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# FLOOD RISK ASSESSMENT

**CHANGE OF USE TO INDEPENDENT SCHOOL  
72 CARLTON ROAD  
BOSTON  
PE21 8PB**



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# **FLOOD RISK ASSESSMENT FOR PROPOSED CHANGE OF USE TO INDEPENDENT SCHOOL, 72, CARLTON ROAD, BOSTON. PE21 8PB**

## **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) March 2012, 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 and to direct development away from areas at highest risk..

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 years 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 outline 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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There is a residual risk relating to any development in a flood risk area particularly in an event with conditions of greater magnitude than those considered by this assessment.

## **APPLICATION SITE**

The site is located at No 72 Carlton Road, Boston, PE21 8PB, within the administrative area of Boston Borough Council. **Plan 1**

Planning permission is sought for the Change of Use to an independent school to be used in conjunction with Bridge House Independent School (formerly called Bridge House Vocational Training Centre). The existing building was the former Black Sluice Internal Drainage Board Offices that have now been vacant for approximately 18 months and which were occupied by them since 1935, prior to such date it formed a large residential dwelling.

The use of the site as already been established as offices since 1935 and the proposed change of use (subject to very minor internal alterations) will operate within the same overall layout. The operational time for using this building during normal school term periods will be 9am - 4pm (Monday – Friday), plus an extra hour each way for staff preparation. During holiday term periods it is not proposed to use this building to facilitate children of working families (known as "Kick It") as currently operates at Bridge House.

Apart from this alternative holiday period use it is proposed to operate this building as Bridge House, thus forming a secondary building with the main administration and operational use being retained at Bridge House. Approximately 5 additional members of staff will be employed on site to undertake the tutorial and vocational courses, of which are closely regulated and inspected.

Such type of school deals with the behavioural attitude and concentration of teenagers who have been excluded or have not attended the normal educational system and therefore needs help and guidance in meeting their individual requirements in preparing them for future employment. Such is the present success of the school over recent years the high level of recommendation as resulted in a considerable intake, which necessitates additional accommodation that is located within a reasonable distance from the existing school.

The Site would be classed as Non Major Development applying the Town & Country Planning (Consultation) (England) Direction 2009 as the site is to be developed is less than 1 Hectare.

The National Grid Reference is TF 31934 44340.

The National Planning Policy Framework Technical Guidance (NPPF TG) 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 TG.**Map1**

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

<p><b>Zone 3a - high probability</b></p> <p><b>Definition</b> This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (&gt;1%), or a 1 in 200 or greater annual probability of flooding from the sea (&gt;0.5%) in any year.</p> <p><b>Appropriate uses</b> The water-compatible and less vulnerable uses of land (table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone.</p> <p>The more vulnerable uses and essential infrastructure 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 users in times of flood.</p> <p><b>Flood risk assessment requirements</b> All development proposals in this zone should be accompanied by a flood risk assessment.</p> <p><b>Policy aims</b> In this zone, developers and local authorities should seek opportunities to:</p> <ul style="list-style-type: none"> <li>• 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 systems;</li> <li>• relocate existing development to land in zones with a lower probability of flooding; and</li> <li>• create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.</li> </ul>
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Applying the Flood Risk Vulnerability Classification in Table 2 of NPPF TG the existing office use and the proposed non-residential institution change of use are both classified as “Less Vulnerable”, with Table 1 of NPPF TG stating that such uses are appropriate in this zone.

**Table 2: Flood Risk Vulnerability Classification**

<p><b>Less vulnerable</b></p> <ul style="list-style-type: none"> <li>• Police, ambulance and fire stations which are <i>not</i> required to be operational during flooding.</li> <li>• Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non-residential institutions not included in “more vulnerable”, and assembly and leisure.</li> <li>• Land and buildings used for agriculture and forestry.</li> <li>• Waste treatment (except landfill and hazardous waste facilities).</li> <li>• Minerals working and processing (except for sand and gravel working).</li> <li>• Water treatment works which do <i>not</i> need to remain operational during times of flood.</li> <li>• Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).</li> </ul>
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PPS25 Practice Guide states in paragraph 4.42 that change of use should not be subject to the sequential and exception tests but will still need to meet the requirements of a site specific flood risk assessment.

From the level survey the level on Carleton Road is 2.60mODN with the site ground levels averaging 2.77mODN. The existing ground floor of the property is elevated above these levels at 3.37mODN **Plan 4**

**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 tidal Boston Haven
- River Witham
- South Forty Foot Drain

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 tidal flooding. These maps indicate that the area would be flooded without flood defences, which are in place along the coastal edge (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 site is shown on the Environment Agency Risk of Flooding from Rivers and Sea Map to be at Low Risk.

The Haven Banks constitute the first line of defence against any tidal flooding. These consist of earth embankments, within in the relatively sheltered environment of the Haven; this is less of a hazard from wave action than the North Sea coastline. These earth embankment crest level is circa 6.50mODN with a predicted 1 in 200 year peak tide of 5.93mODN. (Grand Sluice Northern Area Tidal Model)

### **Tidal Haven**

The Haven is embanked for the whole length to its outfall into the Wash. The first 3 kilometres through Boston the channel is confined within "hard" defence's i.e. concrete walls, sheet piling etc but downstream the defences are conventional earth banks. The hard defences have been subject to a rolling programme of improvement by the Agency and its predecessor the NRA since 1978 when in January that year a 35 metre section of unreinforced brick wall between St Botolph's churchyard and the river collapsed. Temporary repairs were carried out and the temporary works and the remains of the old wall were removed and replaced with a permanent reinforced concrete wall and these defences are now unlikely to fail by breaching.

