should be based upon the 1 in 1000 year return period tidal event, including an allowance for climate change, as shown in Figure 5.2. For a depth of flooding between 0.25m to 0.5m, finished floor level should be situated '500mm above ground level'. Reference to the topographic survey reveals that land levels in the area where the extension is proposed vary from 3.20m to 3.32m AODN. Consequently, a conservative approach has been adopted and the floor levels have been located 500mm above the highest land level in this area (i.e. set to 3.82m AODN).

Flood Resistance Measures - In addition to raising finished floor levels, the Standing Advice states that flood resilient construction should be used 'to a height 300mm above the predicted flood depth'. Based on the flood depths shown in Figure 5.2, it is recommended that flood resistant construction is utilised up to 800mm above the existing ground level.

Flood Resistance or 'dry proofing', includes measures which prevent flood water from entering the building. For example, using low permeability construction materials, and flood barriers across doorways and airbricks. Details of flood resilience and flood resistance construction techniques can be found in the document 'Improving the Flood Performance of New Buildings; Flood Resilient Construction', which can be downloaded from the Communities and Local Government website.

Surface Water Management – The South Lincolnshire SFRA states that, ‘all developments, regardless of scale and constraints, should seek to incorporate sustainable drainage.’ The general requirement for all new development is to ensure that the runoff is managed sustainably and that the development does not increase the risk of flooding at the site, or within the surrounding area. A range of typical SuDS that can be used to improve the environmental impact of a development is listed in Table 7.1 below, along with the relative benefits of each feature and the appropriateness for the subject site.

SuDS	Description	Constraints/Comments	Appropriate for site?
Rainwater harvesting systems	Collecting of rainwater and storing for reuse on site, e.g. in form of water butts.	Potential to be used depending on external demand for water use	Potentially
Green roofs	Provide landscaping and planting at roof level to reduce surface water runoff rates.	Unsuitable roof design	No
Infiltration systems	Allow water to percolate into the ground at a controlled rate via natural infiltration.	Limited infiltration based on impermeable characteristic of the underlying geology	No
Filter strips	Wide gently sloping densely planted areas promoting sedimentation and filtration	Limited infiltration based on impermeable characteristic of the underlying geology	No
Filter drains	Trenches infilled with stone/gravel providing attenuation, sedimentation and filtration	Insufficient space on site due to building covering entire curtilage of site.	No
Swales	Broad shallow channels that convey and store runoff and allow infiltration.	Insufficient space on site	No
Bioretention systems / rain gardens	A shallow landscaped depression allowing runoff to pond temporarily on the surface.	Limited opportunity to be integrated into planters around the proposed dwelling	Yes
Pervious surfacing	Runoff is allowed to soak into structural paving and stored, potentially being allowed to infiltrate	Areas of external paving to be retained as part of the development	No
Attenuation storage tanks	Large, below ground voided spaces which can be used to temporarily store storm water.	Areas of external paving to be retained as part of the development	No
Detention basins	A landscaped depression for attenuation with a restricted runoff.	Insufficient space on site	No
Ponds and wetlands	A permanent pool of water which can be used for attenuation and controlled outflows by water levels.	Insufficient space on site	No

Table 7.1 – Suitability of SuDS.

From Table 7.1, it can be seen that the opportunities to incorporate SuDS are limited by the previously developed condition of the site. However, it may be possible to incorporate water butts and bioretention planters into the development proposals to capture runoff and reduce the rate of runoff from the development. The use of these SuDS should be considered in further detail as part

of the detailed design for the site. With the measures in place, the proposed development will provide a betterment when compared to the existing site condition and will not increase the risk of flooding offsite.

8 Conclusions

The overarching objective of this report is to appraise the risk of flooding at 54 Spalding Road, Holbeach to ensure that the proposals for development are acceptable and that any risk of flooding to the occupants of the proposed residential unit is appropriately mitigated. This report has therefore been prepared to appraise the risk of flooding from all sources, in accordance with the NPPF and local planning policy.

An appraisal of the risk of flooding from all sources has identified that the site could be flooded from surface water and coastal sources. In accordance with the Standing Advice specified by the LPA, in conjunction with the EA, a number of mitigation measures have been recommended for this development;

- **Finished floor levels should be located at 3.82m AODN or above.** For the flood conditions identified within this report, the SFRA requires the finished floor levels of any single storey development to be situated 500mm above the ground level. Reference to the scheme drawings identifies that this has been achieved.
- **Flood resistant construction should be utilised up to 800mm above ground level.** The SFRA requires that flood resistant construction is specified up to '*300mm above the predicted depth of flooding*'. This *may* include the use of low permeability construction materials, airbrick covers and flood doors/barriers.
- **The use of water butts and bioretention planters should be considered as part of the detailed design for this development.** The SFRA requires that all development should seek to incorporate SuDS. The use of such measures will ensure the development does not increase the risk of flooding offsite, and will provide a betterment in terms of the rate at which surface water runoff is discharged from the site when compared to the existing site.

The recommendations above are based on mapping which represents the *residual risk* of flooding (i.e. from a breach) and assumes the coastal defences are not upgraded over the next 100 years. These conditions are considered to provide an overly conservative picture of the risk of flooding to the site over the next 100 years. Given the risk of flooding to the development is likely to be lower than is currently inferred by the mapping, the measures recommended in this report are considered to be oversized in terms of the level of protection that they will provide to the proposed development.

Based on the above information it is concluded that, following the recommendation of this report, the occupants of the development will be safe, and the development will not increase the risk of flooding elsewhere. Therefore, the development can pass Part B of the Exception Test and will meet the requirements of the NPPF.

9 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Environment Agency Flood Report

Appendix A.3 – Anglian Water Asset Location Data