Humberston Fitties
Flood Risk Assessment

October 2014

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HUMBERSTON FITTIES
FLOOD RISK ASSESSMENT

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HUMBERSTON FITTIES
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1. INTRODUCTION

1.1 Background

Humberston Fitties is a holiday chalet park located on the east coast at the mouth of the Humber estuary, just south of Cleethorpes (refer to Figure 1.1). North East Lincolnshire Council (NELC) is the freehold owner of the park and although the chalets are privately owned, the land is leased from NELC to 320 individual chalet owners. NELC require a Flood Risk Assessment (FRA) for the Humberston Fitties chalet park site to inform decisions on future lease renewals and management of the site.

Figure 1.1 – Location Plan

1.2 Requirements and Format of Report

Although this is not an FRA is the sense that it is being submitted as part of a planning application, the report will be used to inform the council on its lease renewal process and the future management of the site. The report also makes reference to relevant planning documents and guidance, including the National Planning Policy Framework (NPPF) and the accompanying technical guidance.

NELC have asked that the assessment consider a number of key requirements, including:

- the appropriateness of the Closed Season for the chalet park;

- the maximum term of lease that NELC should seek to offer in light of climate change prediction;

- ways of mitigating the risk of flooding, including the provision of a Flood Evacuation Plan.

Section 2 of this report describes the site and the existing flood defences. **Section 3** then assesses the risk of flooding from the tide, both in the present day and in the future, and assesses the seasonality of extreme tides. Although the predominant flood risk is perceived as being tidal, other sources of flood risk are considered in **Section 4**. **Section 5** examines possible mitigation measures, such as the implementation of a Flood Evacuation Plan. **Section 6** draws together the conclusions of the assessment and make recommendations.

Figures, photographs and tables are generally included in or at the end of the relevant sub-section of the report text. The exception is for large sheets, which are marked * in the contents list and are included at the end of the report.

2. HUMBERSTON FITTIES

2.1 History

Humberston Fitties was first developed at the end of the First World War upon reclaimed marshland. It was passed to the council in 1938 and the site has largely been preserved. Although the chalets are privately owned, the land is leased from NELC to 320 individual chalet owners. All the chalets are single story construction, but the size, building material and condition varies widely. Over the years roads have been built around the site, water and electricity supplies have been added and a sewerage system installed. Access to the site is via public road and the site is open to public access.

Practice in recent years has been for NELC to renew leases over short terms so that they all have a common end date of 2021. A planning condition of the site is that it must be closed for 8 consecutive weeks between November and March, during which time the chalets must be unoccupied between 4pm and 9.30am the next morning. As landlords, NELC have chosen January and February to be the Closed Season on the basis that this period is when tidal patterns are thought to be at their most extreme and unpredictable. Also, the chalets are for holiday use and therefore not intended as the owners main or principle residence; this is reinforced by having a Closed Season. In 1996 the area was declared a Conservation Area, which gives NELC greater planning control over the site than otherwise might be the case.

2.2 Description of Flood Defences

Figure 2.1 shows the locations of flood defences at Humberston Fitties that are described below; a summary of these defences is provided in Table 2.1. The primary flood defence is a grass embankment which runs through the Fitties site and the sand dunes along the beach frontage are the secondary defence here.

The site is separated from the sea by a dune system running along the rear of the beach. The total length of the dune system frontage at the site is around 1200m. The level of the dunes is in the range of 6m to 8m OD and they are 40-50m wide and covered with marram grass. The lowest spots are clearly identifiable at those locations where access to the beach is gained; at these access points the grasses which help to stabilise the dunes have disappeared; refer to Photograph 2.1. There are five such access points, the lowest of which is located at the northern end, with a level of around 6m OD.

Rock filled gabions support the toe of the dunes on the seaward side. These have recently been replaced along much of the frontage by NELC on a like for like basis; refer to Photograph 2.2. Various methods are employed by the council to encourage the dunes to accrete. When the sections of the gabions were replaced, there was some evidence that in the past the dunes have been built up using various man-made materials, but nothing that would constitute a formal flood embankment. There is a significant section of frontage where the gabions haven't been replaced and are in poor condition; refer to Photograph 2.3. In some places the original line of gabions has been buried by an increase in the beach level following a rock groyne construction in 1988/89. Here the beach is flatter and wider and the dune system is also at its widest. Where the beach is narrower, groynes are provided to minimise sand movement and undercutting.

Photograph 2.1 – Dune system (secondary defence), showing a typical low spot

Photograph 2.2 – Recently replaced gabions at toe of dunes

Photograph 2.3 – Old gabions in poor condition

At the northern end of the site the dune system gives way to a sea defence wall that provides protection to Thorpe Park (caravan park). At the southern end of the chalet park

is the Yacht Club, the buildings and car parks of which are on high ground. Beyond this is the RSPB's Tetney Marshes nature reserve, an area of intertidal mudflats and saltmarsh. Running along the back of the nature reserve is a flood defence embankment with a crest level of around 5.0 – 5.5m OD.

Heading inland from the dune system, the primary flood defence runs through the Fitties site and is maintained by the Environment Agency. This primary defence consists of a grass embankment, a little over 1200m long and has a crest level of between 4.3 – 4.8m OD; refer to Photograph 2.4. A ditch runs along the landward facing side and flows via the network of agricultural drains to the south of the chalet park. The majority of the chalet park is contained between the sand dunes (secondary defence) and this primary defence. Between the two defence lines, ground levels are generally between 3.0 – 4.0m, although there are some chalets located on a slight ridge of higher ground of around 5.0m OD at the southern end of the site. A small proportion of the chalet park is situated on the landward side of the primary defence and is lower lying with nearly all the chalets below 3m OD. Further inland is the Humberston Fitties Holiday Camp, which is designated for caravan use, and beyond this open farm land.

Figure 2.2 at the end of this section shows ground levels from the LiDAR Digital Terrain Model across the area. Figure 2.3 shows the levels of the primary and secondary flood defences as a longitudinal section.

Photograph 2.4 – Primary flood defence embankment

Table 2.1 – Summary of Flood Defences at Humberston Fitties

Flood Defence Location	Description	Approx. Level
Thorpe Park defence, north of Humberston Fitties	Concrete sea defence wall	6.5 – 7.0m OD
Secondary Flood Defence along Humberston Fitties frontage	Dune system with gabions built into toe of dunes to provide erosion protection	6 – 8m OD
Primary Flood Defence, within Humberston Fitties	Grass embankment with ditch running along western side	4.3 – 4.8m OD
RSPB Tetney Marshes defence, south of Humberston Fitties	Grass embankment	5.0 – 5.5m OD

Note: Flood defence levels are derived from LiDAR, which has an accuracy of +/- 0.15m

