FLOOD RISK ASSESSMENT

PROPOSED RESIDENTIAL DEVELOPMENT,
LAND OFF SPALDING ROAD
PINCHBECK,
SPALDING,
LINCOLNSHIRE.
PE11 3UE

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RMA

FLOOD RISK ASSESSMENT FOR PROPOSED RESIDENTIAL DEVELOPMENT, LAND OFF SPALDING ROAD, PINCHBECK, SPALDING, LINCOLNSHIRE. PE11 3UE

INTRODUCTION

The Government has placed increasing priority on the need to take full account of the risks associated with flooding at all stages of the planning and development process. This seeks to reduce the future damage to property and the risk to life from incidents of flooding. Their expectations relating to flooding are contained in the National Planning Policy Framework (NPPF) February 2019, which identify how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications by avoiding inappropriate development in areas at risk from flooding.

Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. Local Plans should apply a sequential, risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change.

The Environment Agency's flood maps show areas that are at risk, from fluvial and tidal flooding. These maps show the limits of the flood plain of the area which could be affected by flood events, over topping or breaching of flood defences. They are based on the approximate extent of floods with a 1% annual probability of exceedance (1 in 100-year flood) for rivers and 0.5% annual probability of exceedance (1 in 200-year flood) for coastal areas under present expectations or the highest known flood. However, they do not take into account of the presence of defences or the likelihood that flood return intervals will be reduced by climate change.

This Flood Risk Assessment has been prepared in support of the planning application and considers the risk of flooding from fluvial and tidal sources. It also considers the risks of localised flooding due to inadequate Foul and Surface Water Sewers, Failure of Reservoirs, Water Main pipe bursts, Sewer Blockages, Pump Failures or High Ground Water Table etc.

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APPLICATION SITE

The site is located off Spalding Road, Pinchbeck, Spalding, Lincolnshire within the administrative area of South Holland District Council. The National Grid Reference for the middle of the site is TF24570 24741, with a site area 0.24 ha or thereabouts. **Plan 1**

This FRA has been prepared for an Outline Planning Application for 4No dwellings. **Plans 2 & 3**

Planning approval was granted for up to 4 dwellings Ref H14-0666-16 Date of Decision: 5th September 2016

The Site would be classed as Non-Major Development applying the National Planning Policy Guidance (NPPG) as the site is to be developed for less than10 dwellings

The National Planning Policy Framework Technical Guidance NPPG defines three levels of flood risk depending upon the annual probability of fluvial flooding occurring.

Zone 1 – Low Probability (<0.1%)

Zone 2 – Medium Probability (0.1 – 1.0%

Zone 3 – High Probability (>1.0%)

The proposed development site is shown to be within Flood Zone 3a 'High Probability' as detailed on the Environment Agency's Flood Zone Maps without defences, and as defined in Table 1 of NPPF. Map**1**

Table 1: Flood Zones Definition (Ignoring the presence of defences)

Flood Zone 3- High Probability
Definition Land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. The water-compatible and less vulnerable uses of land are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable and essential infrastructure uses should only be permitted in this zone if the Exception Test is passed. Essential Infrastructure permitted in this zone should be designed and constructed to remain operational and safe for uses in times of flood **Flood Risk Assessments requirements** All proposals in this zone should be accompanied by a Flood Risk Assessment. **Policy aims** Developers and local authorities should seek opportunities to: • reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; • relocate existing development to land with a lower probability of flooding; • create space for flooding to occur by allocating and safeguarding open space for flood storage.

Applying the Flood Risk Vulnerability Classification in Table 2 of NPPG the proposed residential development is classified as "More Vulnerable", with Table 1 of NPPG stating that such uses are appropriate in this zone subject to the Exception Test.

Table 2: Flood Risk Vulnerability Classification

More Vulnerable
• Hospitals • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels • Non-residential uses for health services, nurseries and educational establishments • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravan and camping, subject to a specific warning and Evacuation Plan.

From the topographical survey the site is roughly rectangular in shape and reasonably level averaging 2.95m ODN with levels on the western boundary being 3.00mODN and on the eastern boundary 2.95mODN and the road level on Spalding Road at the site entrance is 3.64mODN

It is proposed that the lowest ground floor level of the dwellings be raised 500mm above the existing ground level to a minimum level of 3.50mODN.

DRAINAGE AUTHORITIES

Environment Agency

The Environment Agency is responsible for reducing the risk of flooding from designated main rivers and from the sea.

The following potential sources of flooding affecting the development site have been identified as:

- From the River Welland (Tidal)
- The River Glen (Fluvial)
- Welland & Deepings Internal Drainage Board system

The Flood Zone Maps identify river catchments over 3 sq. km. These maps are a theoretical estimate of areas that could be inundated should no defence exist. In practice, current standards of protection would result in flood envelopes substantially less than shown by these maps. The maps make no allowance for local, site specific features.

The flood zone maps show that the site of the proposed development is considered at risk from flooding. These maps indicate that the area would be flooded without flood defences, which are in place, (with an annual probability of more than 0.5% i.e. return frequency of less than 1 in 200 years for tidal flooding or more than 1.33% return frequency of less than 1 in 100 years for fluvial flooding). **Map 1**

The Environment Agency Risk of flooding from Rivers and Sea shows that the site is at Very Low to Low risk of flooding. Low means that each year, this area has a chance of flooding less than 1 in 100 (1.0%) but greater or equal to 1 in 1000 0.1%)). This takes into account the effect of any flood defences that may be in this area. Flood

defences reduce, but do not completely stop the chance of flooding as they can be overtopped or fail. **Map 2**

River Welland

The River Welland lies some 2.77Km to the south- east of the site and is tidal down stream of Marsh Lane Sluice and the present day 1 in 200-year tide flood level is 5.98mODN. The tidal flood defences of the tidal River Welland consist of earth embankments which are in good condition and the crest heights are circa 7.00mODN.

From the Lincolnshire and Northamptonshire Area, Tidal Modal Analysis (June 2006) **Map 3**

Peak tide levels Present Day (2006) at Marsh Road (Tidal River) 0.5% (1 in 200) = 5.98mODN.

Peak tide levels (2116) at Marsh Road (Tidal River) 0.5% (1 in 200) = 5.98mODN plus climate change allowances from Table 3 of 1.21mm = 7.11mODN

Taking the precautionary approach, the Hazard Rating following a breach which in Flood Risk Assessment (FD 2320) Guidance for New Development Phase 2 R& D Technical Report these are classified as low <0.75, moderate 0.75-1.25, significant 1.25-2.50 and extreme >2.50 based upon an empirical measure of velocity and depth.

Flood Hazard			Description
	<0.75	Low	**Caution –** Flood Zone with shallow flowing water or deep standing water.
	0.75 – 1.25	Moderate	**Danger for Some -** (i.e. children) Danger Flood Zone with deep or fast flowing water.
	1.25 – 2.0	Significant	**Danger for Most –** Danger Flood Zone with deep fast flowing water.
	>2.0	Extreme	**Danger for All** – Extreme Danger Flood Zone with deep fast flowing water.

HR = d x (v + 0.5) +DF

Where V = Flood flow velocity (m/sec)

D = Flood depth (m)

DF = A debris factor included to represent the greater damage, or risk of injury to people, that can occur if debris is swept along with the water. = 0.5 for depths <0.25 or 1.0 for depths

For the degree of Flood Hazard to be classified as low HR must be <0.75

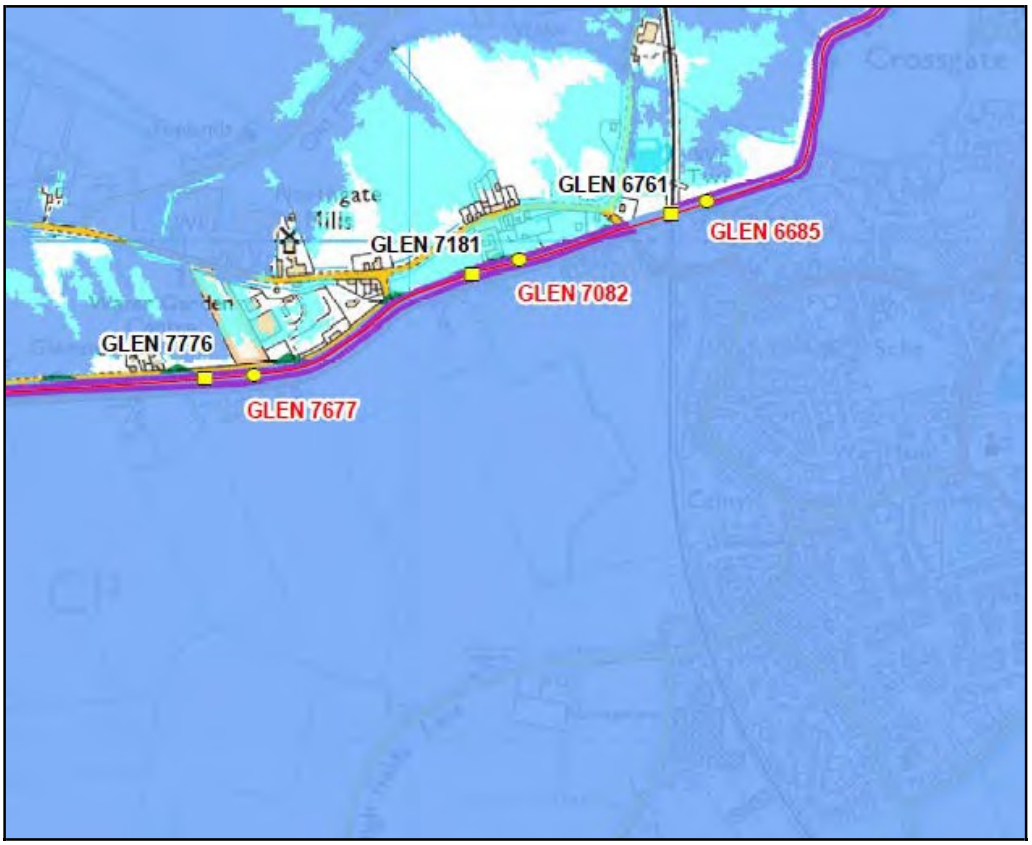
The 2017 Update to SHDC, SFRA has carried out a Breach Hazard Mapping, following a breach to the defences the Residual Hazard Maps present day for the 0.1% tidal event shows that the site is not within a Hazard Rating Area. **Map 4**

With climate change (2115) the site is within a hazard area between 0.75 – 1.25 (Danger for Some), Depth 0.25 – 0.5m and Velocity 0 – 0.3m/sec. **5, 4 & 7.**

River Glen

The River Glen lies some 1.6km to the north of the site and the present day 1 in 1000-year flood level with 20% climate change is 4.94mODN. The flood defences of the River Glen between Herring Bridge and the A151 bridge consist of the B1180 Road which are in good condition and the crest heights for the right bank along this stretch of river are circa 5.90mODN. (SHDC SFRA)

The fluvial flood data for the model nodes shown on the map are set out in the tables below.