### **Breach Analysis to Haven Tidal Defences**

From Northern Area Tidal Modal Analysis (June 2006) **Map 2**

Peak tide levels Present Day (2006) at Grand Sluice (Tidal River) 0.5% (1 in 200) = 5.93mODN

Peak tide levels (2113) at Grand Sluice (Tidal River) 0.5% (1 in 200) = 5.93mODN plus climate change of 1096mm = 7.03mODN

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 value	Degree of flood hazard	Description	Indicative depth range
< 0.75	Low	Caution 'Flood zone with shallow flowing water or deep standing water'	Up to 0.25 m
0.75 – 1.25	Moderate	Danger for some (i.e. children) 'Danger: flood zone with deep or fast flowing water'	Up to 0.5 m
1.25 – 2.0	Severe	Danger for most 'Danger: flood zone with deep fast flowing water'	0.5 m to 3 m
> 2.0	Extreme	Danger for all 'Extreme danger: flood zone with deep fast flowing water'	0.5 m to over 3 m

$$HR = d \times (v + 0.5) + DF$$

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

Flood depth (m)	All areas (rural and urban)
≤ 0.25	0.5
> 0.25	1

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

The Environment Agency has recently carried out a Tidal Hazard Mapping for the Haven following a breach to the defences. The Northern Area Tidal Hazard Maps (2009) for Scenario year 2006 for the 1 in 200 year event show that the site is within a Hazard Rating area of between 1.25 – 2.0 (Danger for Most). With climate change up to year 2115 the maps show that the site is within a Hazard Rating area of greater than 2.0 (Danger for All), with a velocity of 0.3 -1.0/sec and depth of flow 0.5 – 1.0m.

**Map 3** shows the Hazard rating for the present day and **Maps 4; Map 5 & Map 6** show the results for The Haven taken from the Environment Agency Northern Area Tidal Hazard Mapping. Licence No CCN-2010-24014.

The Environment Agency has also produced maps based on computer modelling of simulated overtopping of defences along the coastline for specific tidal scenarios. The maps only consider the consequences of overtopping of defences and do not show the possible consequences of breaches of the tidal defences. For future climate change scenarios, it is assumed that the defences remain at 2006 heights. The outputs are based on computer modelling of simulated overtopping of the main coastal defences for specific tidal scenarios. They do not include overtopping along the following tidal rivers which are currently being investigated the Witham Haven upstream of Hobhole and Welland upstream of Fosdyke Bridge.

For the scenario year 2006 the 1 in 200 year annual chance from overtopping, the site is not affected. The

Northern Area Tidal Overtopping Hazard Maps for Scenario year 2115 (1 in 200 year) shows that the site is not affected.

The existing ground floor level is 3.37mODN which is 0.77m above Carlton Road and 0.60m above the ground level surrounding the property.

### South Forty Foot Drain

The South Forty Foot Drain lies some 800m south of the site. Under normal conditions the South Forty Foot Drain discharges into the tidal Boston Haven by gravity and there is a major pumping station at the outfall (Black Sluice Pumping Station) which enables flows to be discharge at all tide levels.

The South Forty Foot Drain is an artificial fenland drainage channel which runs from near Bourne to its outfall into the Boston Haven, a distance of some 33km.

Label	Easting	Northing	Annual Exceedance Probability Maximum Water Levels (mODN)					Bank Levels (mODN)	
			4% 1 in 25	1% 1 in 100	1%+CC 1 in 100	0.1% 1 in 1000	0.1%+CC 1 in 1000	Left Bank	Right Bank
SF100145	532516	342898	2.57	2.62	2.76	2.79	2.72	5.50	3.84
SF100500	532170	342997	2.46	2.62	2.61	2.67	2.70	2.35	2.98

Source (South Forty Foot Drain Design Model (May 2009)

With the site levels being above the 1 in 100 year flood level including climate change flooding from this source has been discounted.

### River Witham

The River Witham, (fluvial), lies some 450m north-east of the site. Upstream of Grand Sluice the flood defence for the right bank to the River Witham is an earth embankment which is in a good structural condition, which generally has a crest level of 5.00m ODN. When the river is tide locked when the river is in flood water is stored at Branston Island some 35 km upstream until the tide recedes.

The 1 in 100 year level in the River Witham 4.22mODN at Grand Sluice and with climate change is 4.37m ODN, Node LWA\_15880!

Label	Easting	Northing	Annual Exceedance Probability Maximum Water Levels (mODN)				
			5% 1 in 20	1% 1 in 100	1%+CC 1 in 100	0.1% 1 in 1000	0.1%+CC 1 in 1000
LWA_15880!	520960	353998	4.17	4.22	4.37	4.27	4.38
LWA_07190!	526546	347573	4.08	4.13	4.36	4.17	4.37

Source (Lower Witham Flood Map Improvements) Project 2009.

# 1 D Breach Analysis for the River Witham

Taking the precautionary approach that the river breaches the flood defences using the following assumptions:-

1. Flow through the breach is calculated using the broad crested weir formula.  $Q = 1.7 \times B \times H^{3/2}$  and with constant flow.
2. Water spreads out from the breach at 45 degrees.
3. Flow across each section moving away from the breach is the same as calculated at the breach i.e. no attenuation on the floodplain
4. Floodplain topography ignored i.e. It is assumed that there are no buildings or infrastructure between the defences and the site that could absorb or deflect the flood flows.
5. Debris Factor as per Flood Risks to People FD2320

The Hazard Rating following a breach, which in Flood Risk To People FD 2320 Guidance document 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.

$$HR = d \times (v + 0.5) + DF$$

HR = (flood) hazard rating D = depth of flooding (m)