Figure 2.1 – Flood Defences at Humberston Fitties

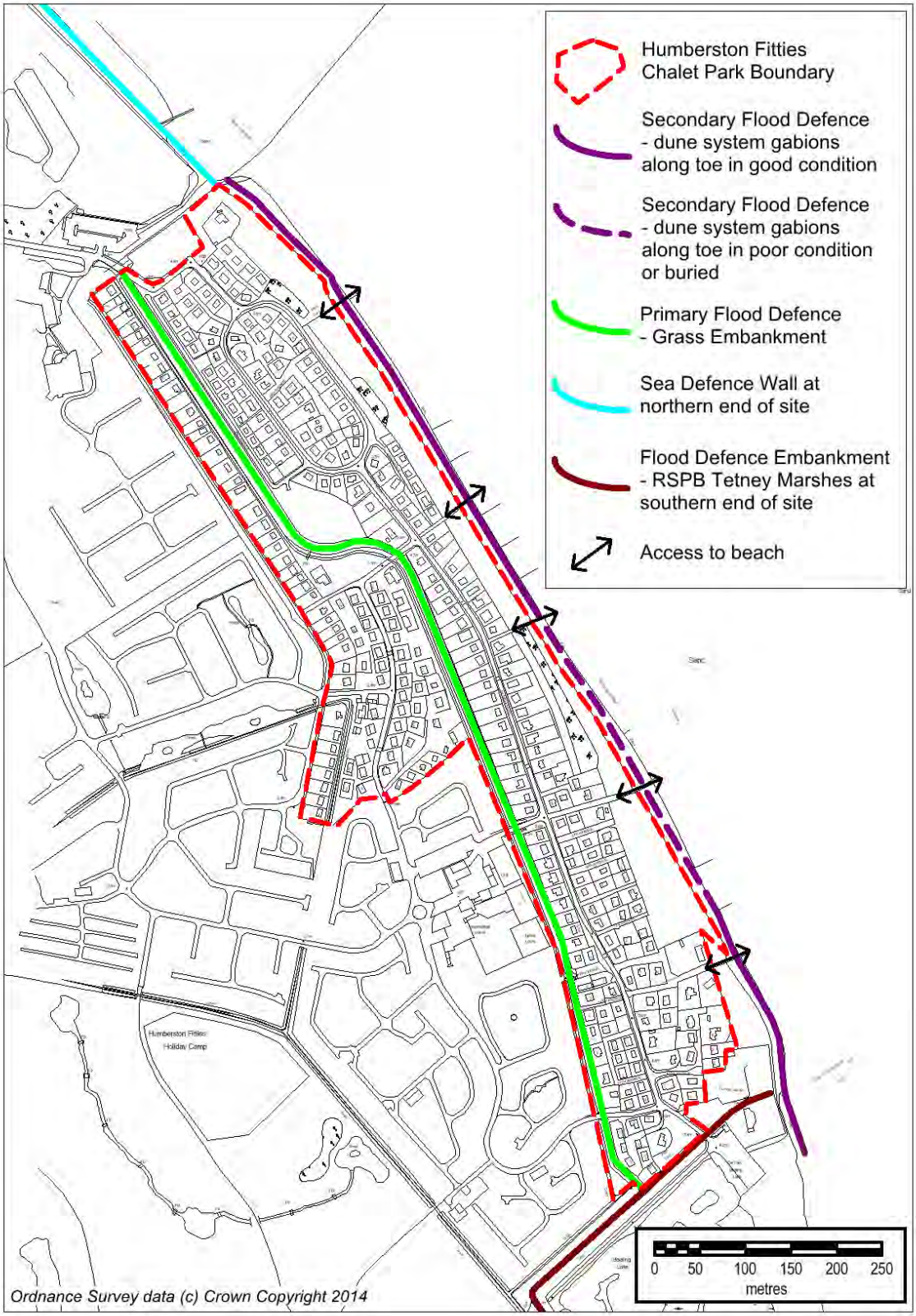


Figure 2.2 – Ground Levels in and around Humberston Fitties

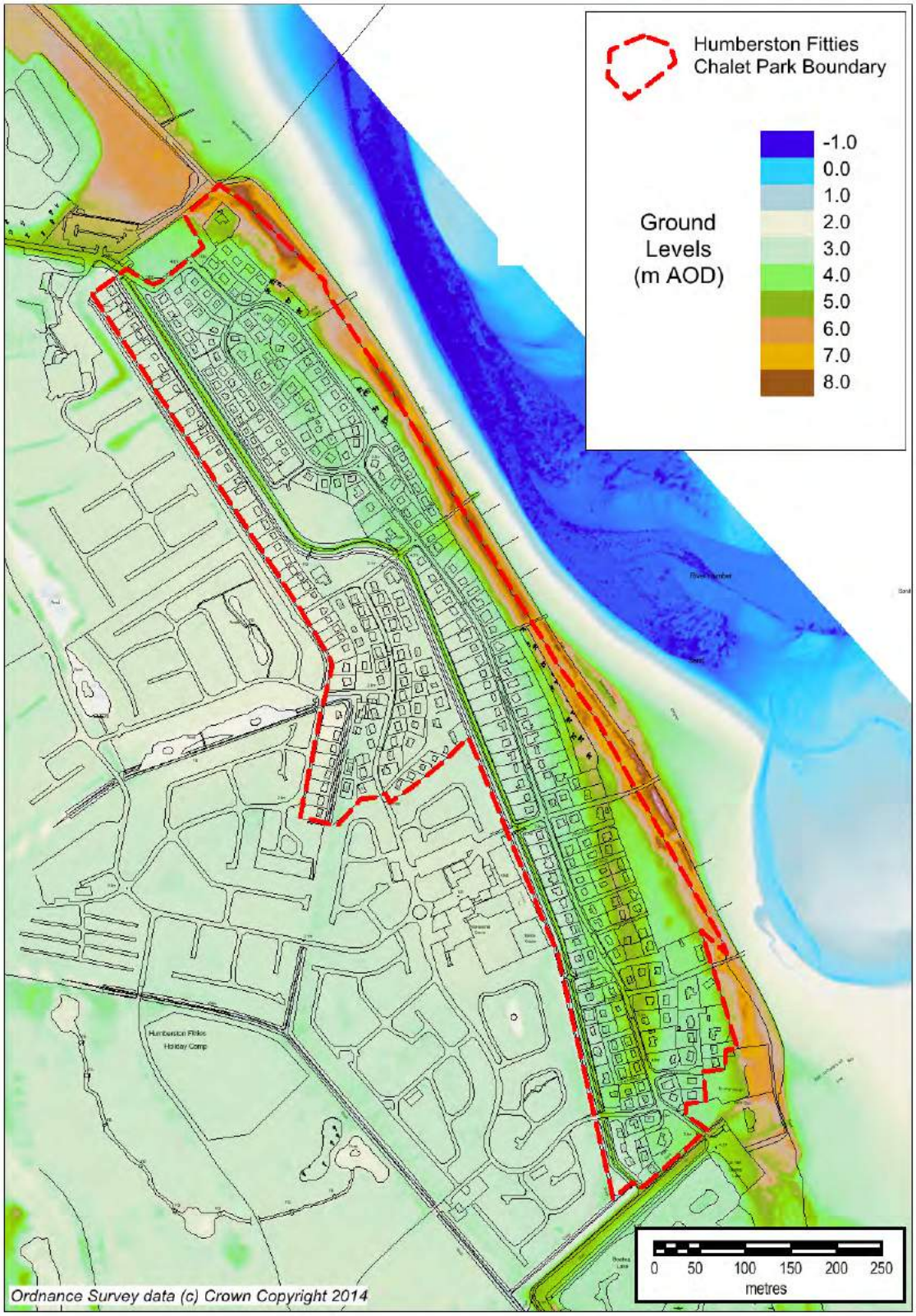
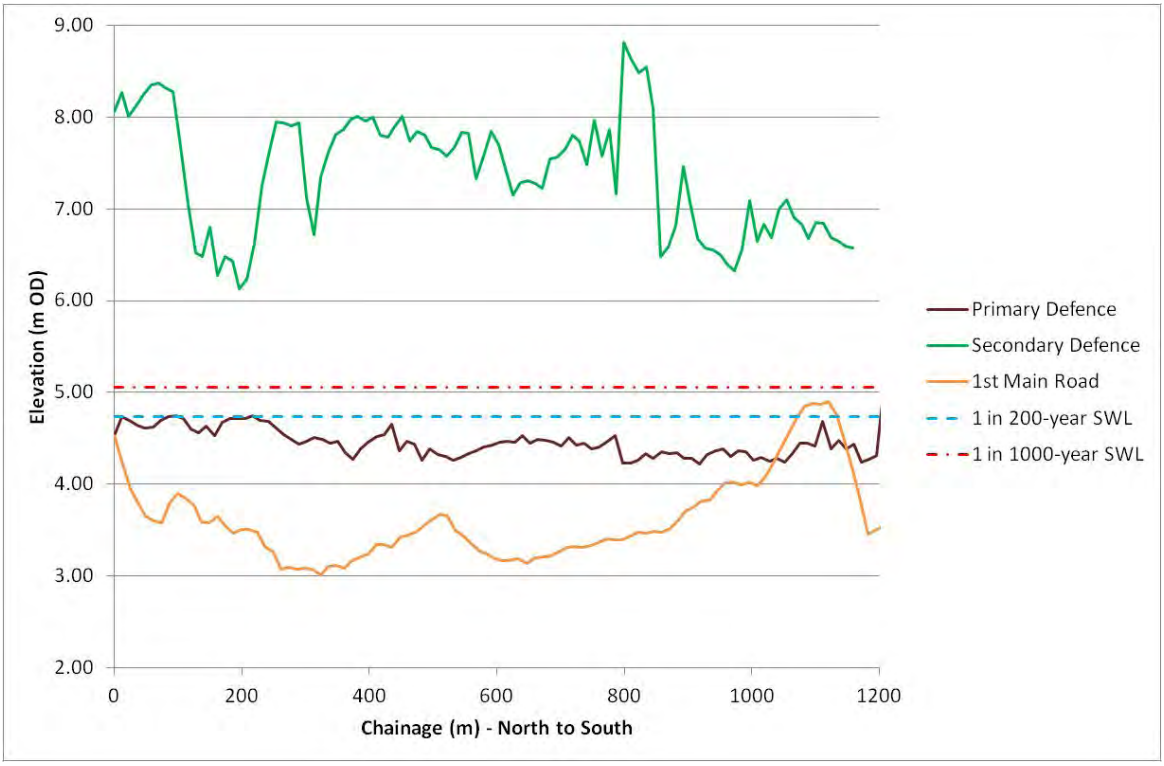


Figure 2.3 – Longitudinal Section of the Flood Defences



2.3 Flood Zones

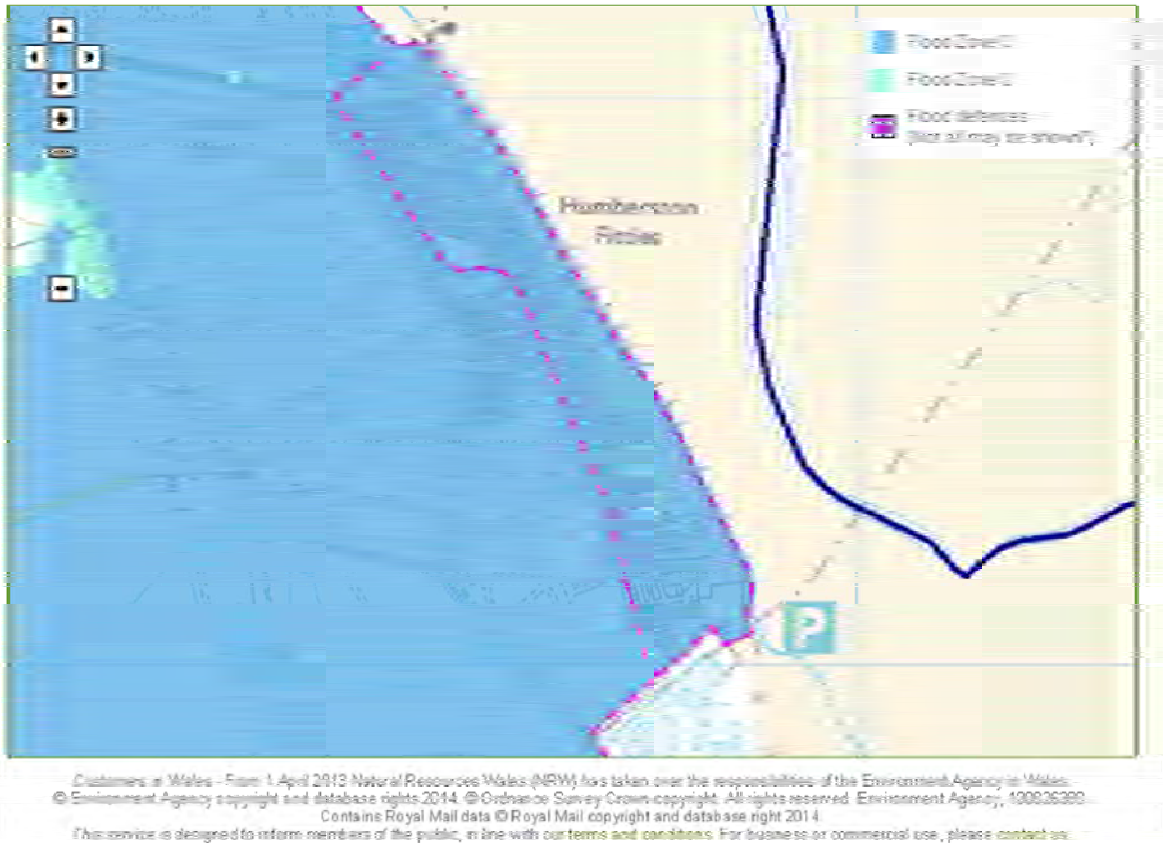
The National Planning Policy Framework (NPPF) defines flood zones as follows:

- Flood Zone 1 – This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding.
- Flood Zone 2 – This zone comprises land assess as having between a 1 in 100 and 1 in 1000 annual probability of river flooding, or between a 1 in 200 and 1 in 1000 annual probability of sea flooding in any year.
- Flood Zone 3 – This zone comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding or a 1 in 200 or greater annual probability of flooding from the sea in any year.

These flood zones ignore the presence of any defences and do not distinguish between defended and undefended areas due to the risks of breaching and overtopping. Figure 2.4 is an extract from the Environment Agency "Flood Map for Planning" and shows effectively all of Humberston Fitties chalet park to be within Flood Zone 3. The NPPF states that highly vulnerable uses should not be permitted in this zone. Highly vulnerable uses include "caravans, mobile homes and park homes intended for permanent residential use".

This flood risk assessment therefore focuses on the 1 in 200 annual probability floods from the sea. Other sources of flooding are considered, but these are of less significance at this site.

Figure 2.4 – Flood Zones at Humberston Fitties Chalet Park



3. TIDAL FLOOD RISK

3.1 Present Day Flood Risk

The latest extreme tide levels were published by the Environment Agency in April 2011[1]. Table 3.1 gives peak tide levels (Still Water Levels – SWL) for a range of extreme tides for the nearest published coastal location to Humberston Fitties. The base year for these values was 2008, so they have been updated here to 2014 levels based on sea level rise [2] of 4mm/yr. It is understood that following the East Coast storm surge in December 2013, the Environment Agency are re-assessing the extreme tide levels in and around the Humber Estuary; this re-assessment may increase the levels given in Table 3.1.

The SWL of the 1 in 200 annual probability tide is 4.74m OD. Referring to the summary in Table 2.1 and Figure 2.3, this is below the crest level of all of the sea frontage, i.e. the secondary defences. The majority of that defence line is also above the 1 in 1000 annual probability tide SWL of 5.05m OD. In this respect the secondary defences will prevent flooding from the still water tide level up to and including a minimum of the 1 in 200 annual chance tide. However, these SWLs do not take account of the waves that will undoubtedly occur in such an event. The generated waves could result in overtopping and breaching of defences. It must be noted that most of the primary defence is well below the 1 in 200 SWL.

Table 3.1 – Extreme Peak Tide Levels

Annual Probability (1 in X)	Peak Tide Level (m OD)
1	3.86
5	4.10
10	4.21
25	4.36
50	4.48
75	4.55
100	4.60
200	4.74
1000	5.05

Note: These extreme peak tide levels are based on data published by Environment Agency in 2011. They are currently under review following the winter storms of 2013/14 and are likely to change.

To consider the risk and consequences of flooding to the site from overtopping or breaching, a hydraulic model has been built. The model is based on the modelling carried out by the Environment Agency along this stretch of coastline for the Northern Area Tidal Modelling project[3,4]. This modelling is carried out using TUFLOW, a 2-dimensional modelling software package, which is able to generate flood depths, velocities and

[1] Coastal Flood Boundary Conditions for the Mainland UK Coasts and Islands (SC060064), Environment Agency, April 2011

[2] Sea level rise based on "Table 4: Recommended contingency allowances for net sea level rise" in Technical Guidance to the National Planning Policy Framework. March 2012; refer also to Table 3.3 in this document.

[3] Northern Area Tidal Modelling – Breach Flood Mapping, Mott MacDonald/Environment Agency, Dec-10

[4] Northern Area Tidal Modelling – Overtopping Flood Mapping, Mott MacDonald/Environment Agency, Dec-10

hazard ratings across the inundated area. Technical detail on the TUFLOW modelling is given in Appendix A.

The hazard rating is a function of the depth and velocity of flood water. People are at risk of death or serious injury once they are unable to stand. As a general rule, an adult is unable to stand in a still depth of flood water of about 1.5m or greater; if the flood water is flowing then this is much less[5]. For example, some people will be at risk with a flood depth of just 0.5m if the velocity is 1 m/s. The hazard rating is calculated using a formula derived to provide a robust reflection of the degree of hazard posed by flooding. The following expression is used:

$$HR = d * (v + 0.5)$$

HR = hazard rating
d = depth of flooding (m)
v = velocity of floodwaters (m/s)

Table 3.2 describes how the hazard rating is categorised to communicate the degree of risk.

Table 3.2 – Hazard to People as a Function of Velocity and Depth[6]

Hazard Rating	Degree of Flood Hazard	Description
<0.75	Low	Caution: *"Flood Zone with shallow flowing water or deep standing water"*
0.75 – 1.25	Moderate	Dangerous for some (i.e. children): *"Danger: Flood zone with deep or fast flowing water"*
1.25 – 2.50	Significant	Dangerous for most people: *"Danger: flood zone with deep fast flowing water"*
>2.50	Extreme	Dangerous for all: *"Extreme danger: flood zone with deep fast flowing water"*

The modelling has been refined to make it site specific to Humberston Fitties. The grid on which TUFLOW operates has been updated using 0.25m horizontal-resolution LiDAR (flown Dec-11 to Mar-12) and the model grid size reduced from 20m to 4m. The Environment Agency has confirmed that the LiDAR has been ground-truth surveyed and has an accuracy of +/-0.15m (standard accuracy for flown LiDAR). More details of the TUFLOW modelling are provided in Appendix A.