Fluvial Flood Levels (mODN)

The fluvial flood levels for the model nodes shown on the attached map are set out in the table below. They are measured in metres above Ordnance Datum Newlyn (mODN).

			Annual Exceedance Probability - Maximum Water Levels (mODN)										
Node Label	Easting	Northing	50% (1 in 2)	20% (1 in 5)	10% (1 in 10)	5% (1 in 20)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (1 in 100) inc 20% Climate Change	0.5% (1 in 200)	0.1% (1 in 1000)	0.1% (1 in 1000) inc 20% Climate Change
GLEN 6685	523603	326081	4.01	4.16	4.23	4.31	4.34	4.35	4.38	4.84	4.44	4.60	4.94
GLEN 7082	523224	325963	4.04	4.17	4.25	4.32	4.36	4.39	4.41	4.87	4.49	4.70	5.01
GLEN 7677	522687	325733	4.06	4.20	4.28	4.35	4.41	4.43	4.45	4.91	4.54	4.79	5.07

Fluvial Flood Flows (m³/s)

The fluvial flood flows for the model nodes shown on the attached map are set out in the table below. They are measured in metres cubed per second (m³/s).

			Annual Exceedance Probability - Maximum Flows (m³/s)										
Node Label	Easting	Northing	50% (1 in 2)	20% (1 in 5)	10% (1 in 10)	5% (1 in 20)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (1 in 100) inc 20% Climate Change	0.5% (1 in 200)	0.1% (1 in 1000)	0.1% (1 in 1000) inc 20% Climate Change
GLEN 6761	523531	326057	25.95	29.44	31.06	33.13	34.59	35.32	35.84	43.56	38.87	48.22	56.95
GLEN 7181	523130	325934	25.69	29.20	30.85	32.93	34.37	35.09	35.60	43.18	38.62	48.05	56.90
GLEN 7776	522589	325726	25.40	29.03	30.65	32.71	34.14	34.86	35.37	42.73	38.33	48.07	56.87

This data is taken from the Welland Model (2016) and are the most up-to date currently available. The Environment Agency aim to review the models on a regular basis.

These levels are “in-channel” levels and therefore may not represent the flood level on the floodplain, particularly where the channel is embanked or has raised defences.

The site lies within the Anglian River Basin District, Peak River flows should be adjusted to reflect the latest climate change allowances. It must also be assumed, to provide a worst-case scenario, that flood defences have been raised during this period to cater for the rise in river level.

Using the Peak River Flows from the NPPF Climate change allowances shown in Table 1 in the spread sheet. The graph and data show a prediction for the increase in river levels for the 35% and 65% increase in river level of: - **Appendix A**

EXTRAPOLATED WATER LEVEL OUTPUTS AT NODE Glen 6685		
Upper End Scenario	**5.33**	mODN
Higher Central Scenario	**5.10**	mODN
Central Scenario	**5.01**	mODN

With the crest level of the right bank being at a level circa 5.10mODN and the left bank being some 200mm lower the climate change river levels for the Higher Central (35%) and Upper End (65%) would overtop away from the site.

The greatest risk of flooding of the site would therefore be from a breach to the tidal earth embankments for the River Welland.

The minimum mitigation measures required for developments that do have ground floor sleeping shall be determined by the flood depths arising from the 2115 0.1% breach scenario. The finished floor Level (FFL) of any new dwellings shall be informed by the flood depths. For flood depths between 0.25 – 0.5m deep the FFL shall be set at a minimum of 500mm above the ground level.

With the main risk to flooding of the site being tidal flooding following a breach to the tidal defences, any flooding from fluvial flooding sources has been mitigated against.

With the average site ground level being 3.00mODN, the minimum floor level will be set at 3.50mODN. which is considered to be above the tidal breach level to the River Welland for 2115.

South Holland District Council

In order to inform the process of risk assessment and site selection the District Council commissioned Haskoning UK Ltd Consultants to prepare a Strategic Flood Risk Assessment in December 2002.They have carried out an update of this report and this report was published in January 2010 and this was further

updated in February 2017.

This Flood Risk Assessment has taken the results of the (2017) updated South Holland Strategic Flood Risk Assessment (SHSFRA) into account in its findings

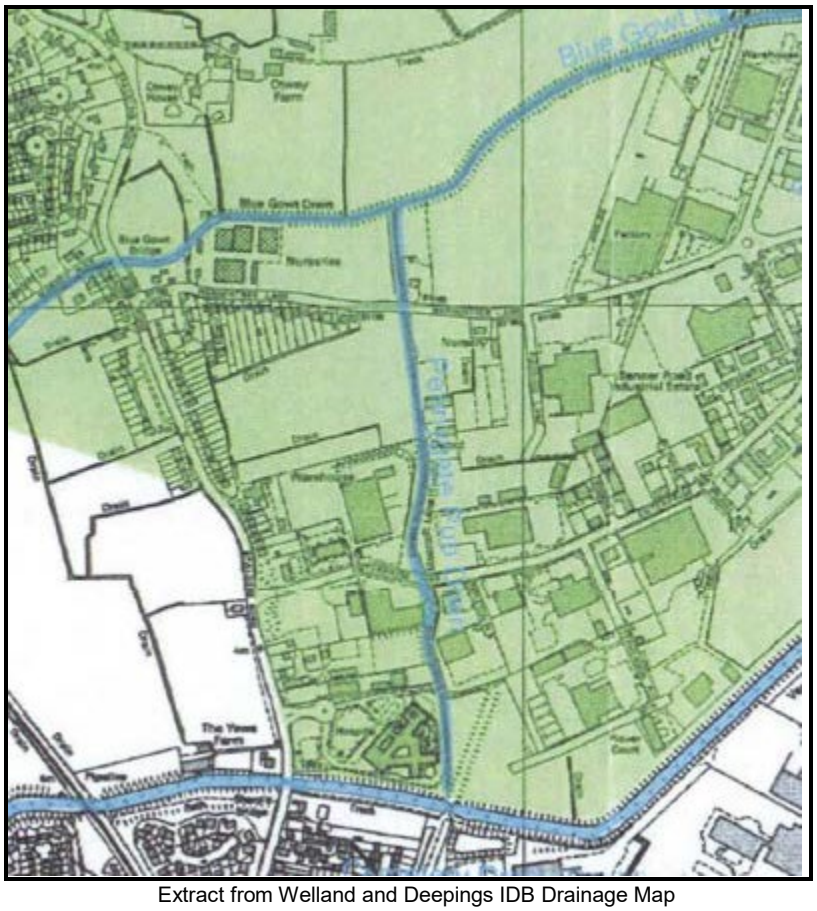
The whole of the tidal flooding information has been replaced by the mapping from the latest Environment Agency Tidal Hazard mapping. Where the mapping for an area contains both fluvial and tidal components, the more severe of the two has been presented.

From the Residual Flood Hazard, Depth and Velocity Spalding - Year 2115 1% fluvial and 0.5% tidal Event Probability maps, from the update of strategic flood risk assessment for South Holland District Council the site is affected from a breach to the flood defences and these maps have been used in the findings of this assessment.

Welland & Deepings Internal Drainage Board

The proposed development site is located within Catchment area of Welland & Deepings Internal Drainage Board. The Board is responsible to operate and maintain the arterial fluvial system.

The Board's nearest watercourse is the Drain located to the east of the site.



Extract from Welland and Deepings IDB Drainage Map

The Board's prior written consent will be required for any of the following works:

- No person without the previous consent of the Board shall erect any building or structure, whether temporary or permanent, or plant any tree, shrub, willow or other similar growth within 9 metres of the

landward toe of the bank where there is an embankment or wall or within 9 metres of the top of the batter where there is no embankment or wall, or where the watercourse is enclosed within 9 metres of the enclosing structure.

- No person shall, without the previous consent of the Board, for any purpose, by means of any channel, siphon, pipeline or sluice or by any other means whatsoever, introduce any water into the District or, whether directly or indirectly, increase the flow or volume of water in any watercourse in the District.

- The erection or alteration of any mill dam, weir or other like obstruction to the flow, or erection or alteration of any culvert within the channel of a riparian watercourse.

SURFACE WATER FLOODING

The site is shown on the 'Risk of Flooding from Surface Water' map to be at Low risk of flooding from surface water. Low risk means that each year this area has a chance of flooding of between 1 in 1000 [0.1%) and 1 in 100 [1.0%]). The maps also show that the site entrance from Spalding Road is at a Very Low risk of flooding. (less than 1 in 1000 0.1%)

Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast.
Map 8

FLOODING FROM OTHER SOURCES

Flooding is a natural process and can happen at any time from sources other than watercourses and the sea.

- Flooding from land can occur from intense rainfall, often over short duration of time that is unable to soak into the ground or enter the drainage system. However, with the natural topographic nature of the ground being flat, with no high ground around the site this will not cause any rapid inundation of the site and is likely only lead to local ponding of shallow depth and low velocity following the natural land contours. The properties are also raised 500mm above the average ground level. The updated SFRA concluded that flooding from this source is limited to minor isolated cases and is not of strategic significance as regards to flood risk.