V = velocity of flood waters (m/sec) DF = debris hazard =0.5, >0.26 = 1

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

<b>Hazard Rating</b>		Site Name: Carlton Road Boston		Date: Dec-13										
Defence Type: Fluvial River - Earth Bank		Ground Level at breach	2.5 mODN	Flood Level	4.35 mODN	Head at Breach	1.85 m	Hazard Ratings						
Breach Width		40 m						Danger for all						
Increments from breach		50 m						Danger for most						
Debris Factor		Shallow 0.5		Deep 1		(note: shallow <0.26m)		Danger for all						
		DISTANCE FROM BREACH												
		0	50	100	150	200	250	300	350	400	450	500	550	600
DEPTH AT BREACH	1.55	2.07	2.08	1.79	1.58	1.46	1.36	0.83	0.79	0.76	0.74	0.72	0.70	0.69
	1.60	2.10	2.11	1.82	1.60	1.48	1.40	0.84	0.80	0.77	0.75	0.72	0.71	0.69
	1.65	2.13	2.14	1.85	1.63	1.50	1.41	0.85	0.81	0.78	0.76	0.73	0.72	0.70
	1.70	2.16	2.17	1.89	1.65	1.52	1.43	0.87	0.83	0.79	0.77	0.74	0.72	0.71
	1.75	2.19	2.20	1.93	1.68	1.54	1.45	0.89	0.84	0.80	0.78	0.75	0.73	0.72
	1.80	2.22	2.23	1.96	1.70	1.56	1.47	0.90	0.85	0.82	0.79	0.76	0.74	0.72
	1.85	2.25	2.26	2.00	1.73	1.58	1.49	0.91	0.87	0.83	0.80	0.77	0.75	0.73
	1.90	2.28	2.29	2.04	1.76	1.60	1.50	0.93	0.88	0.84	0.81	0.78	0.76	0.74
	1.95	2.31	2.32	2.07	1.78	1.62	1.52	0.94	0.89	0.85	0.82	0.79	0.77	0.75
	2.00	2.34	2.35	2.11	1.81	1.64	1.54	0.96	0.91	0.87	0.83	0.80	0.78	0.76
<b>Velocity</b>		DISTANCE FROM BREACH												
		0	50	100	150	200	250	300	350	400	450	500	550	600
DEPTH AT BREACH	1.55	2.13	1.40	1.17	1.04	0.95	0.89	0.84	0.80	0.77	0.74	0.72	0.69	0.68
	1.60	2.16	1.42	1.19	1.06	0.97	0.90	0.86	0.81	0.78	0.75	0.73	0.71	0.69
	1.65	2.20	1.44	1.20	1.07	0.98	0.92	0.87	0.83	0.79	0.76	0.74	0.72	0.70
	1.70	2.23	1.46	1.22	1.09	1.00	0.93	0.88	0.84	0.80	0.78	0.75	0.73	0.71
	1.75	2.26	1.48	1.24	1.10	1.01	0.95	0.89	0.85	0.82	0.79	0.76	0.74	0.72
	1.80	2.29	1.51	1.26	1.12	1.03	0.96	0.91	0.86	0.83	0.80	0.77	0.75	0.73
	1.85	2.33	1.53	1.27	1.14	1.04	0.97	0.92	0.88	0.84	0.81	0.78	0.76	0.74
	1.90	2.36	1.55	1.29	1.15	1.06	0.99	0.93	0.89	0.85	0.82	0.79	0.77	0.75
	1.95	2.39	1.57	1.31	1.17	1.07	1.00	0.94	0.90	0.86	0.83	0.80	0.78	0.76
	2.00	2.42	1.59	1.33	1.18	1.08	1.01	0.96	0.91	0.87	0.84	0.81	0.79	0.77

Depth	DISTANCE FROM BREACH												
	0	50	100	150	200	250	300	350	400	450	500	550	600
1.55	1.55	0.68	0.47	0.37	0.31	0.27	0.25	0.22	0.20	0.19	0.18	0.17	0.16
1.60	1.60	0.70	0.49	0.39	0.32	0.28	0.25	0.23	0.21	0.20	0.18	0.17	0.16
1.65	1.65	0.72	0.50	0.40	0.33	0.29	0.26	0.24	0.22	0.20	0.19	0.18	0.17
1.70	1.70	0.74	0.52	0.41	0.35	0.30	0.27	0.24	0.22	0.21	0.19	0.18	0.17
1.75	1.75	0.76	0.53	0.42	0.36	0.31	0.28	0.25	0.23	0.21	0.20	0.19	0.18
1.80	1.80	0.78	0.55	0.43	0.37	0.32	0.28	0.26	0.24	0.22	0.21	0.19	0.18
1.85	1.85	0.81	0.56	0.45	0.38	0.33	0.29	0.27	0.24	0.23	0.21	0.20	0.19
1.90	1.90	0.83	0.58	0.46	0.39	0.34	0.30	0.27	0.25	0.23	0.22	0.20	0.19
1.95	1.95	0.85	0.59	0.47	0.40	0.35	0.31	0.28	0.26	0.24	0.22	0.21	0.20
2.00	2.00	0.87	0.61	0.48	0.41	0.35	0.32	0.29	0.26	0.24	0.23	0.22	0.20

From the above table the depth of water, at 450m from the breach, is 230mm, with the ground floor level of the building being 3.37mODN this is above the flood level at the site ( $2.50 + 0.23$ ) = 2.73mODN

Velocity at the site is 0.81m/sec. This gives a hazard rating of 0.80 (Danger for Some)

### **Boston Borough Council**

In order to inform the process of risk assessment and site selection the Borough Council commissioned Consultants to prepare a Strategic Flood Risk Assessment which has recently been updated in accordance with the provisions of PPS25.

The report has identified that Boston has land in all Flood Hazard categories and ranges from high to low probability of flooding. The degree of flood risk throughout each of the ten study areas has been assessed from a combination of factors, sources of information and engineering judgment. The detailed assessment of flood risk in the study areas is based on the predicted level of risk in 2115, allowing for the impacts of climate change and further detailed information on flooding is available from the Environment Agency.

The proposed development lies within the Boston Town study area includes not only the town centre but extends to include the whole of the built-up area around the town including the suburbs of Skirbeck, Skirbeck Quarter, Wyberton, Chain Bridge and the Marsh lane Industrial Area. The study area has a population of about 37,000 (including Skirbeck and Wyberton) and covers an area of 2,262 hectares (22.6 sq.km), more than six times the size of the next largest study area.