(a) Wave Overtopping

Wave overtopping calculations were carried out by the Environment Agency as part of the Northern Area Tidal Modelling project. This is the most recent and best available

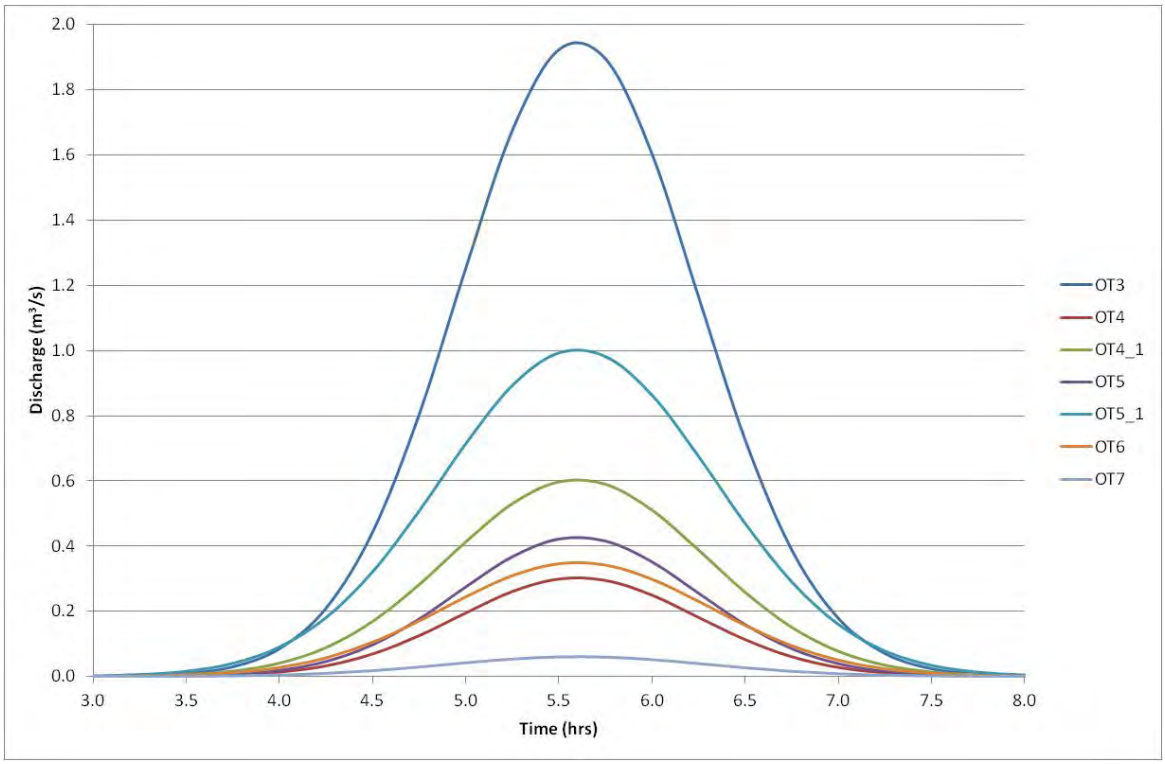
[5] R&D Outputs: Flood Risk to People – Phase 2 (FD2321/TR2 Guidance Document), Environment Agency & Defra, March 2006
[6] Taken from Table 3.2 of R&D Outputs: Flood Risks to People – Phase 2 (FD2321/TR1), Environment Agency & Defra, March 2006

information on wave overtopping discharge rates for this section of coastline. Although extreme tide levels have been marginally adjusted downwards since this work was carried out (from 4.89m OD to 4.74m OD for the 1 in 200 annual probability tide), confidence limits on current predicted extreme tide levels are given as +/-0.2m. The adjustment to tide levels is therefore within this range and so the discharge rates provided remain realistic.

The boundaries conditions have therefore been taken directly from the Northern Area Tidal Model and applied to the refined Humberston Fitties model. The calculation of overtopping discharge rates is based on 1 in 1 annual probability wave heights and it is assumed that these wave conditions occur for a full 12 hour tidal cycle. The coastline is divided into reaches and the discharge rates calculated along each reach at nine different times through the tidal cycle to derive inflow hydrographs to the model. The inflow hydrographs to the model are shown in Figure 3.1 (for reaches OT3 to OT7) and Figure 3.2 (for reaches OT8A to OT8D). These show that the overtopping of defences is typically only significant for around 2 – 4 hours at the peak of the tidal cycle. It will be noted that the overtopping rates for reaches OT8C and D are significantly higher than others, and OT8B is also high; this is due to the lower ground levels through those areas. The division of defences into reaches and the peak discharge across each reach is shown in Figure 3.3.

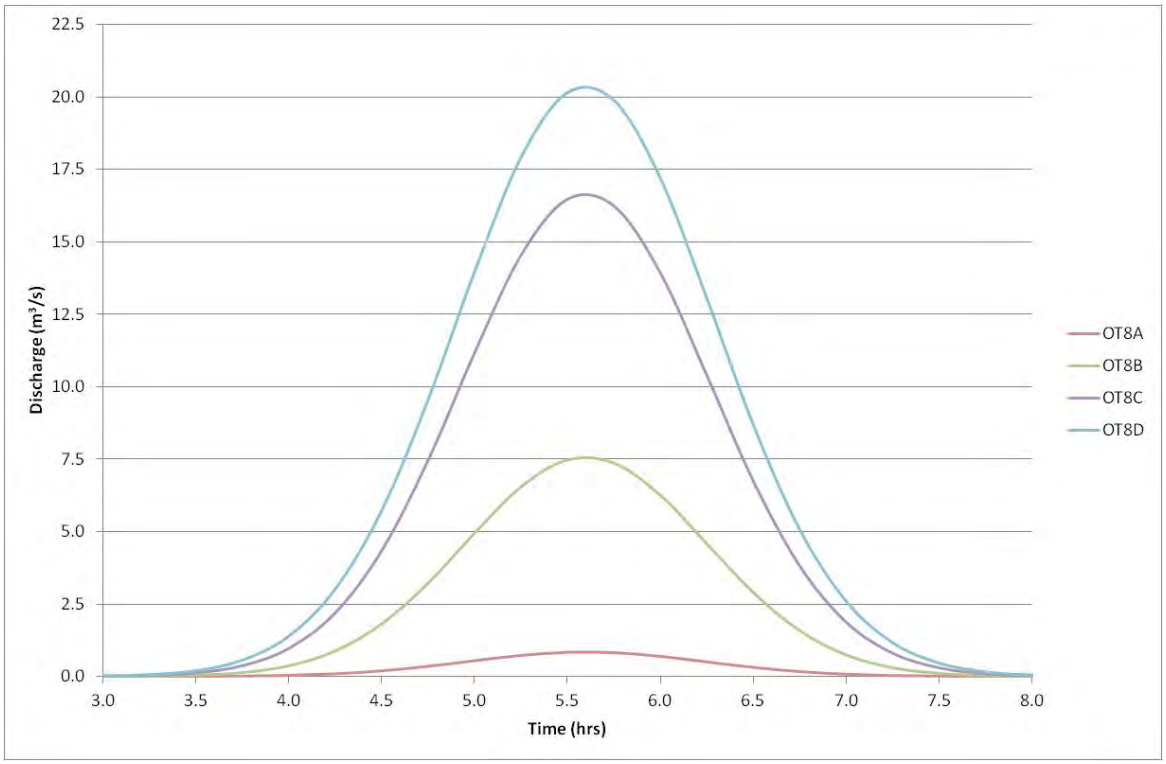
Although the flood defence did not overtop along the chalet park sea frontage during the storm surge on 5th December 2013, it did get close. A slipway in the dunes located midway along the Humberston Fitties frontage acted as a ramp for the swell breaking against the dunes to run up. Fortunately, there was an offshore wind and so the waves generated during the surge were not as large as they might otherwise have been.

Figure 3.1 – Present Day Overtopping Discharge Hydrographs (OT3 to OT7)



Note: Overtopping discharges based on 1 in 200 annual probability tide with 1 in 1 annual probability waves; refer to Figure 3.3 for location of reaches.

Figure 3.2 – Present Day Overtopping Discharge Hydrographs (OT8A to OT8D)



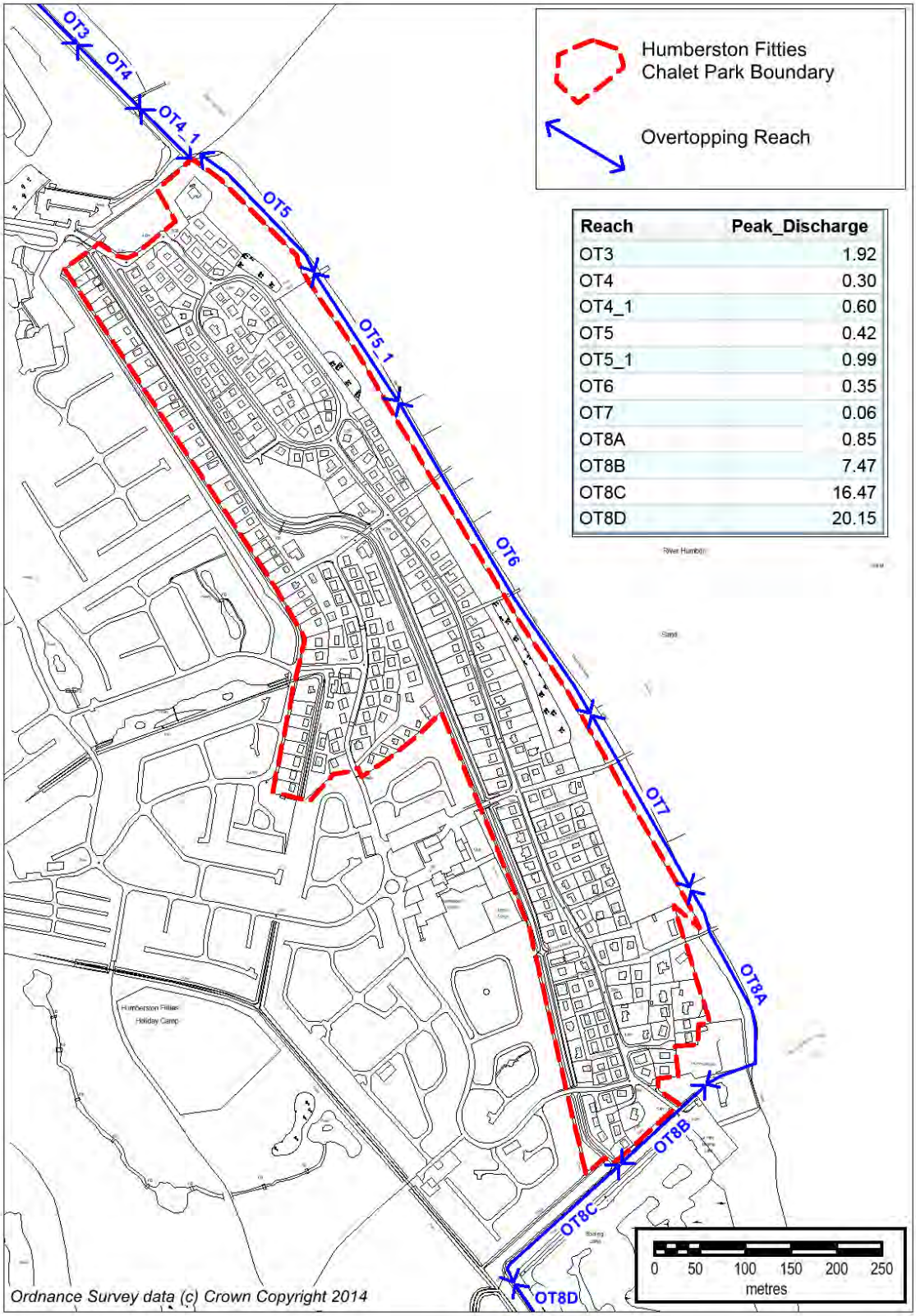
Note: Overtopping discharges based on 1 in 200 annual probability tide with 1 in 1 annual probability waves; refer to Figure 3.3 for location of reaches.