- The area is not known to suffer from any groundwater problems and therefore is taken as having no strategic significance as regards to flood risk.

- Flooding from sewers can occur from over loading from heavy rainfall caused by blockages or having inadequate capacity. The resulting back pressure could cause foul sewage to flow from manholes which would flow over areas of the carriageway at a lower level and be contained within the confines of the kerb lines following the natural land contours The Updated SFRA concluded that flooding from sewers is limited to minor isolated cases and is not of strategic significance as regards to flood risk.

- Non-natural or artificial sources of flooding such as reservoirs, lakes or canals where water is stored above natural ground level could cause flooding if the structure fails or is over topped.

CLIMATE CHANGE

Global warming is now recognised that it is likely to affect the frequency and severity of extreme events as both tidal and fluvial flooding. The Climate change allowances in the NPPF Guidance was updated on the 19th February 2016.

The site is located within the Anglian River Basin, for sites within Flood Zone 3a and for "More Vulnerable" land uses the Higher Central and Upper End river flow allowances figures in Table 1 should be used.

Table 1 Peak river flow allowances by river basin district (1961 to 1990 baseline)				
River basin District	Allowance category	Total potential change anticipated for '2020s' (2015 to2039)	Total potential change anticipated for '2050s' (2040 to2069)	Total potential change anticipated for '2080s' (2070 to2115)
Anglian	Upper End	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

The effect of global warming on peak rainfall allowances is given in Table 2.

Table 2 Peak rainfall intensity allowance in small and urban catchments (1961 to 1990 baseline)			
Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Central	5%	10%	20%

The annual sea rise due to climate change is given in NPPF and 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 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

The climate change allowances for Peak River Flows in Table 1 are used in the calculations to ascertain the Higher Central (35%) and the Upper End (65%) climate change flood level.

SEQUENTIAL APPROACH

When applying the sequential approach for flood risk in accordance NPPF the site would fall into Zone 3a

(High Probability) as the site is shown to be within the tidal flood plain as shown on the Environment Agency's Flood Map without defences in place.

However, the results of the updated South Holland SFRA shows that the site is located within a low/medium probability flood zone, but the area is reliant on protection by flood defences providing a standard of protection of 1 in 100 years return period.

Applying the Flood Risk Vulnerability Classification in Table 2 of NPPG, the proposed residential development is classified as "More Vulnerable", with Table 1 of NPPG stating that such uses are appropriate in this zone (as summarised in Table 3 NPPG).

TABLE 3: Flood risk vulnerability and flood zones 'compatibility'

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Flood Zone 1	✓	✓	✓	✓	✓
	Flood Zone 2	✓	✓	Exception Test Required	✓	✓
	Flood Zone 3a	Exception Test Required	✓	×	Exception Test Required	✓
	Flood Zone 3b Functional Floodplain	Exception Test Required	✓	×	×	×

Sequential Test & Exception Test

NPPF Guidance Paragraphs 155- 165 requires development within high areas of flood risk be determined using a sequential risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, but where development is necessary making it safe without increasing flood risk elsewhere.

With the site having an extant planning permission the use of the site has already met the requirements of the Sequential and Exceptions Tests.

This FRA in support of the development and indicates that the development would be safe for the lifetime of the development and does not increase flood risk elsewhere.

There would be a significant amount of time for the Authorities to predict the risk of flooding and to issue appropriate warnings so that the owner of the property can take the necessary precautions to protect and /or vacate the property.

DRAINAGE STATEMENT

A Sustainable Drainage Systems (SuDS) strategy and design has been prepared by Larkfleet Homes for the neighbouring land. An agreement has been reached for the surface water from this site to connect into the surface water manhole on the extreme SE corner of the proposed site.



In accordance with recognised guidance, National Planning Policy Framework 2019, there is a hierarchy of where surface water should discharge. This hierarchy should be followed where practicable, and is as follows:

1) Infiltration
2) Watercourse
3) Public sewer

Reference to the British Geological Survey online mapping (1:50,000 scale) indicates that the land is underlain by superficial Tidal Flat Deposits, comprising Clay and Silt. The superficial deposits are identified as being underlain by bedrock consisting of the Oxford Clay Formation comprising mudstone.

The site would not therefore be suitable for infiltration methods to be used.

It is therefore proposed that the following principle be adopted to serve the new development. Roof water from the new dwellings driveways and the access road will be constructed with permeable paving with a storage reservoir, which will discharge into underground pipes and connected into the surface water manhole previously described. A water butt of at least 120L internal capacity can also be installed to intercept rainwater draining from the roof of the buildings, to reduce the risk of flooding and demand for water by recycling and to increase the level of sustainability of the development.

Foul Water

Foul sewers designed and laid in accordance with Sewers for Adoption adopted by Anglian Water Services Ltd, under Section 104 of the Water Industry Act 1991, (as amended by the Water Act 2003) will be provided to serve the development and to be connected into the Anglian Water 150mm public foul sewer in front of the site. A Section 106 application will be made to Anglian Water for the connection to the sewer.

As there is a positive drainage system capable of receiving flows from the development there is no likely impact on neighbouring property.

FLOOD PROTECTION

Any impact of damage to the properties can be foreseen and mitigated against by relatively simple design and construction techniques. There are two forms of flood protection works: -

- **Flood-resistance or proofing works**: - these try to reduce the amount of water entering a building.
- **Flood-resilient works: -** these reduce the amount of damage caused by water entering the building.

The proposed property will have the following resilient measures incorporated in the construction in accordance with “Improving the flood performance of new buildings” CLG (2007).

- The lowest ground floor level for the properties is to be raised 300m above existing ground level with the lowest level being 3.50mODN.

- Use Close Cell cavity insulation to the ground floor level.

- The ground floor to be constructed with a solid concrete floor with no voids beneath and no low-level wall vents.

- Arrange for all service circuits at ground floor level to be routed at a high level and where practical socket outlets, boilers etc. to be a minimum of 0.5m above the raised ground floor level.

- As this site is in an area that is capable of receiving flood warnings from the Environment Agency Floodline Warning Direct system. It is recommended that the individual property Owner contact the Environment Agency’s Floodline on 0845 988 1188 to register the property to receive advance warning of flooding by telephone, mobile, fax, SMS text, email or pager. The Environment Agency aim to issue a ‘severe flood warning’ approximately 2 hours before existing defences are overtopped.

CONCLUSION

- The proposed development site is shown to be within Flood Zone 3a ‘High Probability' as detailed on the Environment Agency's Flood Zone Maps without defences.

- The site does have the protection of both tidal and fluvial flood defences which are well maintained by the Environment Agency.

- The lowest ground floor level for the properties is to be raised 500m above the existing ground level with the lowest level being 3.50mODN, which is considered to be above the 2115 climate change breach level at the site. This is the level accepted for the current application

- The Flood Risk Vulnerability Classification in Table 2 of NPPG the proposed residential development is classified as “More Vulnerable”, with Table 1 of NPPG stating that such uses are appropriate in this zone subject to the Exception Test.

- With the site having an extant planning permission the use for the site has already met the requirements of the Sequential and Exceptions Tests.

- Any impact of damage to the properties can be foreseen and mitigated against by relatively simple design and construction techniques. They will be constructed using materials which are flood resilient construction as outlined in the report

- Flooding from other sources is unlikely to affect the site.

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APPENDIX

Document 1	Climate Spreadsheet & Graphs.
Map 1	Extract from Environment Agency Flood Zone Map.
Map 2	Flooding from Rivers and Sea Map.
Map 3	Tidal Model Analysis 2006 Map and Levels.
Map 4	South Holland SFRA Residual Flood Hazard, Spalding – Present day 0.1% Event
Map 5	South Holland SFRA Residual Flood Hazard Spalding - year 2115 0.1% Event
Map 6	South Holland SFRA Residual Peak Depth Spalding year - 2115 0.1% Event
Map 7	South Holland SFRA Residual Peak Velocity Spalding year - 2115 0.1% Event
Map 8	Surface Water Flood Map
Plan 1	Location Plan
Plan 2	Proposed Layout Plan
Plan 3	Topographical Survey

Site Name	**Spalding Road Pinchbeck**
Date	**Jun-19**
Comments:	**FRA**
Environment Agency CCN Number	

INPUT DATA TO BLUE CELLS ONLY

Model Information

Model Name	**Welland Model**
Date of Model	**Sep-16**
Model Node	**Glen 6685**

OUTPUTS IN YELLOW CELLS

Modelled Results

Re-order based on Flow	FLOW	LEVEL
2	25.95	4.01
5	29.44	4.16
10	31.06	4.23
20	33.13	4.31
50	34.59	4.34
75	35.32	4.35
100	35.84	4.38
200	38.87	4.44
100+20	43.56	4.84
1000	48.22	4.60
1000+20	56.55	4.94

Attenuation Factor

-1.27 % FOR 1:100

2.32 % FOR 1:1000

Note: Higher attenuation factors mean results through extrapolation will be over estimated