The Environment Agency's Flood Zone Map shows the whole of the area to be in Flood Zone 3a. However the Relative Probability of Flooding, within the SFRA, (Fig. 2.2A - Relative Probability of Flooding Sheet 2 (Inset).) shows the development site to be at a low probability of flooding.

### **Boston Tidal Barrier**

A scheme has been proposed for the construction of a barrage across the Haven close to the Docks within the next five years and this would effectively mitigate this risk. The proposed barrier would protect those parts of Boston upstream of the barrier against tidal flooding in an extreme storm surge event and the proposed scheme includes the improvement of the existing defences through the town where required. On completion of the scheme the barrier will protect Boston Town from a tidal flood event in excess of 0.5%, (1 in 200 years).

## **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 ground floor level of the property being approximately 770mm above the road level along Queens Road, this will not cause any rapid inundation of the property.
- The area is not known to suffer from any groundwater problems.
- 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 than the dwelling and be contained within the confines of the kerb lines.
- 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. There are no known facilities close by which would affect the site.

## **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. The site is shown on the Environment Agency "Risk of Flooding from Rivers and Sea Map" to be at Low Risk.

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

With the risk of flooding being from the sea 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. In the event that the property is occupied there is a communal area at first floor level which would provide a safe haven for the occupants who could safely await rescue or for levels to recede.

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

Flood risk vulnerability classification (see table 2)	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	x	Exception Test required	✓
Zone 3b functional floodplain	Exception Test required	✓	x	x	x

PPS25 Practice Guide states in paragraph 4.42 that change of use should not be subject to the sequential and exception tests but will still need to meet the requirements of a site specific flood risk assessment.

**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 annual sea rise due to climate change is given in NPPF TG and the recommended contingency allowances are stated in Table 4.

**TABLE 4: Recommended contingency allowances for net sea level rises**

	Net sea level rise (mm per year) relative to 1990			
	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
East of England, east midlands, London, south-east England (south of Flamborough Head)	4.0	8.5	12.0	15.0
South-west England	3.5	6.0	11.5	14.5
North-west England, north-east England (north of Flamborough Head)	2.5	7.0	10.0	13.0

2006-2025 = 4mm 19 x 4 = 76mm

2025-2055 = 8.5mm 30 x 8.5= 255mm

2055-2085 = 12mm 30 x 12 = 360mm

2085-2113 = 15mm 28 x 15 = 420mm.

This for the year 2013 will give a general rise for the East of England south of Flamborough Head of 1096mm for the 1 in 200 year event (5.93 + 1.11 = 7.04mODN).

**Table 5: Recommended National Precautionary Sensitivity Ranges for Peak Rainfall Intensities, Peak River Flows, Offshore Wind Speeds and Wave Heights.**

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	+5%	+10%	+20%	+30%
Peak river flow	+10%	+20%		
Offshore wind speed	+5%		+10%	
Extreme wave height	+5%		+10%	

## **INFRASTRUCTURE**

### Surface Water

The surface water from the development will continue to discharge to the existing outlets as there is no change to the footprint of the building

### Foul Water

The foul drainage will continue to discharge through the existing system into the Anglian Water public foul sewers serving the area.

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

## **RECENT FLOOD EVENT**

On the 5<sup>th</sup> December 2013 the East Coast suffered the most serious tidal surge in 60 years, which was reported to be 600mm above the 1953 event. Parts of Boston suffered from overtopping of the defences but Carlton Road however did not suffer any flooding from this event.

## **CONCLUSION**

- The site does have the protection of both tidal and fluvial flood defences which are well maintained by the Environment Agency.
- Following a breach to the defences, the Northern Area Tidal Hazard Maps (2009) for Scenario year 2006 for the 1 in 1000 year event show that the site is within a Hazard Rating area of between 1.25 – 2.0 (Danger for Most). With climate change up to year 2115 the maps show that the site is within a Hazard Rating area of Greater than 2.0 (Danger for All), with a velocity of 0.3– 1.0m/sec and depth of flow 0.5 – 1.0m.
- With the operational times for using this building during normal school term periods to be 9am - 4pm (Monday – Friday), plus an extra hour each way for staff preparation, with no residential use outside these hours, there is little danger to the occupants of the building. If a “Serve Flood Warning” is issued, the school will either remain closed or be vacated until “No Warnings in Force” is issued by the Environment Agency.
- The proposal is the change of use of the building to an independent school over two floors. The existing ground floor level is raised 0.77m above Carlton Road at a level of 3.37mODN, which is considered to be above the predicted flood level following a breach to the tidal defences’ scenario year 2115. With the risk of flooding being from the sea 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.