The resulting maximum flood depths, velocities and hazard ratings across the Humberston Fitties chalet park is shown in Figure 3.4*. This shows much of the site to be flooded in excess of 0.5m. Those properties with the largest flood depths generally back onto the seaward side of the inland primary defence and are flooded to a depth of around 1.3m. Peak flood levels across the majority of the site are between 3.9 – 4.0m OD. At the very southern end of the chalet park overtopping occurs from two sides, and flood levels reach around 4.4m OD. On the landward side of the primary defence, water levels are much lower due to the protection afforded by the embankment, however overtopping of the Tetney Marsh defences to the south cause flooding in this area of the chalet park, albeit to much lower flood depths of 0.20 – 0.45m.

The velocity of the flood water across the site is generally less than 0.3 m/s. The highest velocities are recorded along the seaward side of the primary defence, which peaks at between 0.5 – 0.9 m/s.

The hazard rating categorises much of the site as being “danger for most”, which is mainly due to the flood depth being in excess of 1m. The area of the chalet park to the landward side of the primary defence is categorised as “low hazard” or “danger to some” because of the shallower flood depths. There are a few isolated pockets where the hazard is increased to “danger to most”, which reflects deeper flood water where the chalets are on particularly low ground. There are around a dozen properties which sit on a ridge of high ground and are not flooded as a result.

Figure 3.3 – Peak discharge rates for individual defence sections



Reach	Peak_Discharge
OT3	1.92
OT4	0.30
OT4_1	0.60
OT5	0.42
OT5_1	0.99
OT6	0.35
OT7	0.06
OT8A	0.85
OT8B	7.47
OT8C	16.47
OT8D	20.15

Notes:

1) *Peak discharge rates are given in m^3/s.*
2) *OT3 extends to the north-west and OT8D extends 220m to the south-east.*

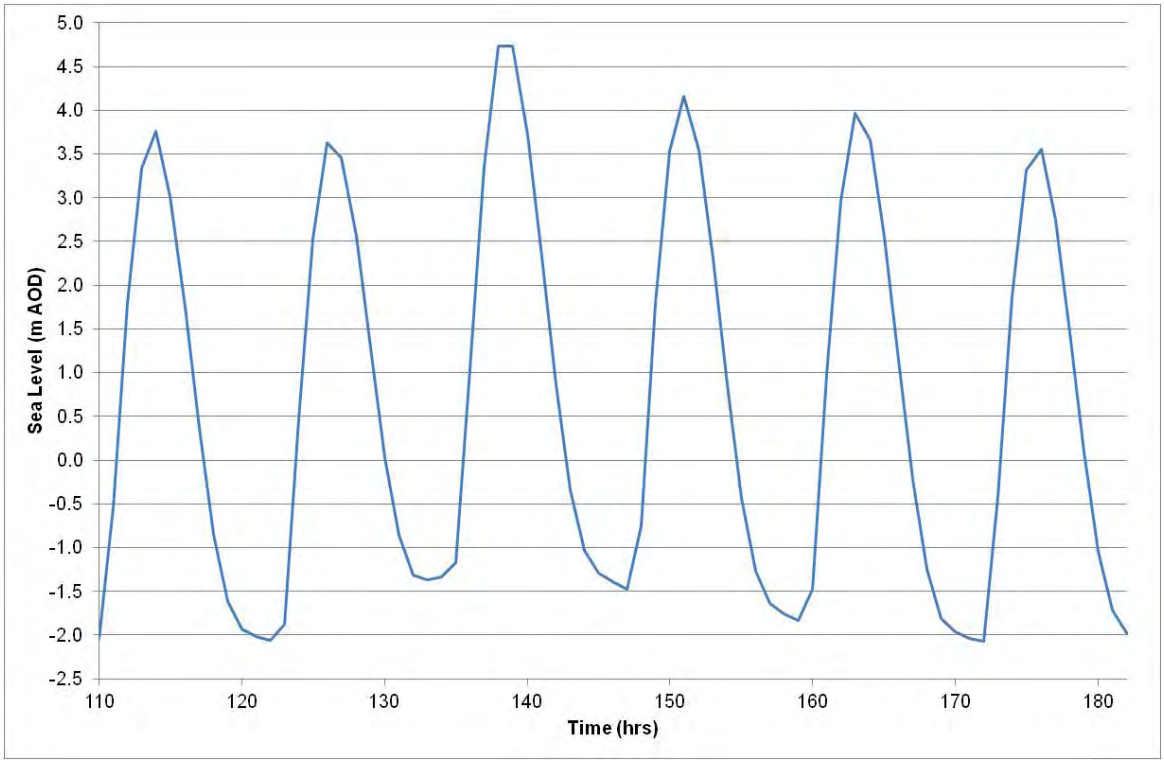
(b) Breach

Saturation and sand movement due to extreme tide levels and wave overtopping could result in the dunes being washed away and the gabions along the toe of the dunes could be undermined and destroyed. Assessing the actual probability of a breach occurring is difficult to do with any degree of confidence, but there is a risk, and that risk is greater in more extreme events.

Although flood defences around the country on the whole withstood the battering from the storm surges through the winter of 2013/14 and the flooding that resulted was less than the comparable storm surge of 1953, the destructive power of the sea was still evident with significant damage caused in some locations. The secondary flood defence was not breached during the storm surge, but damage was caused to the dunes and gabions. A breach did occur in the flood defence embankment further to the south, although the resulting flooding did not extend far enough to affect the chalet park.

The Northern Area Tidal Modelling project applied a 200m wide breach, with the dunes reduced to ground level behind the defence (3.54m OD). The same scenario has been tested for this flood risk assessment. The model is run for 72 hours, which is regarded by the Environment Agency as a realistic timescale for the duration between a breach occurring and its closure. The modelled breach starts two tidal cycles before the peak tide. Figure 3.5 shows the tidal cycle applied to the model.

Figure 3.5 – 1 in 200 annual probability tidal cycle



The resulting maximum flood depths, velocities and hazard ratings across the Humberston Fitties site is shown in Figure 3.6. This shows the severity of flooding resulting from a breach to be much greater than that resulting from overtopping. The majority of the site on the landward side of the inland primary defence is flooded to deeper than 1.0m and parts are deeper than 2.0m, with only the higher ground at the southern end of the chalet park showing shallower flood depths. The flood level reaches

4.77m OD in the area to the north of the breach and is highest, at around 4.85m OD, opposite the breach itself. The peak water level in the southern area is 4.56m OD.

The primary defence is extensively overtopped with a typical flood depth of 0.2m above the embankment crest. The water levels on the landward side of the primary defence are lower at 3.48m OD as the floodwater is able to spread further. As a result flood depths are generally lower in the range of 0.7 – 1.0m, but there are still many low lying chalets for which the flood depth exceeds 1.0m. The flooding to the adjacent caravan sites and other land is correspondingly worse.

The velocities across the site are also higher, generally in the range of 0.3 – 1.0 m/s on both sides of the primary defence. The result is that almost all of the chalets fall into the "danger for most" category and a significant proportion of the site is categorised as "danger for all".

(c) Sensitivity

Due to the inherent uncertainties of some of the parameters used, a number of sensitivity tests have been carried out to assess how this might impact on the assessment of flood risk and its consequences.

The dunes which form the main frontage of the Humberston Fitties chalet park are far from uniform, in terms of width and crest level. Sensitivity to overtopping discharge rates have therefore been tested by increasing and reducing the rates by 20%. The impact of this on flood hazard is shown in Figure 3.7*. The results show that regardless of increasing or decreasing the overtopping discharge rates, there is little change in the hazard rating banding across the site. Even when the overtopping discharge rate is reduced by 20%, there are still significant areas shown to be "danger for most".

The breach model has a wider range of parameters to consider. The sensitivity tests carried out and the analysis of the results follows:

1) The impact of changing the timing of the breach has been tested. The original model shows the impact of the breach occurring two tidal cycles before the peak tide. In the test scenario the breach occurs on the rising limb of the peak tide. The duration of the breach is maintained as 72 hours. The result of this change show negligible changes to the extent and depth of flooding; the model is therefore not sensitive to the timing of the breach. No separate Figure has been produced.

2) Confidence limits for peak SWL extreme tide predictions are given as +/- 0.2m at Humberston Fitties. The impact of these confidence limits on flood risk has therefore been tested by adjusting the levels through the tidal cycle accordingly. Figure 3.8* shows the impact on hazard ratings when these confidence intervals are applied.

   Increasing peak SWL by +0.2m results in little change on the seaward side of the primary defence and water levels are increased by less than 0.1m. On the landward side of the primary defence, flood depths are increased by around 0.3m, which results in most of the area having a "danger for all" hazard rating. The ridge of high ground at the southern end of the chalet park remains free of flood water.

Applying the -0.2m confidence interval to peak SWL gives little discernible reduction on the proportion of the site classed as "danger for most". Whilst the area of "danger for all" is slightly reduced it is still significant. The hazard to other sites is noticeably lower in this scenario.

3) The breach model applies a uniform roughness of 0.05 (using Manning's 'n'). Roughness has been reduced by 20% to 0.04 (making flow easier) to assess the sensitivity of the model to roughness. The result is that flood depths change very little and there is a slight increase in velocities, but not enough to significantly change hazard ratings across the chalet park; the model is therefore not sensitive to the roughness applied. No separate Figure has been produced.

4) The original breach model uses a 200m wide breach. This was used in the Northern Area Tidal Modelling project on the basis that the Humberston Fitties defence is an earth embankment. The reality is that the defence line is sand dunes with gabions along the toe. The model has therefore been tested for a reduced breach width of 50m. The narrower breach results in flood levels around 0.1m lower on the seaward side of the primary defence and around 0.3m lower on the landward side. As shown in Figure 3.9*, although the main impact on the hazard rating across the chalet park is to reduce the area which is shown as "danger for all", nearly all of the site remains in the "danger for most" category.

5) The model has finally been tested to investigate what happens when a breach is applied to the primary defence embankment. This would be most likely to occur as a result of a breach in the sand dune defences, where flow passes straight through and strikes the grass embankment. A 50m breach has been therefore been included at the nearest point in this defence, with the defence taken down to ground level. The results of this are also shown in Figure 3.9* for comparison with the initial breach scenario. This second breach has no discernible impact on the hazard rating across the site on the seaward side of the primary defence. It results in an increase of the area of "danger for all" on the landward side. This is caused by the flood depth being increased by around 0.1m and higher velocities (particularly near the breach itself).

(d) Summary

Both overtopping and breach scenarios have been run through the model to explore the flood risk to the Humberston Fitties chalet park in a 1 in 200 annual probability tide. In both cases a significant proportion of the site is classified at "danger for most". In the breach scenario, all but the ridge of high ground at the southern end of the chalet park falls into this category and a large proportion is classified as "danger for all".

The high hazard ratings across the chalet park are principally a result of the flood depths being in excess of 1m. The primary defence to the rear of the chalet park actually exacerbates flood depths by preventing flood water from dissipating until it is overtopped, thus in any breach scenario the minimum flood depth is likely to be the lowest crest level of this defence, which is around 4.4m OD.

Testing various parameters shows that the model has little sensitivity to changes and the hazard ratings remain broadly unchanged, indicating a significant danger of serious injury to people and loss of life.

3.2 Future Flood Risk

As a requirement of the FRA, B&V have been asked to consider climate change up to the year 2055. Climate change is leading to sea level rise and is also expected to increase storminess, both of which can be expected to result in larger waves. Climate change guidance from NPPF is shown below in Table 3.3.

Table 3.3 – Climate Change Guidance

Parameter	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Extreme Wave Height	+5%		+10%	
Sea Level Rise (mm/yr)	4.0	8.5	12.0	15.0

The Northern Area Tidal Modelling project considered the impacts of climate change on wave overtopping and breaches for the year 2115, but not for the intervening years.

(a) Wave Overtopping

In the Northern Area Tidal Modelling project the increase in wave overtopping discharge rates were calculated based on the increased depth of water at the toe of the defences resulting from predicted sea level rise to 2115. It has therefore been necessary to adjust the discharge rates to reflect sea level rise up to the year 2055 only.

This has been done by interpolating between the two calculated discharge rates, based on sea level rise. By 2055, the sea level is estimated to rise by 0.30m, compared to 1.11m by the year 2115. Sea level rise by the year 2055 is therefore 27% of the total sea level rise to 2115. This factor has been applied to the calculated overtopping discharge rates for 2115 to give an estimate of discharge rates in 2055. The revised peak overtopping discharge rates for each section of defence are given in Table 3.4, with the present day discharge rates for comparison. This shows that that are large increases in overtopping rates compared to the present day. The flood model was re-run with the 2055 discharge rates and the results are shown in Figure 3.10*.