River Basin	Anglian	
Time Horizon	Up to 2115	
AEP Scenario	1000	AEP

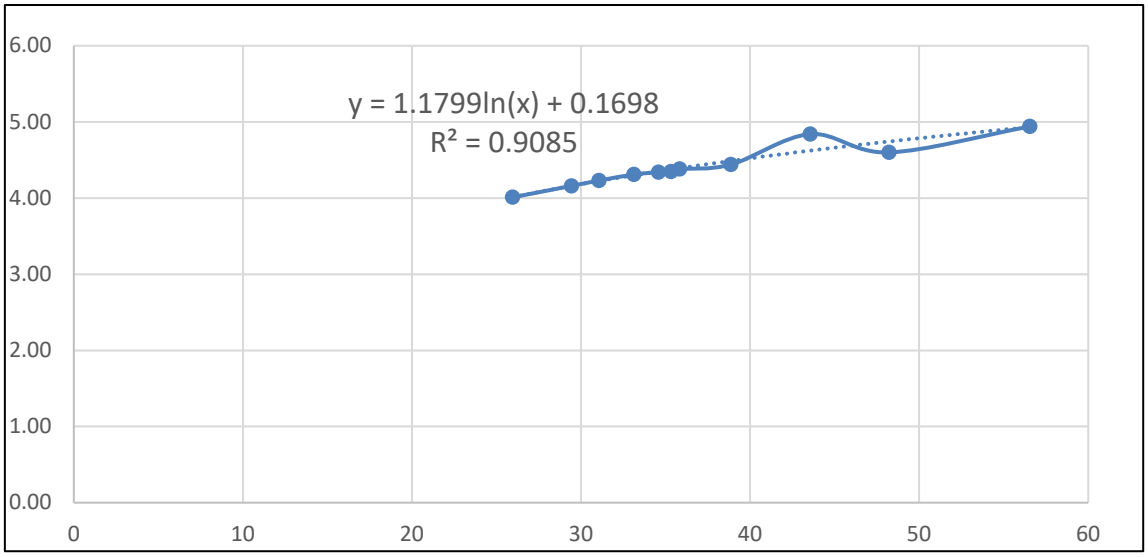
MAKE SURE YOU COPY THE FORMULA VARIABLES AND R^2 ON THE GRAPHS TAB 1

EXTRAPOLATED WATER LEVEL OUTPUTS AT NODE Glen 6685		
Upper End Scenario	**5.33**	mODN
Higher Central Scenario	**5.10**	mODN
Central Scenario	**5.01**	mODN

Log Interpolation

EQUATION > **1.1799** **0.1698** < include sign ie +/-

	1 in 100		1 in 1000	
	FLOW	**LEVEL**	**FLOW**	**LEVEL**
65%	59.14	4.98	79.56	5.33
35%	48.38	4.75	65.10	5.10
25%	44.80	4.66	60.28	5.01



R2 value **0.9085**

Flood map for planning

Your reference	Location (easting/northing)	Created
Spalding Road	**524559/324729**	**12 Jun 2019 3:02**

Your selected location is in flood zone 3, an area with a high probability of flooding.

This means:

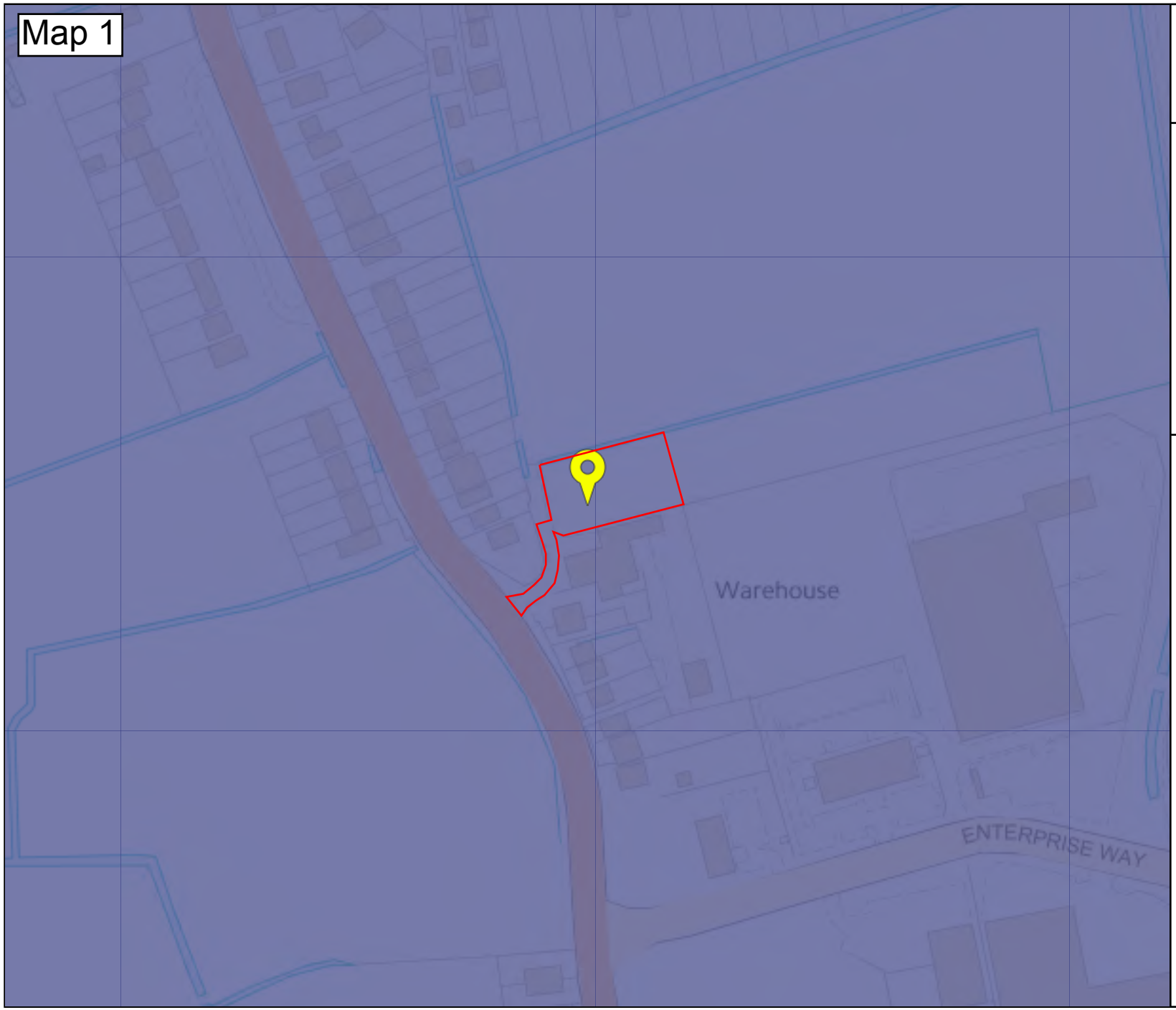
- you must complete a flood risk assessment for development in this area
- you should follow the Environment Agency's standing advice for carrying out a flood risk assessment (see www.gov.uk/guidance/flood-risk-assessment-standing-advice)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

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Environment Agency

Flood map for planning

Your reference
Spalding Road

Location (easting/northing)
524559/324729

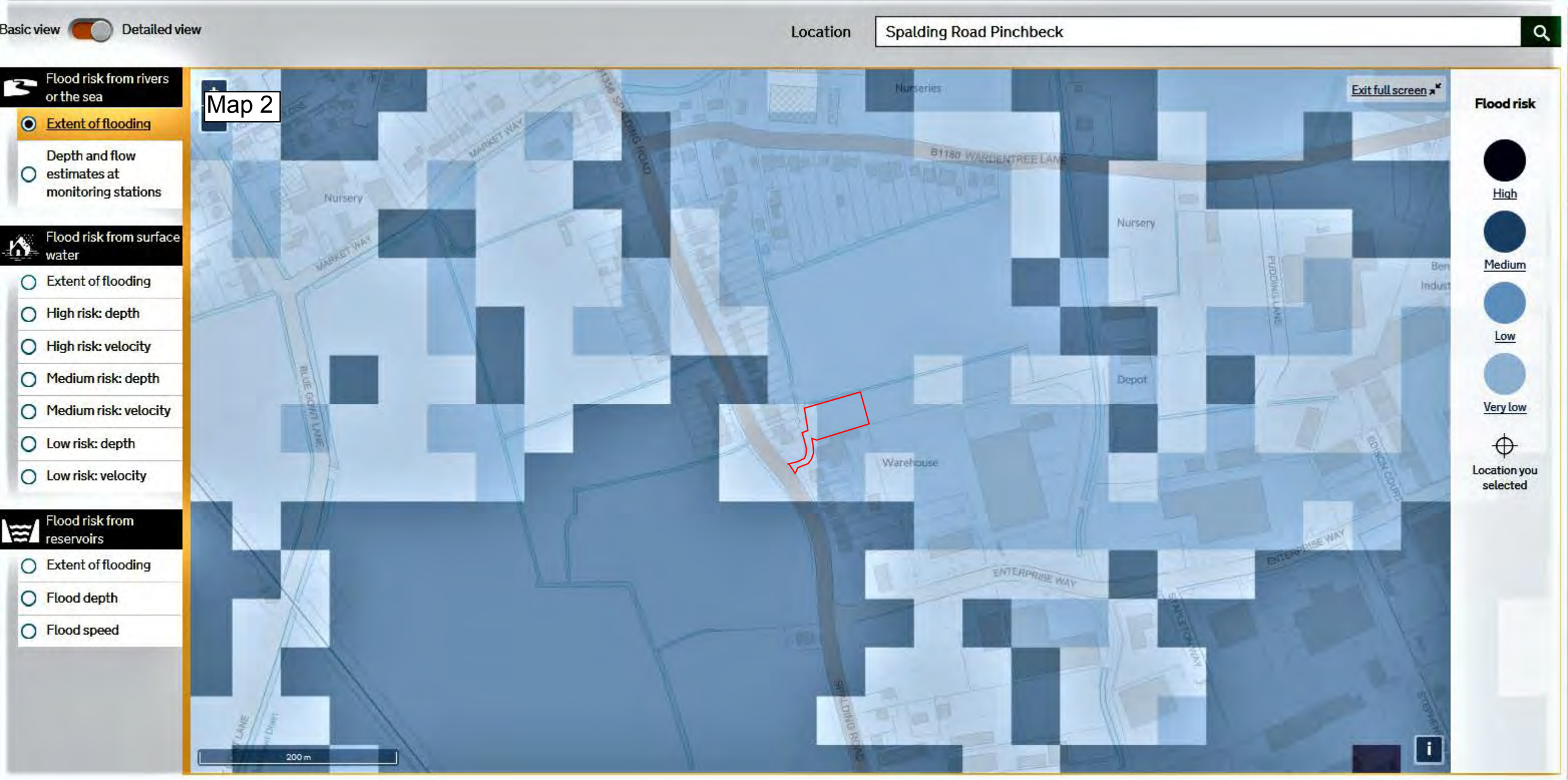
Scale
1:2500

Created
12 Jun 2019 3:02

- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 20 40 60m

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Basic view
Detailed view
Location
Spalding Road Pinchbeck
Flood risk from rivers or the sea
Extent of flooding
Depth and flow estimates at monitoring stations
Flood risk from surface water
Extent of flooding
High risk: depth
High risk: velocity
Medium risk: depth
Medium risk: velocity
Low risk: depth
Low risk: velocity
Flood risk from reservoirs
Extent of flooding
Flood depth
Flood speed
Map 2
Exit full screen
Nurseries
B1180 WARDENTREE LANE
Nursery
MARKET WAY
SPALDING ROAD
Nursery
Depot
Warehouse
ENTERPRISE WAY
BLUE GOWT LANE
200 m
Flood risk
High
Medium
Low
Very low
Location you selected