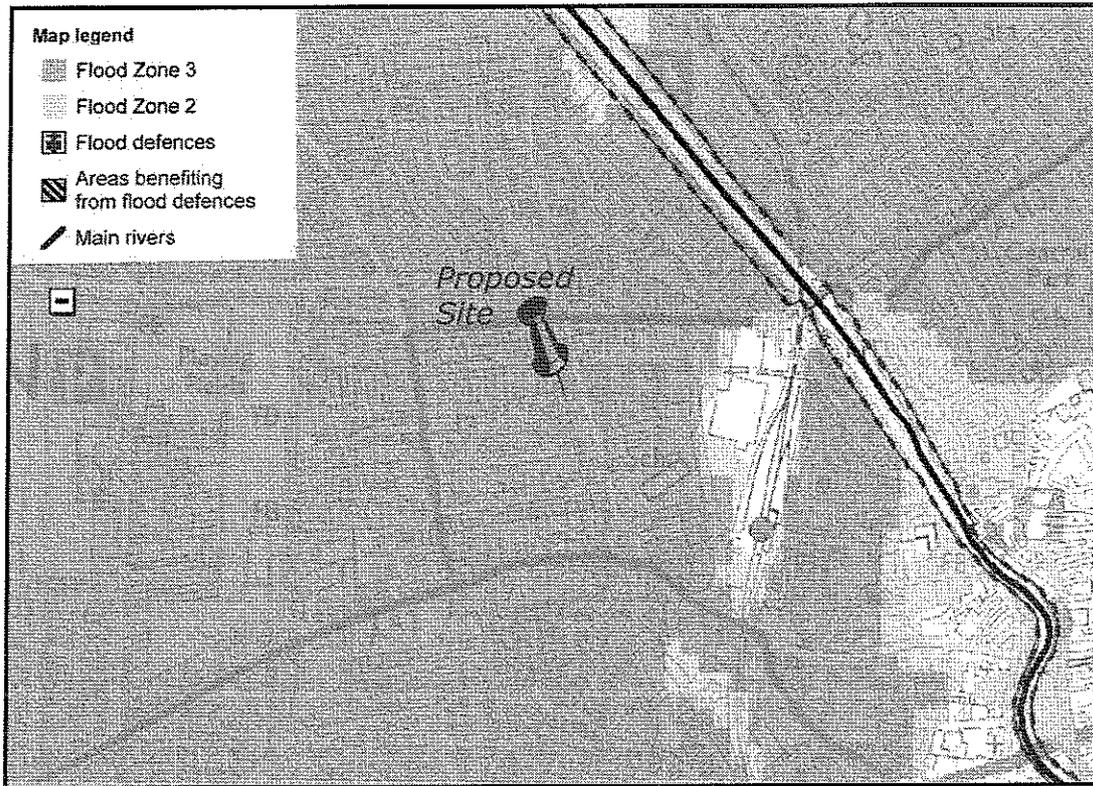
- The occupants of the property will contact the Environment Agency's Floodline on 0845 988 1188 to register the site to receive advance warning of flooding by telephone, mobile, fax, SMS text, email or pager. A flood evacuation plan will be prepared.
- Demountable defences to a height of 600 mm above finished ground floor levels will be implemented to the property.
- The proposed Non-Residential Institutional use falls within the "Less Vulnerable" uses of land as defined in Table 2 NPPF Technical Guide for Flood Risk Vulnerability Classification and the proposed development for is appropriate in Flood Zone 3a Table 1 of NPPF Technical Guide.
- Flooding from other sources is unlikely to affect the site.

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## APPENDIX

Map 1	Extract from Environment Agency Flood Zone Map Extract from Environment Agency Risk of Flooding from Rivers & Sea Map
Map 2	Northern Area Tidal Model Analysis Map
Map 3	Northern Area Tidal Hazard Mapping 2006 –Hazard Map-
Map 4	Northern Area Tidal Breach Hazard Mapping 2115 –Hazard Map-
Map 5	Northern Area Tidal Breach Hazard Mapping 2115 –Depth Map-
Map 6	Northern Area Tidal Breach Hazard Mapping 2115 –Velocity Map-
Map 7	Northern Area Tidal Overtopping Hazard Mapping 2115
Plan 1	Location Plan
Plan 2	Site Plan with Levels