Table 3.4 – Peak Overtopping Discharge Rates

Reach	Peak Overtopping Discharge Rates (m^3/s)	
	2014	**2055**
OT3	1.92	26.4
OT4	0.30	4.56
OT4_1	0.60	7.95
OT5	0.42	3.08
OT5_1	0.99	3.09
OT6	0.35	14.6
OT7	0.06	5.72
OT8	44.8	381

Notes:

1) *Refer to Figure 3.1 for location of each reach of defence.*
2) *OT8 is split into four reaches for the present day overtopping discharge rate calculations; the sum of the discharge rates is given above.*

As sea levels increase, so the overtopping discharge rates rapidly increase. These increases are not straightforward due to the complexities and interdependencies of wave overtopping variables. The result is that flood depths, velocities and consequently hazard ratings across the chalet park increases substantially compared to the present day. Almost all of the chalets are flooded to a depth in excess of 1m and a significant proportion of the site now shows peak velocities in the range of 0.3 – 1.0 m/s. The result is that nearly the entire site is shown as having a hazard rating of "danger to most", with a significant proportion rated as "danger for all.

(b) Breach

Using the sea level rise rates from Table 3.3, climate change is expected to raise the sea level by 44mm by 2025 and by 300mm by 2055. This gives 1 in 200 annual probability tide levels of 4.79m OD and 5.04m OD respectively. The increases in sea levels have been applied to the tidal boundary and the breach model re-run. The results are shown in Figures 3.11* and Figure 3.12*.

There is very little difference between the breach flood mapping for 2025 and for the present day (shown on Figure 3.6*). This is as expected given the predicted sea level rise is only 50mm.

There is, however, a significant impact when looking to the year 2055. On the seaward side of the primary defence, the chalet park flooding is around 0.1m deeper, which results in a slightly larger extent falling into the "danger for all" hazard rating. On the landward side of the primary defence the change is more significant. The higher sea levels results in higher overtopping rates across the primary defence, the result being an increase in flood depths of nearly 0.5m, which result in much of this area falling into the "danger for all" hazard rating.

(c) Summary

In the short term, over the next 10 years or so, sea level rise resulting from climate change will have little impact on the probability and the consequence of flooding compared to the present day. However, looking in the longer term, over the next 40 years to 2055, the probability of flooding to Humberston Fitties will increase as will the consequences of that flooding. Increased wave overtopping discharge rates will mean that nearly all the site is classed as "danger for most" or worse and, in the event of a breach, the majority will be classified as "danger for all".

3.3 Seasonality

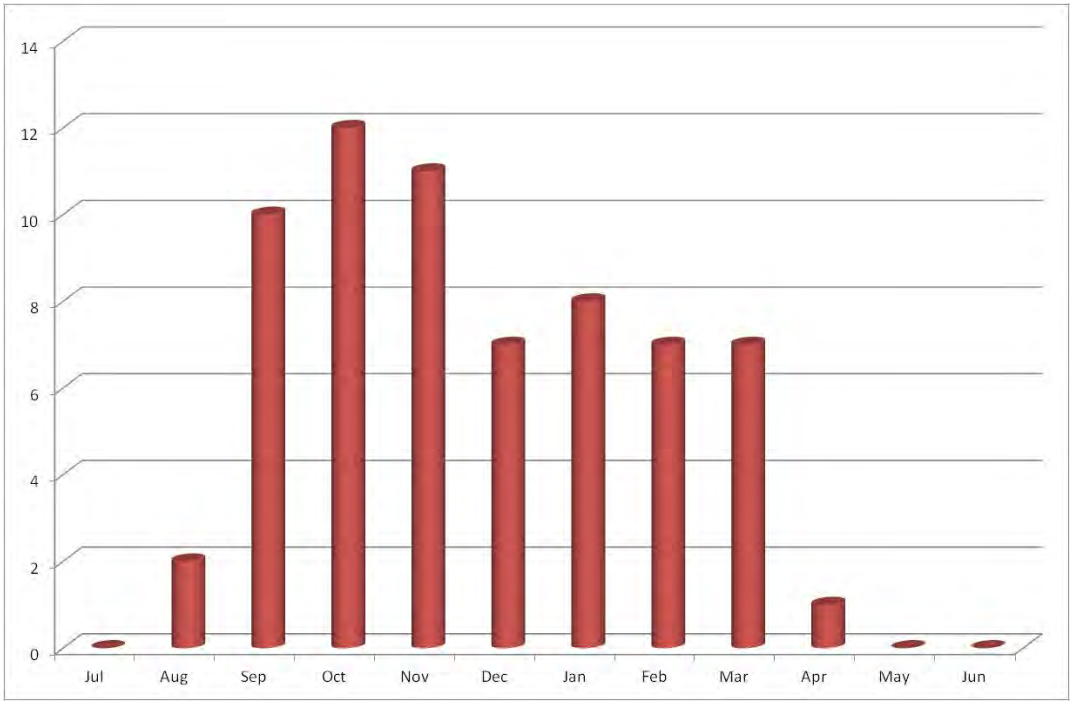
Humberston Fitties chalet park is presently closed each night throughout January and February, between the hours of 4pm and 9.30am the next morning. One of the reasons for this Closed Season is to mitigate for flood risk during a period when the storminess and unpredictability of the weather is thought to be at its greatest. B&V have been asked to assess the seasonality of storm surges and whether this reflects the current Closed Season, or whether alternative arrangements should be considered.

Analysis of tidal data has been carried out using records dating back to 1956 (58 years) from the Immingham tidal gauge. This is a Class A gauging station and forms part of the national tidal gauge network. This analysis considers two sub-sets of tide records and their intersection, namely:

- Tides exceeding the Highest Astronomical Tide (HAT)
- Tides affected by storm surge
- Tides which exceed HAT due to the effects of storm surge

The Highest Astronomical Tide (HAT) for any location is the highest tide predicted to occur without effects from variations in atmospheric conditions; HAT for Immingham is 4.1m OD. Figure 3.13 shows the monthly distribution of tides with a peak occurring above this level. This shows that 7 or more tides per month exceeding HAT have been recorded in the months from September through to March, with the highest number occurring in October.

Figure 3.13 – Number of Peak Tide Levels above HAT per month (1956-2014)

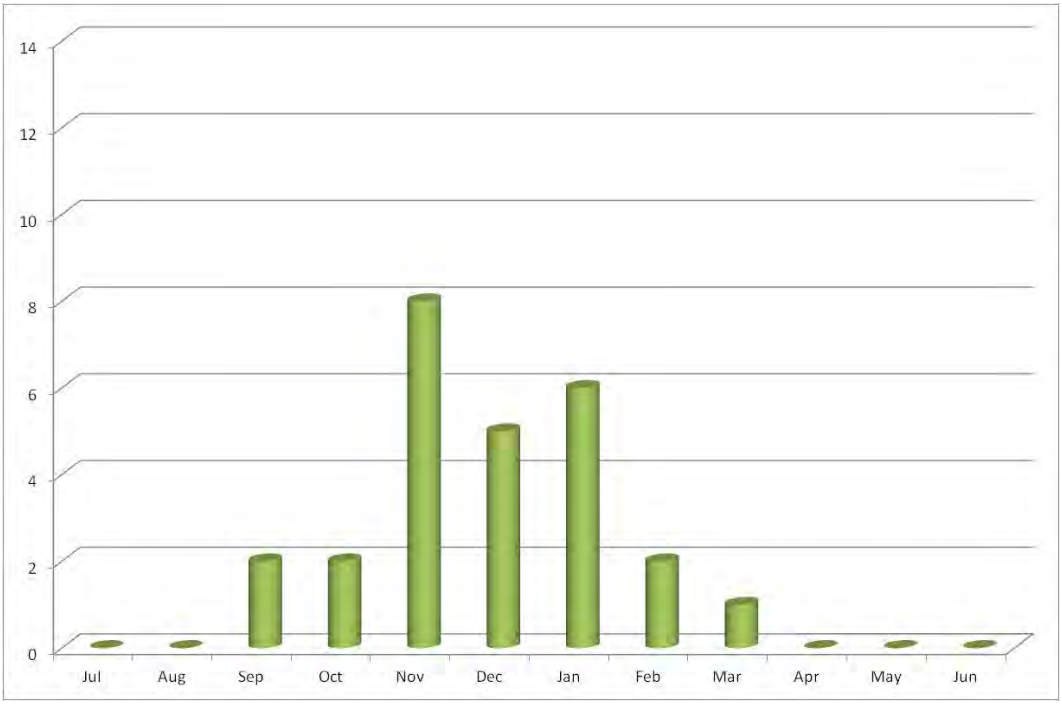


The set of tides above HAT have then been assessed for the influence of atmospheric conditions to determine whether a storm surge occurred. A storm surge is defined by the Met Office as a tide where the residual (the difference in level between the predicted astronomical tide and the recorded tide level) is greater than 0.6m[7]. Storm surges are associated with strong areas of low atmospheric pressure and so normally lead to high winds and large waves.

Figure 3.14 shows the monthly recorded count of these tides. This shows November through to January to have the highest counts, with November recording 8 storm surges that resulted in a tide level above HAT. September, October, February and March all record two or less such tides.

[7] Environment Agency Fact Sheet – Seasonal Occupancy Restrictions on the Lincolnshire Coast (Aug 2013)

Figure 3.14 – Number of Peak Tides above HAT with Surges per month (1956-2014)



3.4 Discussion

Although it is difficult to give a probability of a flood defence breaching, it must be considered a real possibility. The hazard ratings across the site from the breach modelling show that this could lead to serious injury and a risk to life. The chalet park is potentially more vulnerable than in other urbanised areas because the nature of the chalets means that they are single story buildings, and in some cases are of very lightweight construction and may be liable to collapse in the event of flooding. Inundation of the site would also be rapid, leaving occupiers little time to react. Humberston Fitties is in a flood warning area, which would help mitigate this and is discussed further in Section 5.

Whilst under present day sea levels, wave overtopping presents less of a risk to life within the chalet park than a breach, a significant proportion of the site is still classified as having a "danger to most" hazard. A section of defence was almost overtopped on the 5th December 2013. In the short term, sea level rise is unlikely to significantly change these findings, but in the longer term, over the next 40 years, the risk of flooding and the risk to life will significantly increase, particularly when considering wave overtopping.

Currently the chalet park is closed between 4pm and 9.30am the next day for the months of January and February. Analysis of high tides over a 58 year period shows that these two months are not uniquely high-risk. Only 23% of tides above HAT occurred during this period, with high counts of tides above HAT in each month from September through to March. Taking the storm surge component into account, where sea conditions are most likely to result in overtopping and/or a breach, the highest risk is seen to be over a shorter season. The concentration of these tides is from November through to January, which accounts for 73% of the total. Although there are occurrences of such tides in the two months either side, they are much less likely to occur.

Closing the chalet park for January and February each year does not remove flood risk, but it does reduce it. A third of storm surges producing tide levels in excess of HAT over a

58 year period have occurred in these two months. A Closed Season through the winter months therefore represents a significant reduction in the risk to life and of serious injury, but the analysis indicates that January and February are not the most appropriate months. It would be more effective to close the chalet park from early November to the end of January based on high tide and storm surge data.

There is evidence for maintaining the Closed Season through February, The Environment Agency recommends occupancy restrictions along the Lincolnshire Coast of between 1st November and 15th March, which is based on similar analysis to that carried out above, but also includes an assessment of wave heights. This shows that both February and March record significant counts of large waves (>4m) when compared to wave counts for November through January.

Through the Closed Season occupancy is permitted between 9.30am and 4pm each day. The risk to life during daylight hours must be considered to be lower than during darkness as it is more likely that residents will be awake and aware of warnings to facilitate timely evacuation, as well as evacuation being easier in daylight than in darkness. Opening the chalet park through daylight hours therefore is appropriate.

4. OTHER FLOOD RISK

Although tidal flood risk is the most obvious and predominant form of flood risk to Humberston Fitties, all forms of flood risk should be considered. This section assesses flood risk from other sources using the best available information.

4.1 Fluvial

The nearest large watercourse is Buck Beck, which has a catchment area of around 21 km^2 and discharges through a flap valve into the estuary around 800m to the north of Humberston Fitties chalet park. The Strategic Flood Risk Assessment[8] states that modelling has shown the watercourse to be contained in channel during a 1 in 100 annual probability flood. In the event that it did flow out-of-bank (e.g. due to blockage or a more extreme event), then low lying areas closer to the beck will be flooded first, with raised roads and other obstacles inhibiting the flow path towards the chalet park. The risk of flooding extending to the chalet park is therefore very remote.

There is an open drainage channel on the site, on the landward side of the primary defence. This feeds into the agricultural drainage network to the south of Tetney Marshes and discharges into the Louth Canal near Tetney Lock. The gradient is very slack and it is possible that it could suffer from backing up when levels in the estuary are high, or if there was flooding taking place to the south of Humberston Fitties. The primary defence would prevent flooding to the majority of the chalet park, but the smaller area located on the landward side could be affected.