Tidal Level Location Map
Lincolnshire & Northamptonshire Area

Map 3



Produced May 2017

Produced by Partnerships & Strategic Overview Team

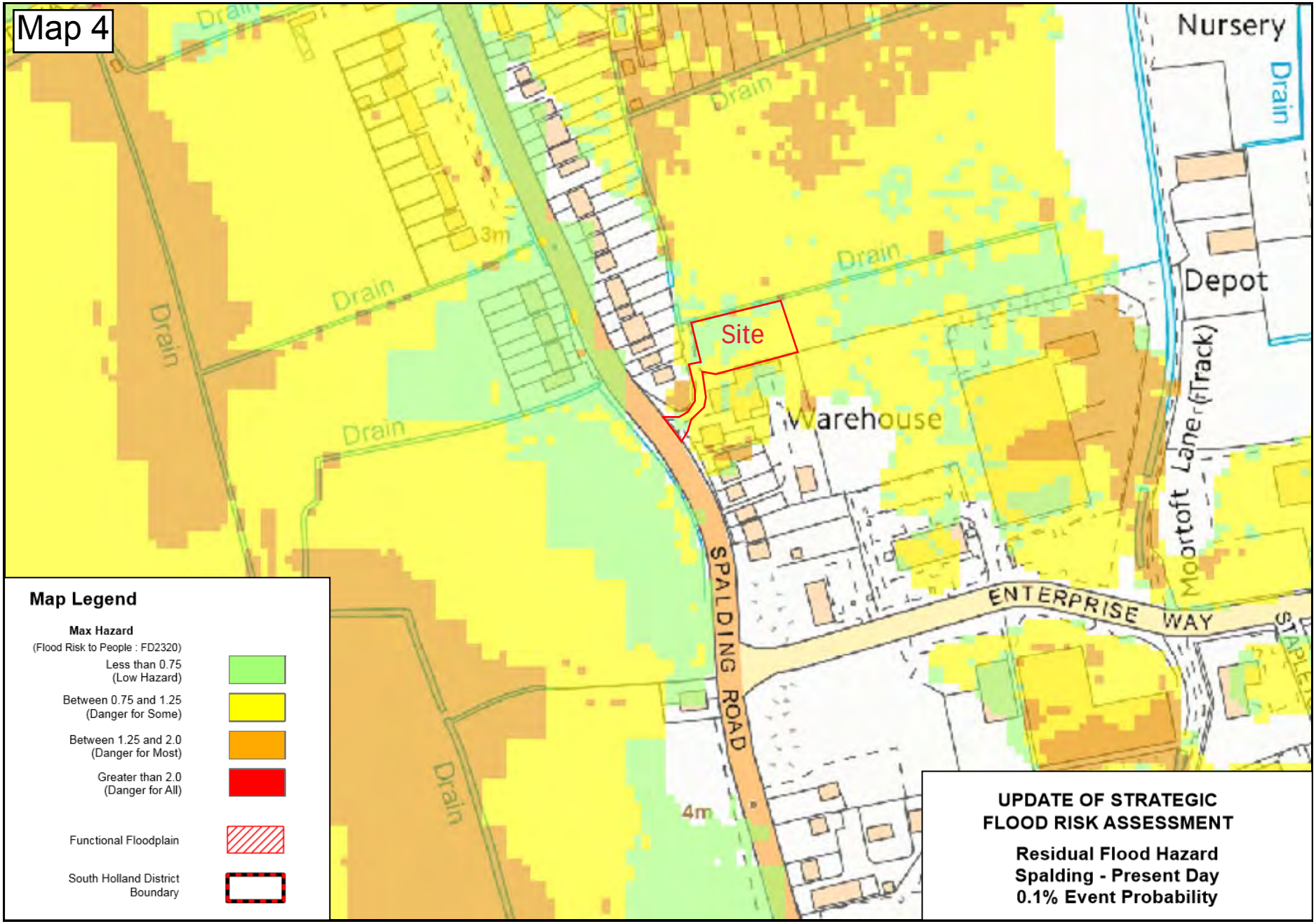
© Environment Agency copyright and / or database rights 2017. All rights reserved. © Crown Copyright and database right. All rights reserved. Environment Agency, 100026380, 2017.

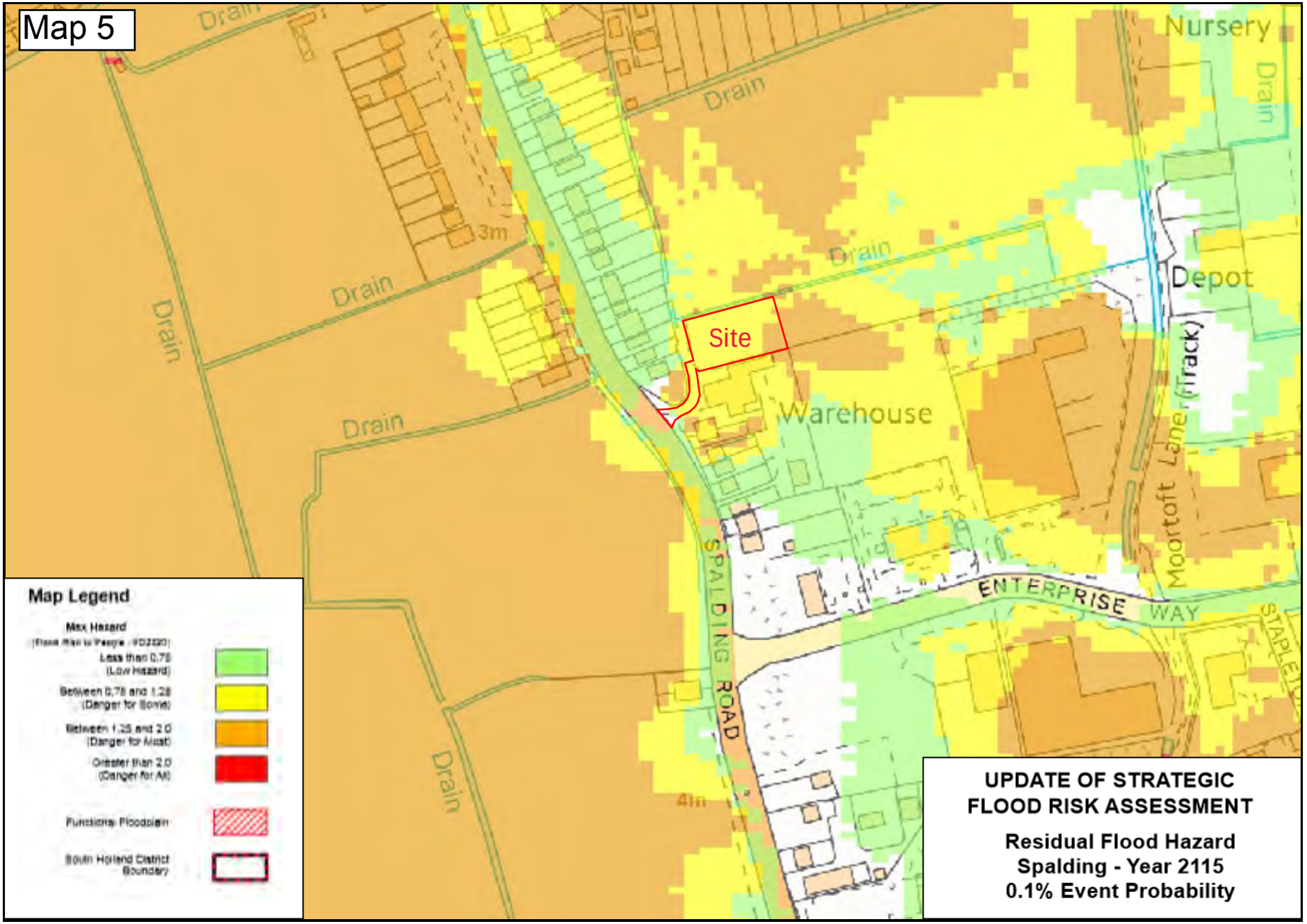
Tidal Water Levels for the South Humber, East Coast and The Wash