Extract from Environment Agency Flood Map

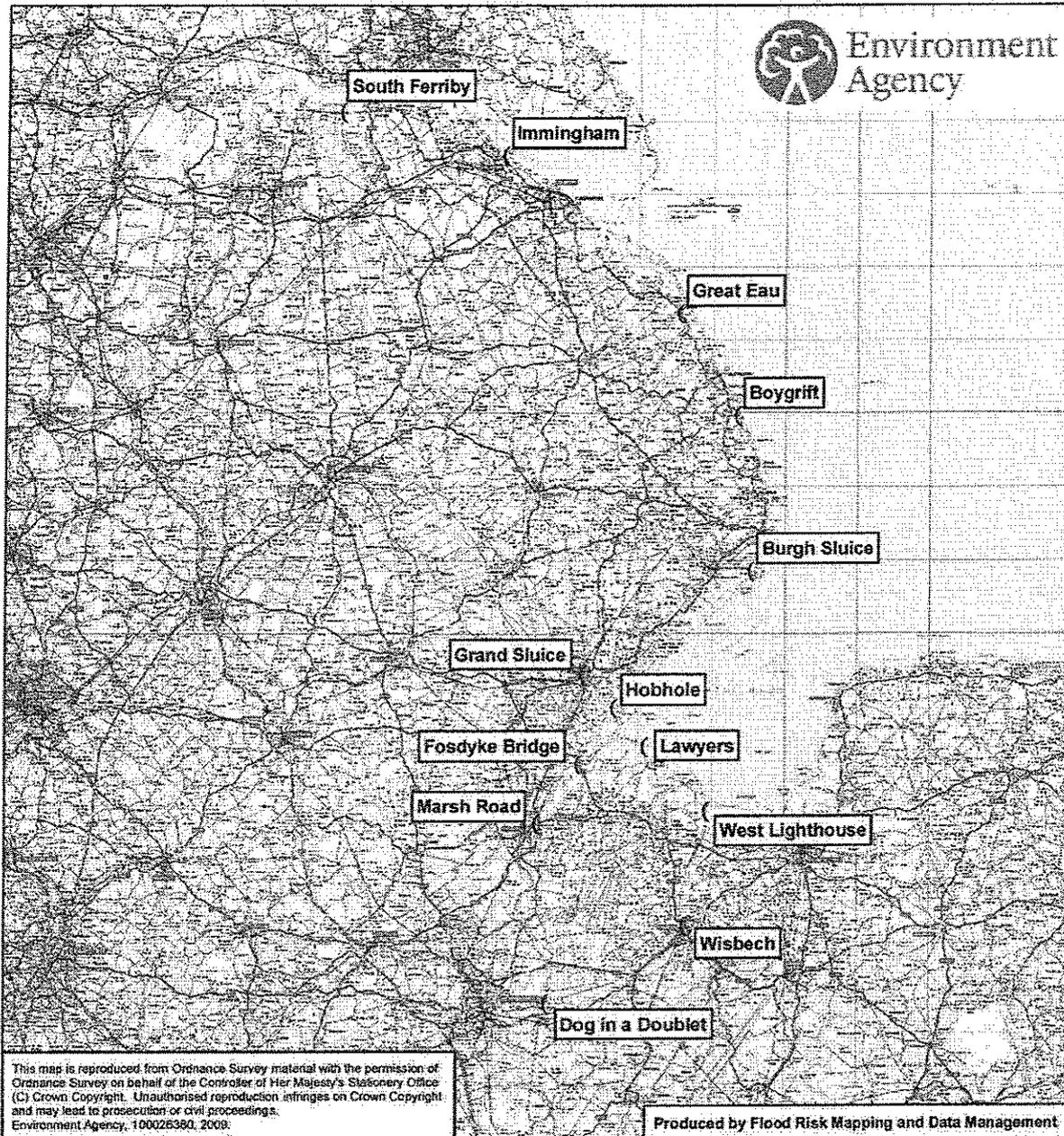


Extract from Environment Agency Risk of Flooding from Rivers & Sea Map



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MAP1

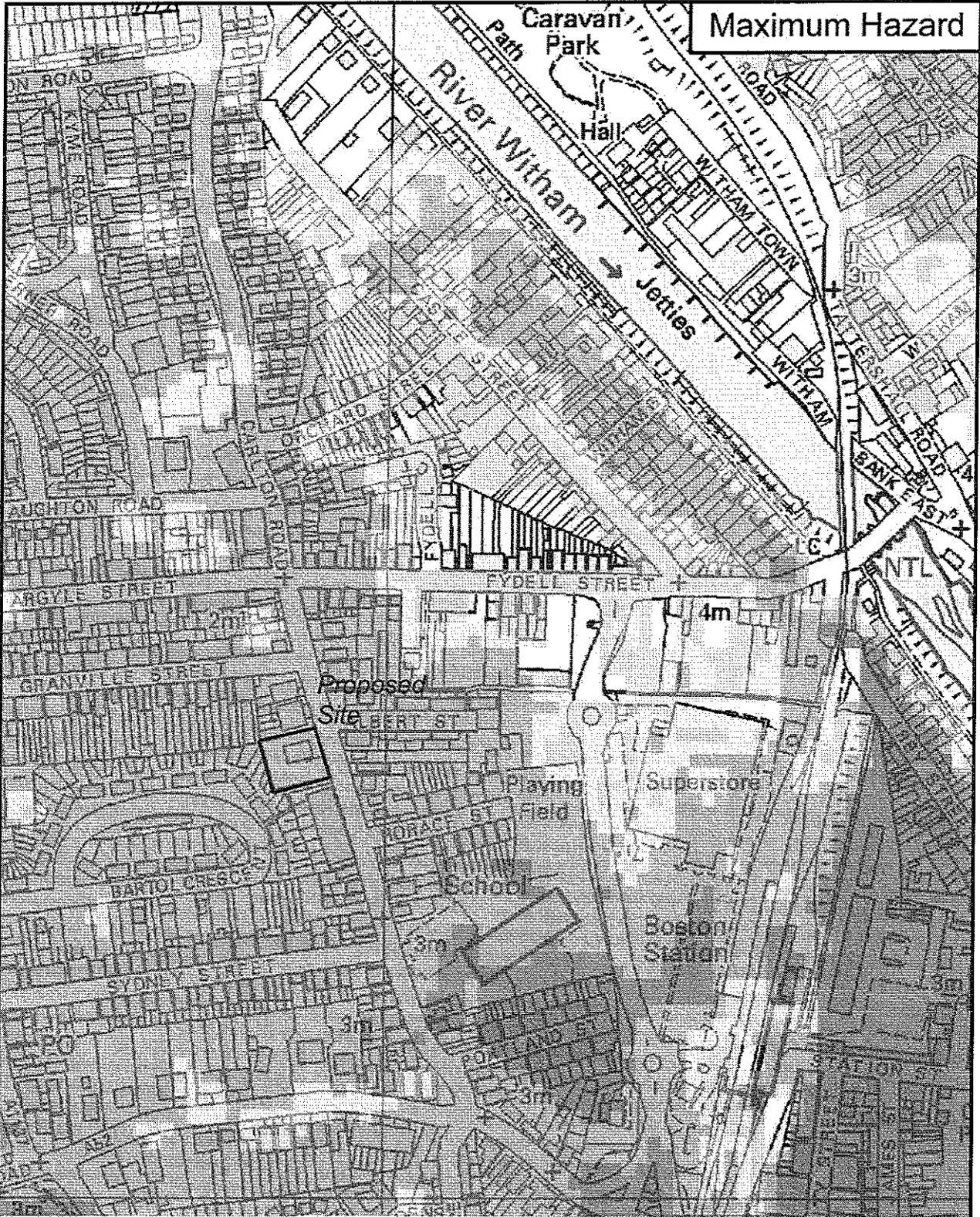


### Tidal Levels mODN - based Northern Area Tidal Model Analysis 2006

Location	Easting	Northing	100% (1 in 1)	10% (1 in 10)	4% (1 in 25)	2% (1 in 50)	1% (1 in 100)	0.5% (1 in 200)	0.1% (1 in 1000)
South Ferriby	498772	421418	4.90	5.29	5.45	~	~	5.55	5.63
Immingham	521381	415464	4.08	4.49	4.65	4.76	4.88	5.05	5.34
Great Eau	545500	393800	3.80	4.19	4.34	4.46	4.57	4.69	4.96
Boygriff	553300	379800	3.84	4.24	4.41	4.53	4.65	4.77	5.05
Burgh Sluice	555190	358620	4.26	4.45	4.63	4.76	4.90	5.03	5.34
Hobhole	536610	339940	4.82	5.30	5.49	5.64	5.78	5.93	6.27
Lawyers	540750	334550	4.84	5.32	5.51	5.66	5.80	5.95	6.29
West Lighthouse	549150	325750	4.88	5.37	5.57	5.71	5.86	6.01	6.38
Grand Sluice	532400	344500	4.88	5.33	5.51	5.65	5.78	5.93	~
Fosdyke Bridge	531700	332200	4.91	5.38	5.56	5.71	5.85	5.99	~
Marsh Road	526000	324000	5.04	5.44	5.60	5.73	5.85	5.98	~
Wisbech	546100	310000	4.83	5.25	5.41	5.53	5.66	5.78	~
Dog in a Doublet	527300	299300	3.67	4.00	4.13	4.22	4.32	4.42	~