There is also a small section of open drainage ditch located at southern corner of the chalet park (landward of the primary defence). This links into the same drainage system that the drainage channel discussed above feeds into. On the east side of this short length of drain, the chalets are on higher ground and at little risk of flooding from it, but the eight chalets located on the opposite bank are lower lying. A small earth bund provides protection to the lowest lying of these. However, the exceptionally heavy rainfall of July 2007 led to flooding of gardens and the internally at a couple of the chalets here.

4.2 Surface Water

Surface water flooding is flooding from heavy rainfall that occurs before the runoff reaches the watercourse or drainage system, or when the capacity of the surface water drainage is exceeded. Flood mapping on the Environment Agency website shows there to be only very localised risk from surface water flooding within the site, with the majority of the site having less than a 1 in 1000 annual probability of flooding.

The history and nature of Humberston Fitties chalet park means that there is no surface water drainage network following the roads through the site and the open drainage channels are the main recipient of any runoff. However, there is no pumping on the drainage system and so it can become tide locked and unable to drain into the Humber estuary when most needed. This was a contributing factor to the flooding seen in the summer of 2007.

[8] North and North East Lincolnshire Strategic Flood Risk Assessment, November 2011

4.3 Groundwater

Groundwater flooding may occur where prolonged periods of rainfall result in a high water table and the emergence of groundwater. Groundwater is generally only considered an issue in those areas where surface water flooding is a known problem. Although flooding from drainage channels has occurred within the chalet park, there are no indications that groundwater flooding is a potential problem.

4.4 Reservoir or Canal Failure

Flooding resulting from an infrastructure failure, such as a reservoir's dam or a canal embankment may result in rapid inundation of an area. Reservoir inundation mapping on the Environment Agency website shows that there is no significant risk of flooding from a reservoir failure. The Louth Canal is located to the south-east of the Humberston Fitties and is embanked. A failure of the embankment would result in flooding of the low lying farmland between the canal and the chalet park. The volume of flood water would be restricted to the section of canal between locks on which the breach occurred. With the chalet park over 3km away across a broad level area, there is little risk of flooding to the site.

4.5 Summary

In additional to the flood risk presented by the sea, other sources of flood risk have been considered. Of these only surface water flooding poses a potential risk and this has occurred in the past. Whilst surface water flooding at Humberston Fitties is a problem that will persist without a formal surface water drainage system, the consequence of flooding from this source are far less than that from the sea. Any flooding will be localised and is likely to cause only internal damage to chalets and does not pose a risk to life.

5. FLOOD MITIGATION

This section looks at what measures can be put in place to mitigate the consequences of flooding to Humberston Fitties in the event of flooding.

5.1 Defence Raising

Flooding could be mitigated by raising the front line defences to reduce the risk of overtopping and/or breaching. The defences currently consist of a dune system with gabions protecting the toe of the dunes from erosion. The gabion baskets along much of the foreshore have recently been replaced by the council. There are also sections where the gabions are in a poor state. The probability of overtopping and breaching will only increase in the future with sea level rise unless the defences are raised.

The recommended policy within the Shoreline Management Plan[9] (SMP) makes this scenario unlikely. The preferred policy from the present day to 2055 is to hold the defences in their current positions. The secondary defence will be maintained at current crest levels, whilst the primary defence will be improved as necessary to counter potential sea level rise. During this period, a review will be carried out into the feasibility of maintaining the current standard of defence for the chalet park into the long-term (i.e. post 2055). This indicates that raising of the front line is unlikely to be applied to mitigate flood risk.

5.2 Flood Resilience

Flooding can be mitigated by installing flood resilience measure to building. However, such measure would be ineffective, given the chalets' nature of construction and flood depths possibly exceeding 1m.

5.3 Flood Warning & Evacuation

One mitigation measure already in place is the Flood Warning service provided by the Environment Agency. This however is dependent on residents taking up the service and then acting upon the information received. It is generally preferable to avoid evacuation as a mitigation measure, but in this instance there is no viable alternative and in response to this NELC have prepared a draft Flood Evacuation Plan. B&V have reviewed the draft and given technical input to provide a reliable and workable document, which is included as Appendix B. For an evacuation plan to work well, it should be practiced with all those involved participating, including the public[5].

[9] Humber Estuary Coastal Authorities Group – Flamborough Head to Gibraltar Point – Shoreline Management Plan, December 2010

6. CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

(a) Background

Humberston Fitties is a holiday chalet park located on the east coast at the mouth of the Humber estuary. B&V have carried out a flood risk assessment for the site to inform NELC on its lease renewal process and future management of the site.

The primary sea defence for this part of the coast is a grass embankment which runs through the chalet park and is maintained by the Environment Agency. The majority of the chalet park is on the seaward side of this embankment and so is only protected by the sand dune system along the beach frontage, known as the secondary defence. Gabions protect the toe of the dunes from erosion and groynes across the beach help to prevent undercutting. The areas to the north and south of Humberston Fitties are also protected by sea defences.

The chalet park is relatively low lying with only a ridge of ground at the southern end sitting above 4m OD. Consequently the site is nearly all contained within Flood Zone 3, which denotes a risk of flooding from the sea greater than a 1 in 200 annual probability.

(b) Flood Risk

An assessment of the risk and consequences of flooding for the 1 in 200 annual probability tide has been carried out using hydraulic modelling. The modelling has been carried out using TUFLOW, a 2d modelling package. The model has been refined from the Environment Agency's Northern Area Tidal Modelling project to make the outputs site specific. The main change has been to reduce the grid size from 20m to 4m.

Wave overtopping discharge rates for a 1 in 200 annual probability event have been taken from the Northern Area Tidal Model, whilst the 1 in 200 annual probability sea levels used in the event of a breach have been updated to reflect the most up-to-date published extreme tide level predictions. The model shows that overtopping of the secondary defence could result in flood depths in excess of 0.5m, with the lowest lying properties flooded to depths of 1.3m. This results in much of the site having a hazard rating of "danger for most", which indicates a risk to life and serious injury. The area of the chalet park on the landward side of the primary defence is protected and as a result is shown mostly to be an area of "low hazard". A breach in the defence would create a wider and more serious risk to life, including the area of the chalet park behind the primary defence. Only the higher ground at the southern end of the site is not shown as "danger for most" or "danger for all".

Sensitivity tests on various parameters have been carried out. This has demonstrated that the model is insensitive to these changes. This is because the primary defence prevents floodwater from dissipating across a wider area. Flood depths are therefore relatively unchanged and so the hazard rating across the site is also largely unchanged.

Climate change is expected to lead to sea level rise and increased storminess. The biggest impact here will be increases in overtopping rates. The result is that by 2055, nearly the entire site is shown as having a hazard rating of "danger to most", with a significant proportion rated as "danger for all". In the breach scenarios, there is little impact from

climate change to the year 2025, but by 2055 a larger proportion of the site is shows as being “danger to all”.

Other sources of flood risk have also been considered. Flooding may occur when heavy rainfall results in the drains that run through the chalet park exceeding their capacity. This has occurred in the past during a period of exceptionally heavy rainfall in the summer of 2007, when the drainage system was unable to discharge due to high tide levels in the Humber estuary. Whilst this flooding is a nuisance for chalet owners, it does not produce the same extent of flooding or consequences as flooding from the sea. Other sources of flooding have a low risk to the site.

(c) Seasonality

The chalet park is currently closed each night throughout January and February. The seasonality of high tides has been assessed to determine the appropriateness of this Closed Season. The analysis of tidal records from Immingham, dating back 58 years to 1956, shows that tides above HAT are most likely to occur between September and March. There is no apparent uniqueness to January and February in this data set.

Separating out tides above HAT that had a storm surge component, it was found that 73% of such tides occurred from November through to January. The current Closed Season of January and February accounts for around a third of such tides. Thus, although having a Closed Season does not remove the risk to life from flooding, it does reduce the risk significantly. The dates of the Closed Season should be reconsidered.

(d) Mitigation

Raising the sand dunes which form the secondary defence would reduce the risk of overtopping and breaching. However the policy within the Shoreline Management Plan for this section of coastline states that the preferred policy here is to maintain the front line defence at its current crest level and improve the embankment which forms the primary defence in-line with climate change. Flood resilience measures would likely be ineffective if applied to the chalets.

Flood warning and evacuation is therefore the only viable mitigation measure that can be applied at this time. A flood warning service is already provided by the Environment Agency, but this is reliant upon uptake and residents then acting upon the warning.

An Evacuation Plan has therefore been prepared, which B&V has provided technical input to. This is included in Appendix B.

6.2 Recommendations

Black & Veatch have been asked for recommendations based on their findings on two specific aspects:

- Closed Season – analysis of the highest tides over a 58 year period clearly shows that there is seasonality in their occurrence. Most storm surges resulting in a tide level above HAT occur from November through to January. The current Closed Season of January and February accounts for around a third of such tides, which is significant and we would recommend that a Closed Season is maintained. We would also recommend that the dates of the Closed Season should be

reconsidered. Based on tide level and storm surge data it would be more effective to close the chalet park from early November to the end of January. However, there is evidence from the Environment Agency based on wave heights that demonstrates the case for also maintaining the Closed Season through February. It is therefore recommended the chalet Closed Season extends from November through to the end of February. We would also recommend that occupancy of the site through the Closed Season is restricted to daylight hours. Removing the Closed Season would significantly increase the risk to life.

- Lease Terms - practice in recent years has been to renew leases over short terms so that all leases will end in 2021. The assessment of the impact of sea level rise shows that over the short term there is little change in the risk to life, but that in the longer term there is a significant change, particularly with regards to wave overtopping. We would recommend that the practice of renewing leases over short term periods of 5 to 10 years be maintained. This will allow the council to frequently review the impacts of climate change as climate models and sea level rise predictions improve and relate this to the policy at the time for defending this area of coastline. We would also recommend that the council revisit the issue of flood risk to Humberston Fitties chalet park prior to the 2021 lease renewals, because of the likelihood of changes to extreme tide level predictions as more data becomes available.

As referred to above, as more tidal data is recorded, extreme tide levels are likely to be reviewed. Following the storm surges that hit Great Britain in the winter of 2013/14, it is understood that the Environment Agency is in the process of reviewing extreme tide levels. It is likely that extreme tide level estimates will increase. When the findings of the Environment Agency review are published, we would recommend that the council reviews the impact of those findings in relation to this flood risk assessment.

APPENDIX A
TUFLOW Model Information

APPENDIX A
TUFLOW MODEL INFORMATION

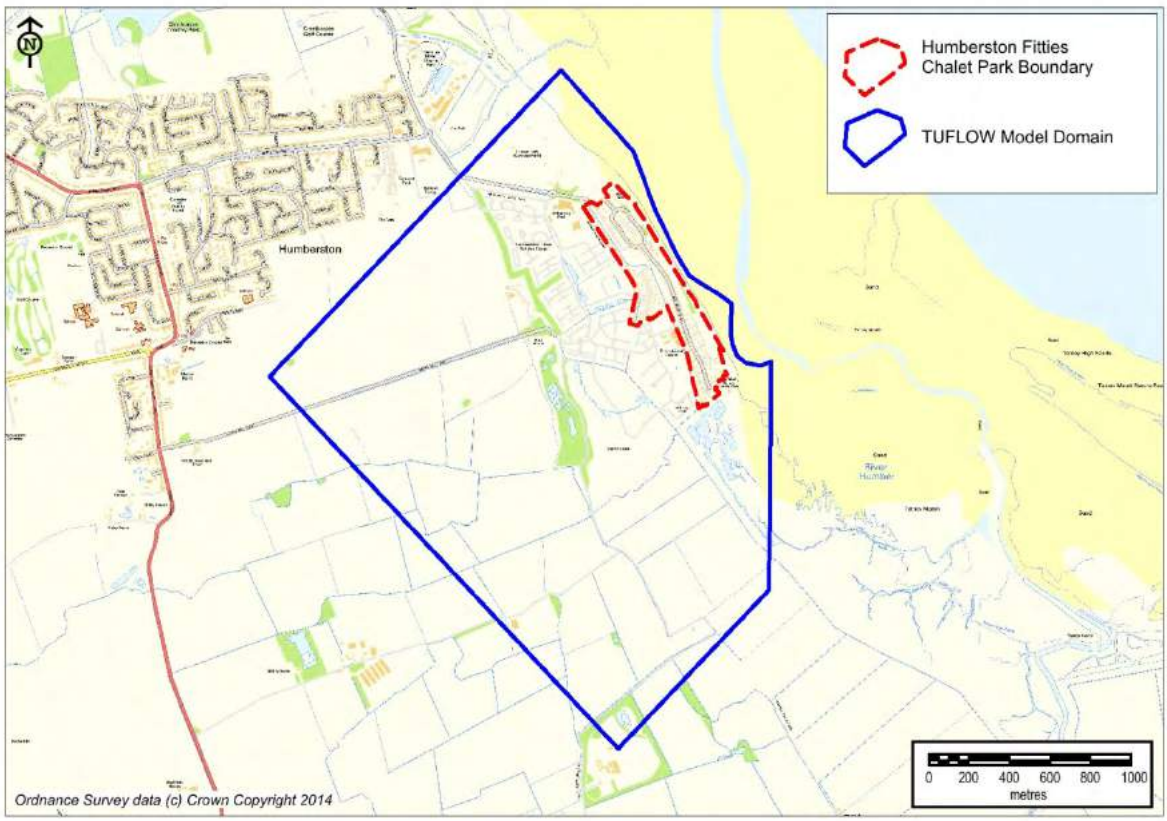
A.1 INTRODUCTION

NELC require a Flood Risk Assessment (FRA) for the Humberston Fitties chalet park site to inform decisions on future lease renewals and management of the site. Black & Veatch have been awarded the contract to carry out this work. To inform the FRA, B&V obtained the modelling from the Northern Area Tidal Modelling project carried out by the Environment Agency. That comprised a series of large models built in TUFLOW, covering an area from the Humber Estuary to the Wash to simulate flooding from overtopping and breaching. B&V have therefore built a new TUFLOW model to make it site specific for the purposes of the FRA. This appendix outlines the modelling work carried out.