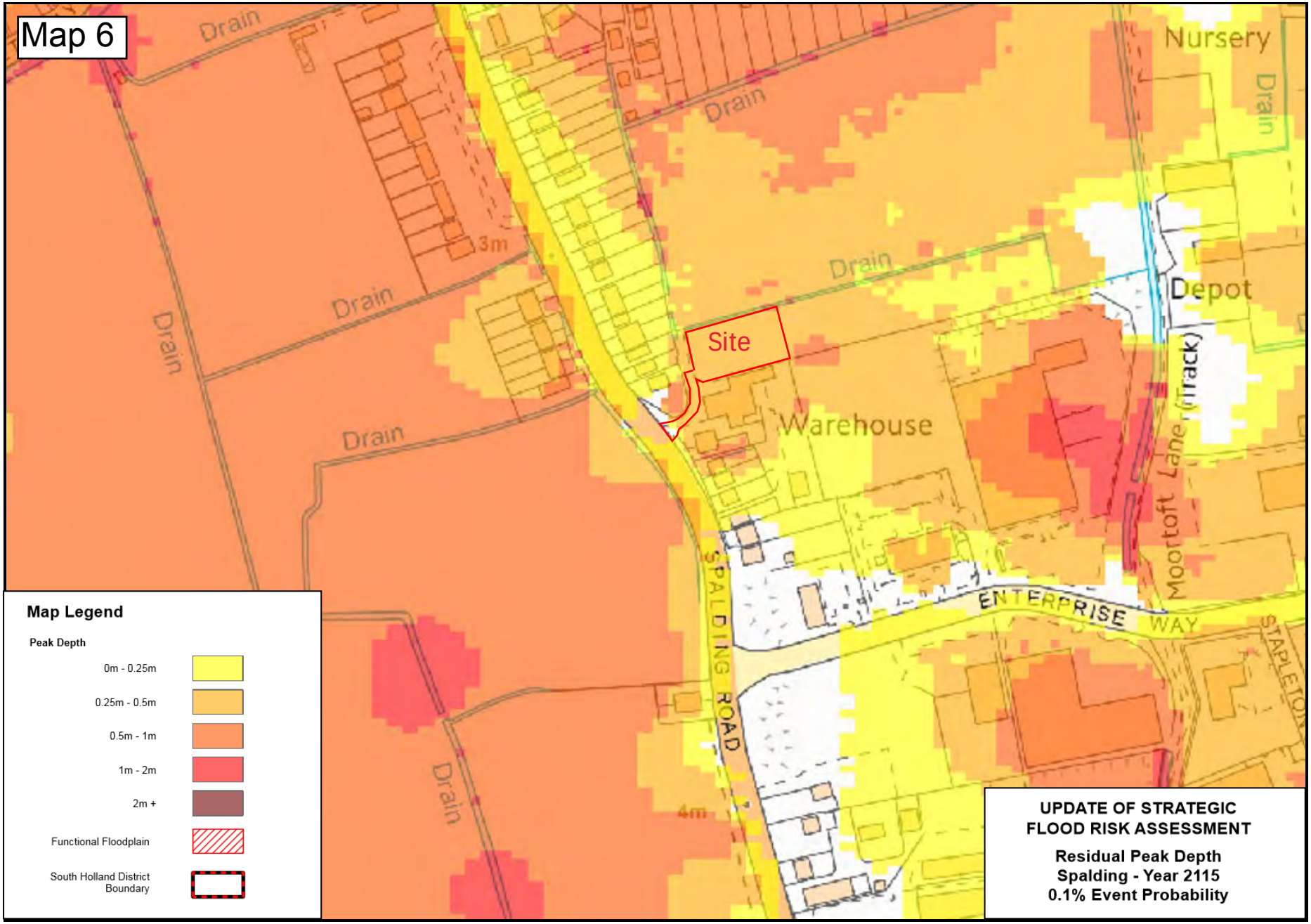
The table below shows still water levels for locations, from the above location map, around the South Humber Estuary, East Coast and The Wash. It is important to note the following:

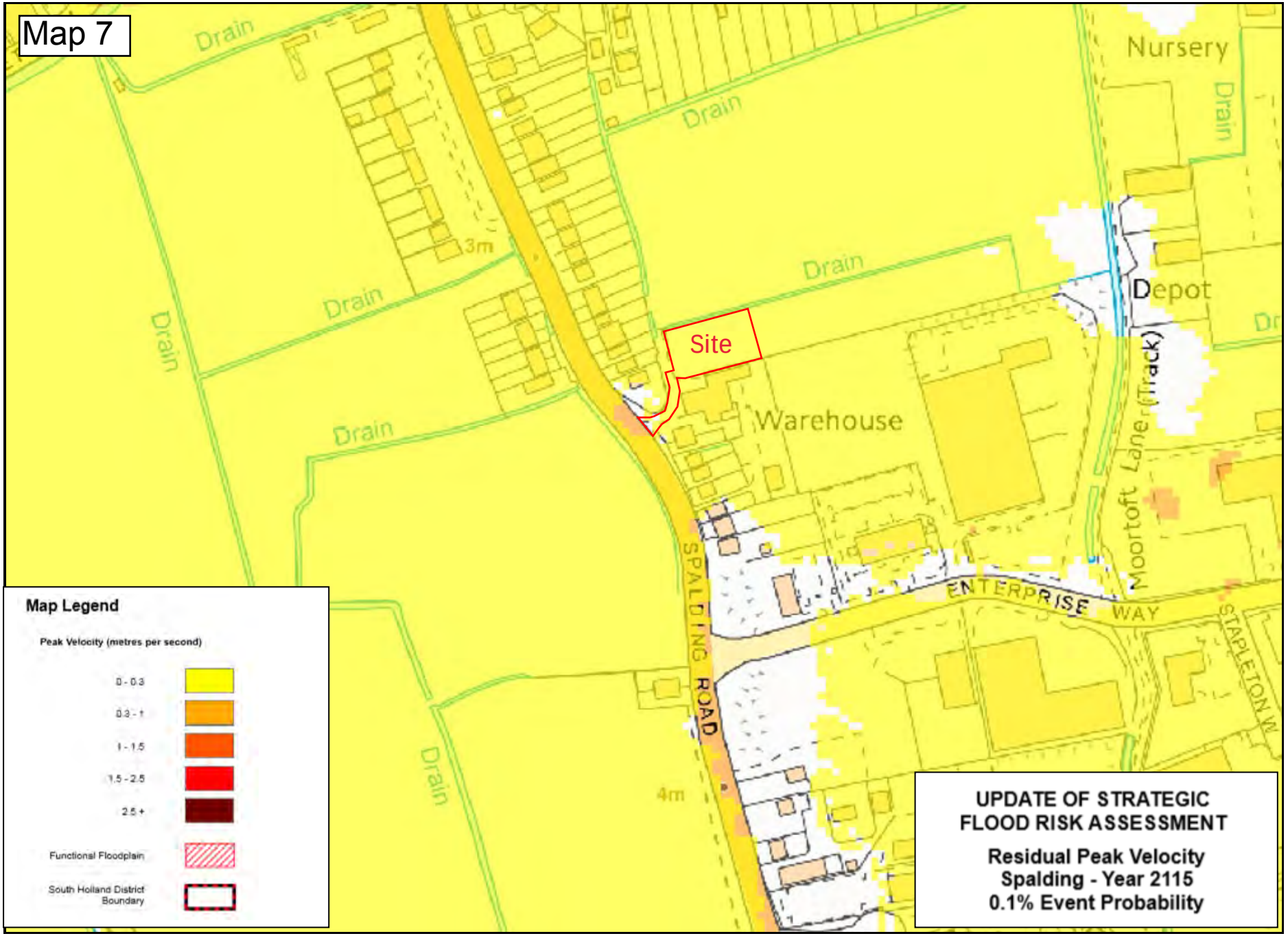
- The base date for the data is 2014 for the South Humber and 2006 for the East Coast and The Wash.
- The data are still water levels. Depending on the use of the data it may be necessary to consider wave heights and / or joint probability analysis of water level and other variables.
- The water level quoted is the 'Best Estimate' water level. Depending on the use of the data it may be necessary to carry out sensitivity testing. Upper and Lower 95% confidence bandings are available upon request.
- Levels for other annual chance scenarios are available if required.

Ref	Location	Easting	Northing	Annual Chance (1 in x) of Tide Level metres ODN					
				1	10	50	100	200	1000
HUMBER									
H030	Tetney	535420	403180	3.94	4.29	4.56	4.69	4.82	5.15
H050	Buck Beck	532700	406580	4.03	4.36	4.62	4.74	4.87	5.18
H060	Grimsby	527878	411346	4.10	4.43	4.70	4.82	4.95	5.27
H080	Haborough Marsh	520790	415740	4.26	4.61	4.88	5.01	5.14	5.47
H090	Immingham	519141	417449	4.26	4.61	4.88	5.01	5.14	5.47
H100	South Killingholme	518700	417120	4.41	4.77	5.05	5.18	5.32	5.66
H130	North Killingholme	516530	420000	4.51	4.87	5.15	5.28	5.42	5.77
H150	East Halton	514450	422870	4.59	4.96	5.25	5.39	5.53	5.89
H170	Goxhill	511970	425440	4.67	5.04	5.34	5.47	5.61	5.95
H200	New Holland	508020	424330	4.87	5.26	5.55	5.68	5.81	6.12
H210	Barrow Haven	506380	422620	4.92	5.31	5.60	5.73	5.86	6.17
H220	Ferriby	497550	421150	5.04	5.42	5.67	5.77	5.86	6.04
H230	Winterton	493420	422830	5.14	5.51	5.74	5.83	5.90	6.02
H250	Blacktoft	484247	424190	5.25	5.62	5.83	5.90	5.96	6.04
H270	Goole	474857	422960	5.46	5.85	6.07	6.15	6.21	6.29
East Coast									
~	Great Eau	545500	393800	3.80	4.19	4.46	4.57	4.69	4.96
~	Boygrift	553300	379800	3.84	4.24	4.53	4.65	4.77	5.05
~	Burgh Sluice	555190	358620	4.26	4.45	4.76	4.90	5.03	5.34
Wash									
~	Hobhole	536610	339940	4.82	5.30	5.64	5.78	5.93	6.27
~	Lawyers Sluice	540750	334550	4.84	5.32	5.66	5.80	5.95	6.29
~	West Lighthouse	549150	325750	4.88	5.37	5.71	5.86	6.01	6.35
~	Grand Sluice	532400	344500	4.88	5.33	5.65	5.78	5.93	~
~	Fosdyke Bridge	531700	332200	4.91	5.38	5.71	5.85	5.99	~
~	Marsh Road	526000	324000	5.04	5.44	5.73	5.85	5.98	~
~	Wisbech	546100	310000	4.83	5.25	5.53	5.66	5.78	~
~	Dog In Doublet	527300	299300	3.67	4.00	4.22	4.32	4.42	~