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MAP 2



**Maximum Hazard**

Max Hazard		Modelled Breach Locations	
Less than 0.25 (Low Hazard)	[Pattern]	[Pattern]	[Pattern]
Between 0.75 and 1.25 (Danger for Some)	[Pattern]	[Pattern]	[Pattern]
Between 1.25 and 2.0 (Danger for Many)	[Pattern]	[Pattern]	[Pattern]
Greater Than 2.0 (Danger for All)	[Pattern]	[Pattern]	[Pattern]

This map shows the level of flood hazard to people (called a hazard rating) four coastal and two food defence sea scenarios. The hazard rating depends on the depth and velocity of floodwater at different locations. The maps are based on computer modelling of simulated breaches at jetties along the coastline. Each breach has been modelled as if it were a dam and the sea is assumed to breach the dam. Multiple breaches occur over various locations of breaches, or different sized sea surges may affect different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. One coastal defence provides a good standard of food defence but a site of breaching remains. The map does not show the potential consequences of overlapping of the defences. Separate maps of the food defence from overlapping are available. These maps do not replace the food zone maps used in Planning Policy Statement 25 (PPS25). Please contact the Environment Agency for information on how these maps are used in the management of food risk.

General Enquiries No: 03703 853 428.

**Environment Agency**  
 Flood Risk Management & Sea Defences  
 General Enquiries No: 03703 853 428

**Northern Area Tidal Hazard Mapping**

Map created on: Boston

Date Printed	May 2010	Scenario year	2050	Scenario	0.5% (1 in 200)
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<b>Max Hazard</b>		<b>Modelled Breach Locations</b>	
	Less than 0.25		Modelled Breach Locations
	Low Hazard		
	Between 0.25 and 1.25 (Danger for Some)		
	Between 1.25 and 2.0 (Danger for Most)		
	Greater than 2.0 (Danger for All)		
<b>Date Printed:</b>	May 2010	<b>Scenario year:</b>	2115
<b>Scenario:</b>	0.6%	<b>Scenario:</b>	0.6% (1 in 200)

This map shows the level of flood hazard to be expected if sea walls and other flood defences are breached. The hazard rating depends on the depth and velocity of floodwater in different locations. The map is based on computer modelling of simulated breaches at rivers along the coastline. Each breach has been treated as rectangular and the regions combined to create the map. Multiple breaches, other combinations of breaches, or different sized sea surges may give different results.

The map only considers the consequences of a breach. It does not make any assumption about the likelihood of a breach occurring. Our coastal defences provide a good standard of flood defence but a sea of breaches remains.

The map does not show the possible consequences of overlapping of the defences. Separate maps of the flood extent from overlapping sea surges. These maps do not replace the flood zone maps used in Planning Policy Statement 2 (PPS2).

Please contact the Environment Agency for information on how these maps are used in the management of flood risk. General Enquiries No. 01753 650 500.

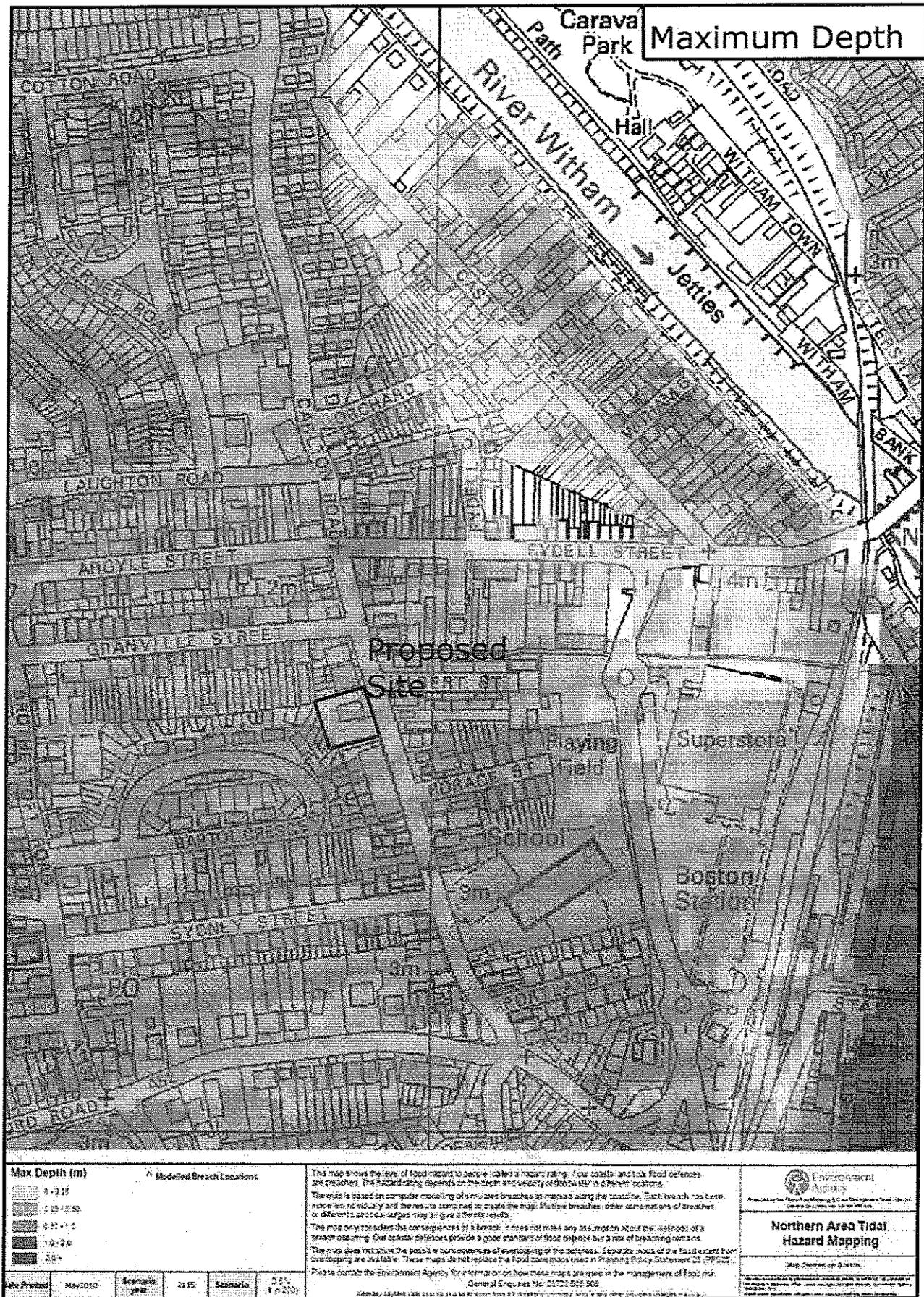
Leaflets, brochures, etc. and information on flood risk services can be found at [www.environmental.gov.uk](http://www.environmental.gov.uk)