A.2 GENERAL

The Northern Area Tidal Model was built using a 20m grid and covered an area extending well beyond Humberston Fitties. The use of a 20m grid is too large for a site specific FRA, and for this reason the grid size has been reduced to 4m and the extent of the TUFLOW domain reduced to make run-times manageable. The area covered by the model is shown in Figure A.1.

Figure A.1 – TUFLOW Model Extent



The new 4m grid has been generated using the latest available flown LiDAR (Dec-11 to Mar-12). This LiDAR was flown on a 0.25m horizontal grid resolution and has an accuracy of +/-0.15m.

The primary flood defence embankment, located to the rear of the chalet park, has been included as a z-line to ensure the defence is properly depicted. In the absence of topographic survey, the LiDAR has been used to define the crest levels.

To stop flood water being contained in the TUFLOW domain should it reach the extents of the model domain, boundary conditions have been set-up to allow the floodwater to discharge out of the TUFLOW domain. These are based on head-flow relationships defined by a 1 in 1000 slope.

Table A.1 describes the TUFLOW layers used in both the overtopping and breach models. All models were run using model version 2012-05-AE-iSP-w32 of the TUFLOW modelling package.

Table A.1 – General TUFLOW layers

Layer File	Description
2d_loc_NT_PH3_HUM_A_003.MIF	Defines the orientation of the grid
2d_code_HF_001.MIF	Defines the TUFLOW domain area
2d_zpt_HF_001.MID	Reads in ground levels to TUFLOW grid
2d_bc_HF_ds_001.MIF	Boundary conditions based on 1 in 1000 slope at landward extents of TUFLOW domain
2d_zln_HF_2nd_defenceline.MIF	Depicts levels along primary flood defence embankment to the rear of chalet park

A.3 OVERTOPPING MODEL

The overtopping model is used to simulate flooding resulting from the waves overtopping the defences during a 1 in 200 annual probability tide. The model uses the hydrographs calculated from overtopping discharge rates used in the Northern Area Tidal Modelling project. The original calculations divided the coastline into a series of sections and derived overtopping hydrographs for each section. These hydrographs are applied along the crest line of the secondary sea defence using a **_sa** layer, which distributes the hydrograph evenly across an area. A similar approach has been used to provide overtopping flows for the 2055 scenario, as described in the main FRA text.

A **_za** layer is applied to the seaward side of the secondary sea defence to ensure that the wave overtopping hydrographs pass flow landward and not back towards the sea.

Roughness values have been defined based on specific land uses as given in Table A.2. Table A.3 describes the TUFLOW layers used specifically in the overtopping model.

Table A.2 – Roughness Values used in Overtopping Model

Reference	Manning's 'n'	Land Use
1	0.050	Rural
2	0.200	Urban
3	0.080	Woodland & Scrub
4	0.042	Sand
6	0.035	Standing Water
8	0.040	Garden

Table A.3 – Overtopping Model – TUFLOW layers

Layer File	Description
2d_sa_HF_Overtop_001.MIF	Distributes flow from inflow hydrograph across a defined area – used for 2014 overtopping discharges and sensitivity tests
2d_sa_HF_Overtop_002.MIF	Distributes flow from inflow hydrograph across a defined area – used for 2055 overtopping discharges
2d_za_HF_Overtop_Glass-Wall_001	Add glass-wall along seaward side of sand dunes to ensure flow from wave overtopping all passes landward
2d_mat_HF_001.MIF	Reads in land use for attribution of roughness values, as given in Table A.2

A.4 BREACH MODEL

The breach model is used to simulate flooding resulting from a 1 in 200 annual probability tide flowing through a breach in the secondary sea defence. The 1 in 200 annual tide level has been updated from the Northern Area Tidal Modelling project to reflect the latest published extreme tide levels and predicted sea level rise from the baseline date (2008) to 2014. The tidal boundary is applied as a Head-Time boundary running along the coastline. The tidal shape from the Northern Area Tidal Modelling project has been applied, but adjusted to reflect the revised tide levels.

A 200m length of the secondary sea defence has been lowered to ground level using a **_za** layer. This allows the tide to flow through the sea defence. The model is run for 72 hour duration and the breach is present from the start of the simulation. A uniform roughness of 0.05 has been applied across the TUFLOW domain. Table A.4 describes the TUFLOW layers used specifically in the breach model.

Table A.4 – Breach Model – TUFLOW layers

Layer File	Description
2d_bc_HF_001.MIF	Used to read in tidal cycle as Head-Time boundary
2d_za_HF_1stBreach_001.MIF	Lowers 200m of the frontal sea defence to ground level
2d_za_HF_1stBreach_002.MIF	Used in sensitivity test to lower 50m of frontal sea defence to ground level
2d_za_2ndBreach_001.MIF	Used in sensitivity test to create 50m long breach in primary flood defence to rear of chalet park.

A.5 CONCLUSION

Modelling of flooding from overtopping of the sand dunes or a breach in the defences at Humberston Fitties has been carried out. The model is based on the same principles used in the Northern Area Tidal Modelling project carried out by the Environment Agency, but the model has been refined and updated to make it site specific to Humberston Fitties. This has included reducing the grid size to 4m, reducing the TUFLOW domain extent and using the most recently flown LiDAR to define ground levels. Tide levels have been updated to use the most up-to-date published extreme tide levels and sea level rise has been applied as appropriate.

APPENDIX B
Evacuation Plan

Humberston Fitties Chalet Park Evacuation Arrangements

SITE ADDRESS:

Humberston Fitties
Cleethorpes
North East Lincolnshire
DN36 4EX

LOCAL AUTHORITY: North East Lincolnshire Council

ORDNANCE SURVEY GRID REFERENCE: TA3105

SECTION 1: PLAN OVERVIEW

PURPOSE OF THE PLAN

The purpose of this plan is to set out the arrangements for an evacuation of the Humberston Fitties Chalet Park in the event of flooding.

Evacuation is where flood warnings provided by the Environment Agency can enable timely evacuation by chalet owners to take place unaided (i.e. without the use of trained personnel to help people from their homes, businesses and other premises).

The plan also considers the need for a flood warden scheme.

SCOPE OF THE PLAN

The scope of this plan is limited to evacuation arrangements contained on Humberston Fitties Chalet Park.

Rescue by the emergency services may be required where flooding has occurred and chalet residents have failed or been unable to evacuate. The emergency services arrangements for rescuing people are covered in their own contingency plan and are not contained here.

It is expected that chalet residents will, in the event of a flood warning, evacuate using their own resources and implement their own evacuation plans.

KEY PRINCIPLES OF THE PLAN

In accordance with National Planning Policy Framework, the key principles of this plan are to document:

- How chalet residents are to be informed of the Environment Agency's 'Flood Warnings Direct' service and encouraged to sign-up
- How chalet residents can be advised of ways to protect their chalets and possessions and encouraged to have a personal evacuation plan in place.
- A traffic management plan, in conjunction with the Council's highways service and Bourne Leisure for access to and from the Humberston Fitties Chalet Park.
- Actions to be followed following the issuing of the 'All Clear'.

PLAN OWNER AND REVIEW

This plan has been produced and is owned by Cofely Workplace on behalf of North East Lincolnshire Council.

The distribution list of the plan is shown in Annex B.

It will be reviewed by the plan owner at least every three years. The plan owner will issue updates to the plan by documenting revisions. Chalet residents will be advised about these changes at the time they are made.

REFERENCES

This plan has been produced taking into account the following guidance documents:

- National Planning Policy Framework
- Cabinet Office Evacuation and Shelter Guidance
- Cabinet Office Statutory Guidance to the Civil Contingencies Act

SECTION 2: ROLES AND RESPONSIBILITIES

EMERGENCY SERVICES, LOCAL AUTHORITY AND OTHER RESPONDING ORGANISATIONS

Emergency response organisations maintain generic plans for evacuation for any place in the Humber area. In the event of the threat of an east coast tidal surge event, the Environment Agency will issue a Flood Warning via the Flood Warnings Direct system. When this warning is issued those residing in chalets should implement their own arrangements, immediately leave their holiday chalet and the site and return to their homes. In the event of an east coast tidal surge event there are no specific plans for any specific response by emergency responders to the Humberston Fitties site

CHALET OWNERS

It is the responsibility of chalet owners to recognise that their holiday home is in a flood risk area and take sensible steps to prepare for an emergency. Advice on preparing for a flood is available from the Environment Agency (www.environment-agency.gov.uk) and advice is available from North East Lincolnshire Council on how to prepare for an emergency including flooding. This is available from www.nelincs.gov.uk or from your local library.

In particular, it is the responsibility of chalet owners to subscribe to Environment Agency flood warning service (Floodline Warnings Direct), to have insurance appropriate for living in a flood risk area, to prepare their home against flooding, to prepare a flood plan and to be prepared to evacuate their chalet.

It is not always possible to guarantee an emergency response within a specified period of time, particularly in the event of a flood where it has not been possible to issue a warning, or a wide area emergency, or any other emergency that severely stretches the resources of the emergency services or other responding organisations. Chalet owners will be expected to be self-sufficient for a period of time.

SITE OWNER – COFELY WORKPLACE ON BEHALF OF NORTH EAST LINCOLNSHIRE COUNCIL

Cofely Workplace, in partnership with North East Lincolnshire Council, is responsible for :

- Evacuation routes from the site and their signposting where necessary and communicating these to chalet owners.
- The siting and maintenance of passive flood warnings on the development (such as signs highlighting the susceptibility of flooding).
- Encouraging all Chalet owners to sign up to the Environment Agency Floodline Warnings Direct.
- Work with key partner organisations to promote the key messages in the evacuation plan.

<OTHERS>

Consideration to be given to setting up a Flood Warden scheme with volunteers from the site and/or Bourne Leisure and other partner organisations. Flood Warden schemes have worked successfully in other locations and are to be recommended. On the implementation of a Flood Warden scheme, the Evacuation Plan would need to be updated to reflect this and then re-issued.

SECTION 3: ACTIONS

EMERGENCY SERVICES AND OTHER RESPONDING ORGANISATIONS

Category 1 or 2 responders (Emergency Services, Local Authorities etc) will identify the need for evacuation and will inform a “lead responder”. The lead responder is identified at the time of the emergency, but will often be Humberside Police if an evacuation is required. The lead responder co-ordinates the multi-agency response to an emergency.

The Category 1 responders (Humberside Police, North East Lincolnshire Council, etc) will use the daily Flood Guidance Statement issued to them by the joint Met Office / Environment Agency Flood Forecasting Centre - http://www.ffc-environment-agency.metoffice.gov.uk/services/guidance.html

Decisions to evacuate will be based on a dynamic assessment of all the risks and the availability of alternative public protection measures. Evacuation is likely to be considered the best option.

The lead responder will assess the situation and consider arranging for:

- public advice to be issued to the area to be evacuated;
    - this will be decided dynamically at the time of the emergency and

could be through a mix of communication channels – for example - radio announcements, door to door knocking, loudhailer announcements etc.