Map 4
Nursery
Drain
Depot
Site
Warehouse
Moortoft Lane (Track)
SPALDING ROAD
ENTERPRISE WAY
3m
4m
Map Legend
Max Hazard
(Flood Risk to People : FD2320)
Less than 0.75 (Low Hazard)
Between 0.75 and 1.25 (Danger for Some)
Between 1.25 and 2.0 (Danger for Most)
Greater than 2.0 (Danger for All)
Functional Floodplain
South Holland District Boundary
UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT
Residual Flood Hazard
Spalding - Present Day
0.1% Event Probability


Map 5
Drain
Drain
Drain
Drain
Drain
Drain
Drain
3m
Site
Warehouse
Nursery
Depot
Moortoft Lane (Track)
SPALDING ROAD
ENTERPRISE WAY
4m
Map Legend
Max Hazard
Less than 0.75 (Low Hazard)
Between 0.75 and 1.25 (Danger for Some)
Between 1.25 and 2.0 (Danger for Most)
Greater than 2.0 (Danger for All)
Functional Floodplain
South Holland District Boundary
UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT
Residual Flood Hazard
Spalding - Year 2115
0.1% Event Probability


Map 6
Drain
Drain
Drain
Drain
Drain
Drain
Drain
3m
4m
Site
Warehouse
Nursery
Depot
Moortoft Lane (Track)
SPALDING ROAD
ENTERPRISE WAY
STAPLETON
Map Legend
Peak Depth
0m - 0.25m
0.25m - 0.5m
0.5m - 1m
1m - 2m
2m +
Functional Floodplain
South Holland District Boundary
UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT
Residual Peak Depth
Spalding - Year 2115
0.1% Event Probability


Map 7
Drain
Drain
Drain
Drain
Drain
Drain
Drain
3m
4m
Site
Warehouse
Nursery
Depot
Moortoft Lane (Track)
SPALDING ROAD
ENTERPRISE WAY
STAPLETON W
Map Legend
Peak Velocity (metres per second)
0 - 0.3
0.3 - 1
1 - 1.5
1.5 - 2.5
2.5 +
Functional Floodplain
South Holland District Boundary
UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT
Residual Peak Velocity
Spalding - Year 2115
0.1% Event Probability

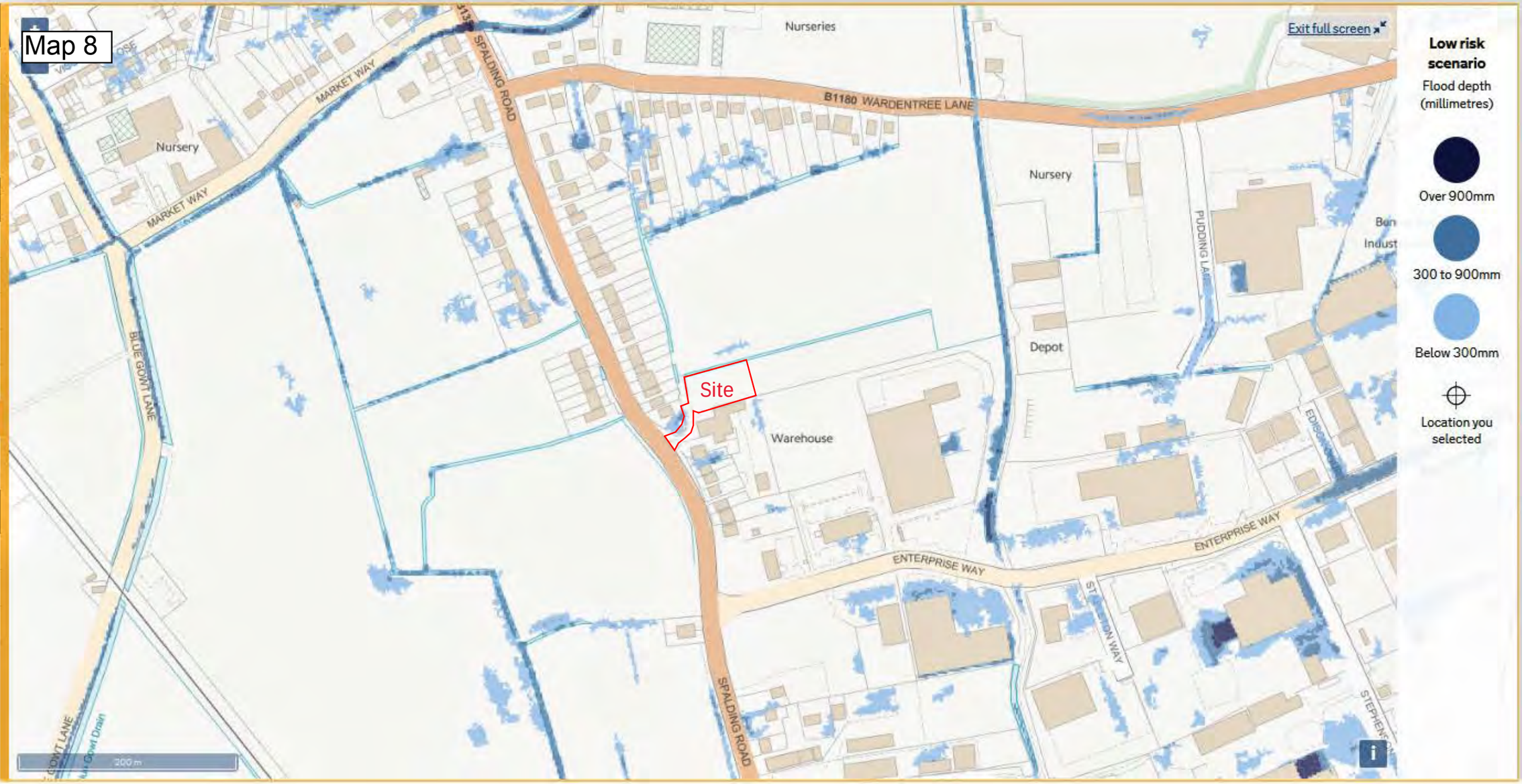
Basic view | Detailed view

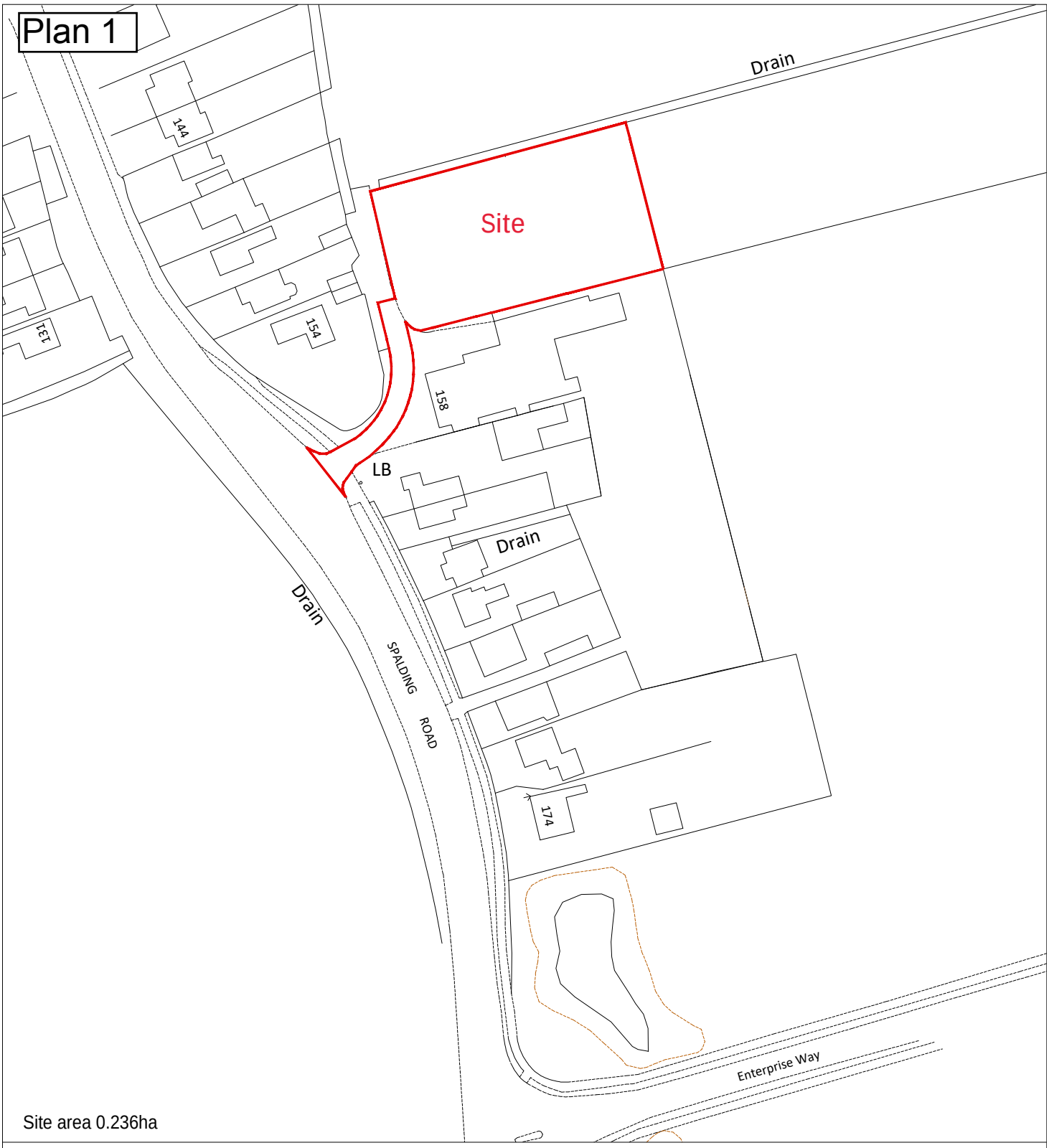
Location: Spalding Road Pinchbeck

Flood risk from rivers or the sea
- Extent of flooding
- Depth and flow estimates at monitoring stations

Flood risk from surface water
- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth
- Medium risk: velocity
- Low risk: depth
- Low risk: velocity

Flood risk from reservoirs
- Extent of flooding
- Flood depth
- Flood speed





CDM NOTE:

The design has been undertaken as far as possible to avoid risks to health and safety or to reduce and control the effects of any unavoidable risks.