Environment Agency  
Produced by the East of England & East Midlands Regional Flood Risk  
Co-ordinating Unit, 1st Floor, 100, High Street, Colchester, Essex, CO1 1JL

**Northern Area Tidal Hazard Mapping**

Map Centre on Boston

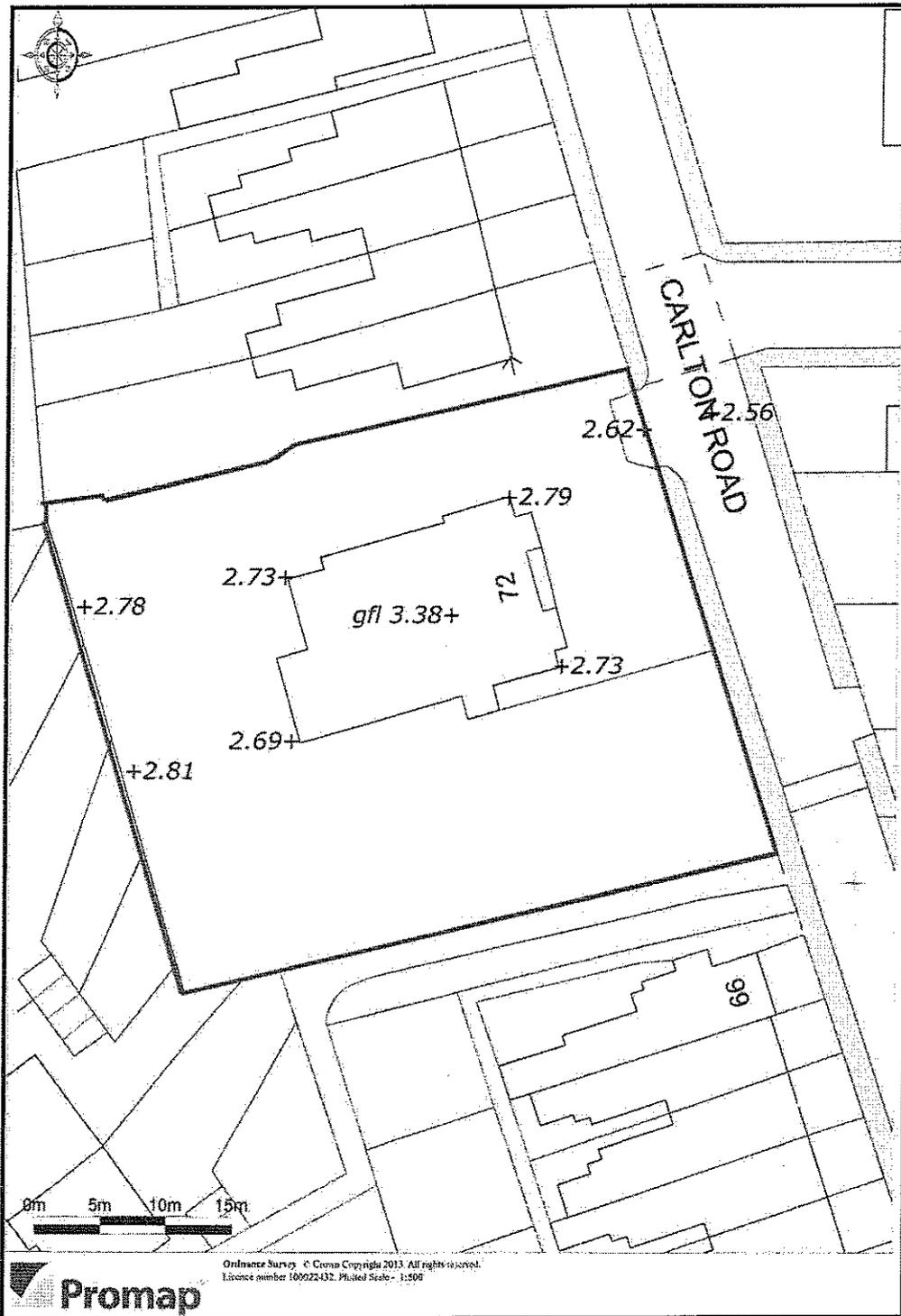
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PLAN 1



PLAN 2