Any relevant information identifying risks which are not able to be eliminated will be included within the project Health and Safety file.

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N

0 10 20 30 40 50m

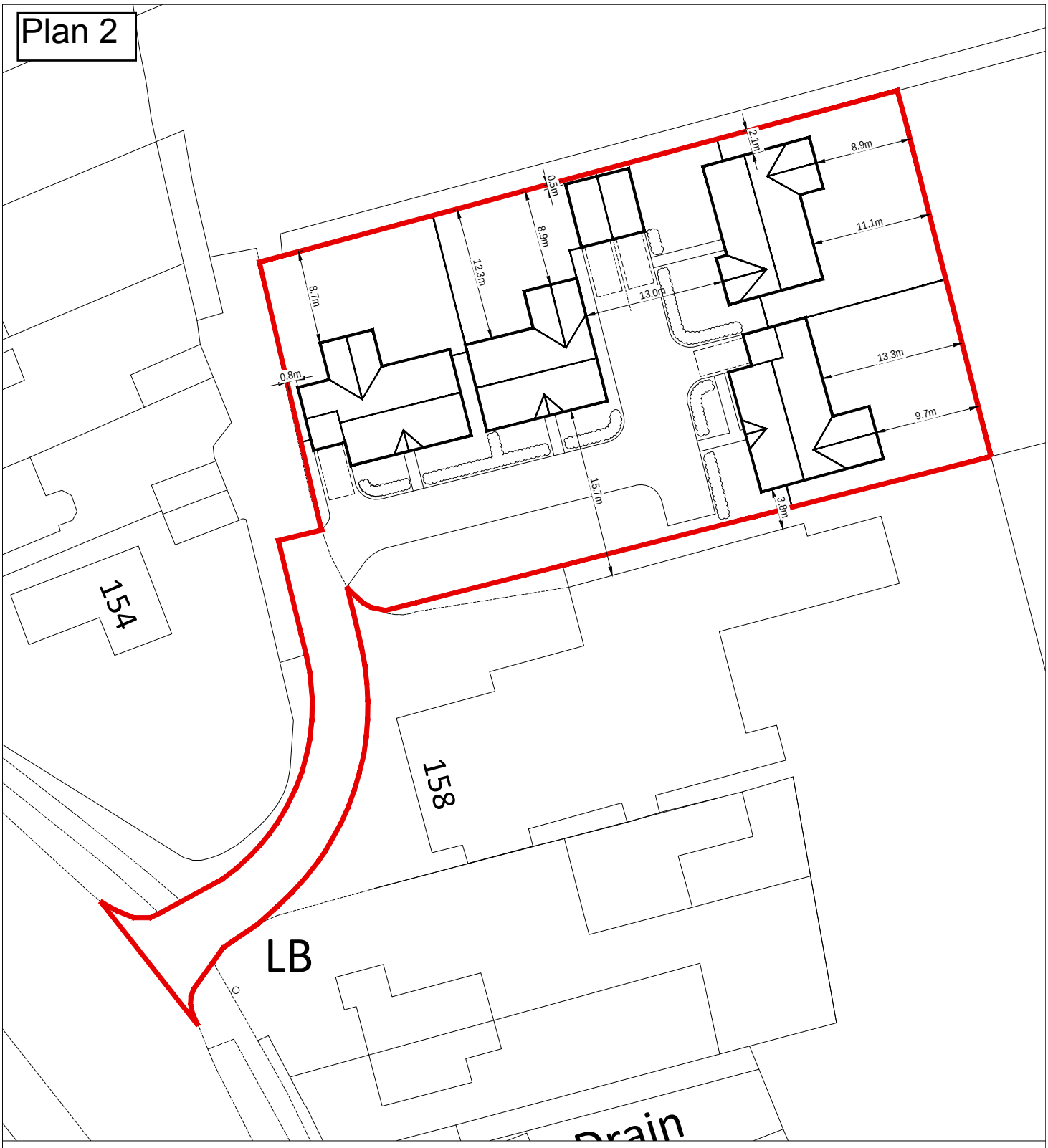
Rev.	By	Notes	Date
A	WW	Red line amended	21/6/16

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Sleaford, Lincolnshire NG34 ORA
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Fax: 01529 421358
Email: admin@rdc-landplan.co.uk
Web: www.rdc-landplan.co.uk

Client: Messers M&K Egar		
Project: Spalding Road, Pinchbeck		
Drawing title: Location Plan		
Drawing No. 1198-2-LP01	Rev. A	Drawn WW
Scale 1:1250 @ A4	Date 13/06/16	Checked LMS

All measurements should be checked against on site conditions and any discrepancies should be brought to the attention of the Robert Doughty Consultancy.

Plan 2



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N

0 5 10 15 20 25m

Rev.	By	Notes	Date
A	WW	Red line amended	21/6/16

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Web: www.rdc-landplan.co.uk

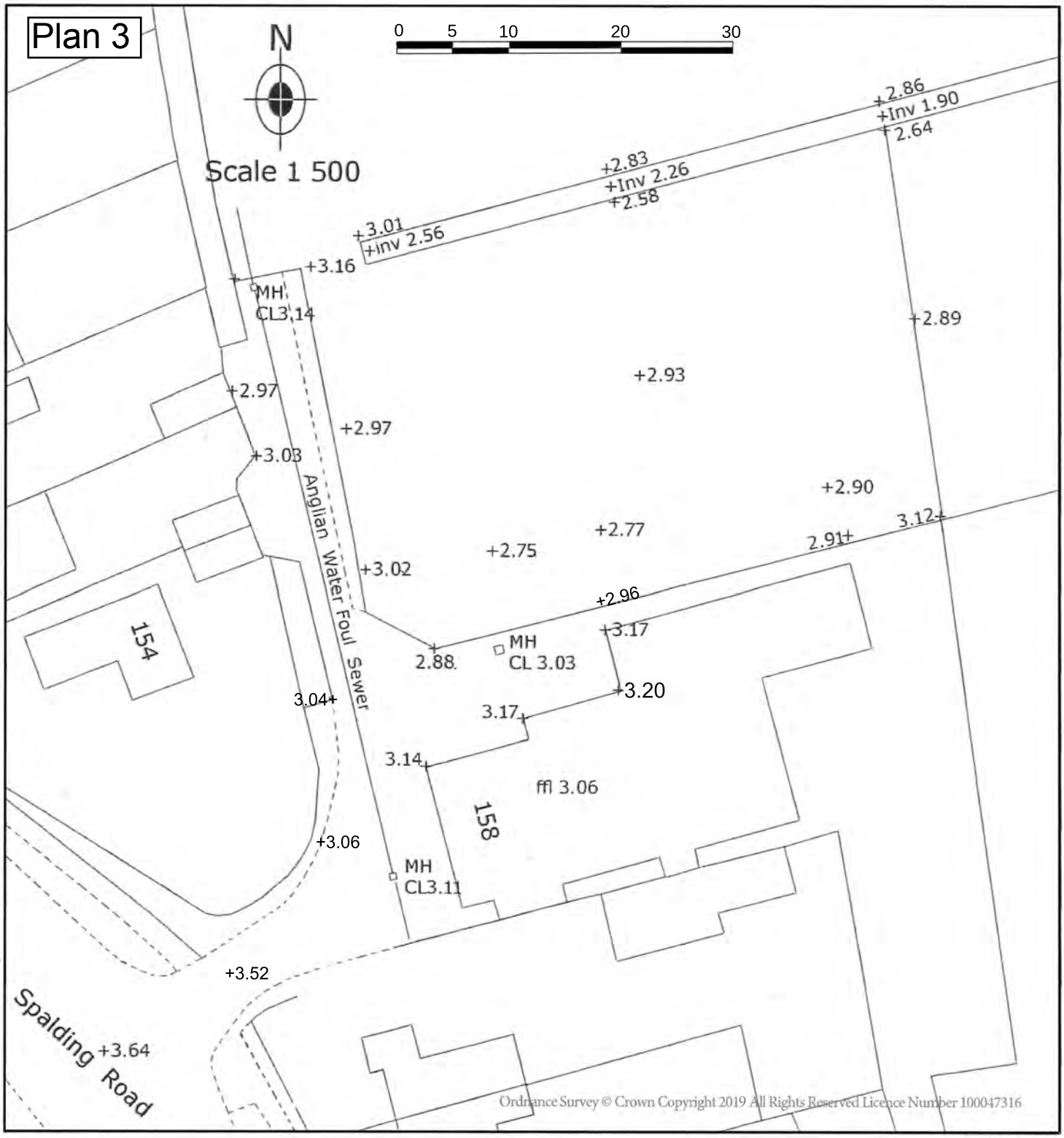
Client: Messers M&K Egar

Project: Spalding Road, Pinchbeck

Drawing title: Block Plan

Drawing No.	Rev.	Drawn
1198-2-BP01	A	WW
Scale	**Date**	**Checked**
1:500 @ A4	13/06/16	LMS

All measurements should be checked against on site conditions and any discrepancies should be brought to the attention of the Robert Doughty Consultancy.


Plan 3
N
0 5 10 20 30
Scale 1 500
+2.86
+Inv 1.90
+2.64
+2.83
+Inv 2.26
+2.58
+3.01
+inv 2.56
+3.16
MH
CL3.14
+2.89
+2.93
+2.97
+2.97
+3.03
+2.90
3.12+
+2.77
2.91+
+2.75
+3.02
+2.96
+3.17
MH
CL 3.03
2.88
154
3.04+
+3.20
3.17
3.14
ffl 3.06
158
+3.06
MH
CL3.11
+3.52
Spalding Road
+3.64
Anglian Water Foul Sewer
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Plan 3