- support to be provided to assist people with evacuation.
- emergency transport to be provided if appropriate;
    - Some specially adapted vehicles may be provided through North East Lincolnshire Council and Cofely Workplace
    - In the event of a Major Emergency being declared North East Lincolnshire Council may use local bus companies to provide transport.
    - Category 1 responders may be able to offer 4x4 vehicles.
- traffic management to be introduced to help manage the impact of flooding if appropriate.
- emergency shelters to be provided;
    - North East Lincolnshire Council buildings, such as a Sports Halls, can provide emergency shelters. Details of the shelters, including facilities, resources, accommodation for pets, access arrangements etc are available in the Council's rest centre plan.
- Priority may be given to those deemed to be vulnerable for whatever reason.

It is not always possible to guarantee an emergency response within a specified period of time, particularly in the event of a no-notice flood, or a wide area emergency, or any other emergency that severely stretches the resources of the emergency services or other responding organisations. Chalet owners may need to be self-sufficient for a period of time.

CHALET OWNERS

When the Environment Agency issues a Flood Warning for the area, they will advise chalet owners to:

- Get flood protection equipment in place.
- Act on their flood plan.
- Protect themselves, their family and help others.
- Turn off gas, electricity and water supplies if safe to do so.
- Move cars, pets, food, valuables and important documents to safety.
- Listen to emergency services.
- Collect things needed for evacuation. .
- Leave their chalet and the site and return to their permanent home address

Chalet owners should leave the Humberston Fitties Chalet Park using the pre-communicated routes to exit the Humberston Fitties site and return to their permanent home address located away from the Humberston Fitties site.

SITE OWNER – COFELY WORKPLACE IN PARTNERSHIP WITH NORTH EAST LINCOLNSHIRE COUNCIL

The site owner will make available appropriately trained staff, if available, to respond to a flood warning, including preparing for evacuation and providing notification of any pending flood - if time permits. Trained staff could act as site flood wardens and be registered for Floodline Warnings Direct. Chalet owners will be expected to be self-sufficient for a period of time.

SECTION 4: HUMBERSTON FITTIES CHALET PARK SPECIFIC INFORMATION

FLOOD RISK IN CONTEXT

Humberston Fitties Chalet Park is at risk of flooding with potential for serious consequences. This would result from overtopping of the frontal sea defence (principally the dune system) by waves, or a breach in the frontal sea defence.

With a 1 in 200 annual probability tide, either scenario would result in deep flooding across most of the chalet park. Whilst the likelihood of this happening should not be overstated, the consequences of such flooding must be emphasised. This would probably result in loss of life or serious injury, particularly to the more vulnerable (e.g. children, disabled and the elderly).

Although there is a ridge of high ground in the southern part of the site on which around a dozen chalets are located and would remain above the flood level, these properties would become isolated with no exit route.

In the event that an evacuation was deemed necessary, this would include the whole site.

ALERTING SYSTEMS

The Environment Agency Floodline Warnings Direct system is the primary means of notifying Chalet owners on the Humberston Fitties Chalet Park of a flood or potential flood. Floodline Warnings Direct is a free service that provides flood warnings direct by telephone, mobile, email, SMS text message and fax. All chalets on the Humberston Fitties Chalet Park are encouraged to sign up to receive these alerts.

The target warning / lead time is 6 hours for Humberston Fitties Chalet Park. However there may be occasions where this is not possible.

Signs highlighting the susceptibility to flooding have been sited at the following locations, as indicated on a map in Annex 3 –

- Main pedestrian access points to the beach
- Entrance to chalet park
- Midway along 1st Main Road
- Midway along Anthony's Bank Road
- At road locations along the western boundary of the chalet park where access can be gained from the caravan park.
- Car Parks at northern and southern end of chalet park

The Emergency Services, Local Authorities and other responding organisations also have plans to issue public warning and informing messages through BBC Radio Humberside.

EVACUATION ROUTES

The flood resilient site access and egress (exit) routes are as follows and are included on a map in Annex 3: -

Primary Route:
Via Main Road, by which access to the site is normally gained. The road is raised 1.5 – 2.0m above normal ground levels and is therefore the preferred route.

Secondary Route:
Via South Sea Lane, at the western boundary of the Humberston Fitties Chalet Park. The road quickly leads to higher ground and away from the danger area, but passes through an area susceptible to flooding and is therefore a less preferred route. There are also gates along this route which would need to be unlocked and opened to allow vehicles to exit the site via this route.

The evacuation routes are clearly signposted, including off site signage. Note that there is no direct exit route from the Southern Car Park without passing through the chalet park.

ASSEMBLY POINTS

Chalet owners are to evacuate the site using their own vehicles and return to their permanent home address.

Those without their own transport should head to the northern end of the chalet part and make their way along Kingsway and congregate at the bus stop located just beyond the first roundabout, as shown on the map in Annex 3. It is likely that the weather conditions will be very poor, and this should be a measure of last resort.

POTENTIAL SUITABLE LOCATIONS FOR PARKING CARS OUTSIDE OF THE FLOOD RISK AREA
Not applicable – chalet owners to follow their own flood plans for possessions and to evacuate the site and return to their permanent home address.

CHALETS THAT ARE LIKELY TO ACCOMMODATE VULNERABLE PEOPLE
In the event of a flood, advice and assistance would be sought from the Care Trust Plus.

SECTION 5: INFORMATION ON FLOOD PREPAREDNESS PROVIDED TO PROPERTY OWNERS

HOW COFELY WORKPLACE IN PARTNERSHIP WITH NORTH EAST LINCOLNSHIRE COUNCIL HAS INFORMED CHALET OWNERS ABOUT THE CONTENTS OF THIS PLAN AND WHAT THEY NEED TO DO IN A FLOOD

Cofely Workplace, in partnership with North East Lincolnshire Council, has taken the following steps to inform property owners of the plan and what they need to do, in the event of a flood;

- Information on the Evacuation Plan has been posted on the North East Lincolnshire Council website.
- An information board is located at the main entrance to the Humberston Fitties Chalet Park.
- Warning signs have been erected at pedestrian access points
- Letters to be mailed to all existing lease holders

The information will need to be updated and re-issued following any subsequent revisions to the Evacuation Plan.

Residents should also be made aware of how to prepare for flooding, including their own personal Flood Plan by referring to the following website:

https://www.gov.uk/prepare-for-a-flood

DATE WHEN THE INFORMATION WILL BE RE-ISSUED
Cofely Workplace, in partnership with North East Lincolnshire Council, will re-issue the information at each periodic review of this document.

HOW CHALET OWNERS WILL BE KEPT INFORMED DURING AN INCIDENT

Cofely Workplace, in partnership with North East Lincolnshire Council, have the following arrangements in place to provide advice to Chalet owners in the event of a flood:

- Staff from NELC would attend the site and inform residents of the flood risk and provide advice. It should be recognised that there will undoubtedly be pressure on resources in such an event, which may delay a response. Using residents of the chalet park as Flood Wardens would relieve this pressure and better ensure that timely warning and information is passed on to residents.

- If the issued advice is that evacuation is necessary, then Humberside Police would attend the site to advice residents of the need for evacuation.

The Environment Agency Flood Warning Service will keep Chalet owners informed during a flood. Chalet owners are encouraged to register with Flood Warnings Direct and those that are signed up to will receive flood warnings directly. Flood warnings will be sent to North East Lincolnshire Council.

Public warning and information messages will be provided through BBC Radio Humberside and will be available on responding organisations websites, and at North East Lincolnshire Council's Customer Service Centres.

SECTION 6: ALL CLEAR

ISSUING THE ALL CLEAR

When the multi-agency command, co-ordinating the response to the emergency, considers it is applicable, the decision to issue an ‘All Clear’ will be made. The methods chosen to notify the ‘All Clear’ will be dependent on the nature and extent of the emergency and the public perception of it.

Multi-Agency responders will consider the effect of the incident on the public, and any measures necessary to manage the aftermath and the return to normality, before standing down.

Chalet owners should ensure that they are aware of the “All Clear” message which will indicate that they may be able to return to the site. Notification will be sent to the permanent homes of all tenants. Advice may be given by responding organisations on the measures that can be taken to mitigate the situation, for example, clean up, reinstatement of utilities, environmental health advice, etc.

ANNEX 1: KEY CONTACTS

In the event of an emergency dial 999. 999 should only be used in an emergency.

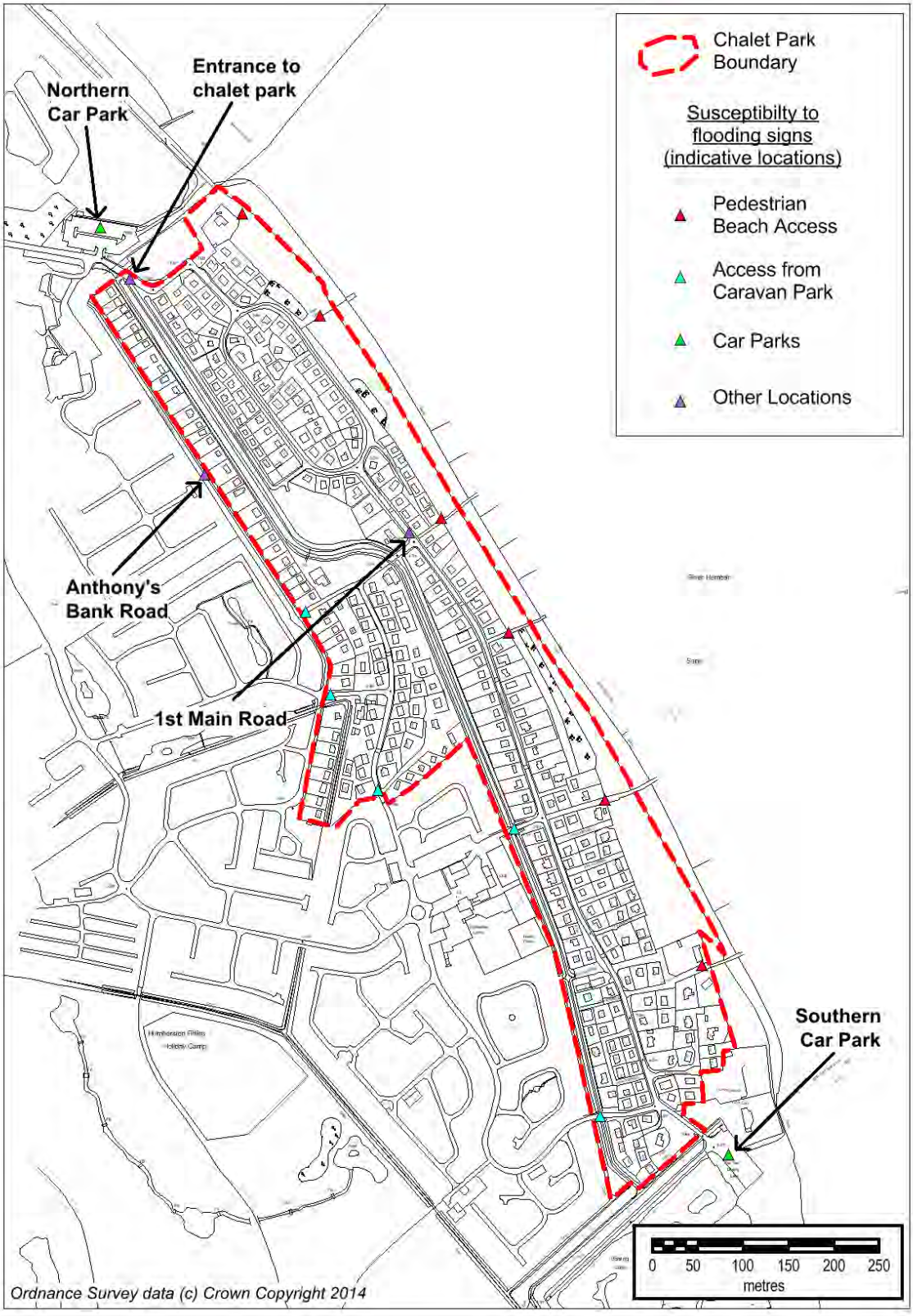
Environment Agency Floodline 0845 988 1188 www.environment-agency.gov.uk	**Fire and Rescue (non emergency)** www.humbersidefire.gov.uk (01482) 565333
Police (non emergency) www.humbersidepolice.co.uk 101	**North East Lincolnshire Council** www.nelincs.gov.uk (01472) 313131
NHS Direct (24 hour confidential health advice and information) www.nhsdirect.nhs.uk 0845 4647	**BBC Radio Humberside** www.bbc.co.uk/humber Tune in to 95.9FM or 1485AM
Electricity (24 hour emergency service and supply failures only) 0845 733 1331	**Gas (24 hour emergency service and gas escapes)** 0800 111 999
Anglian Water (24 hour emergency service) 08457 145 145	**Met Office** www.metoffice.gov.uk

ANNEX 2: DISTRIBUTION LIST

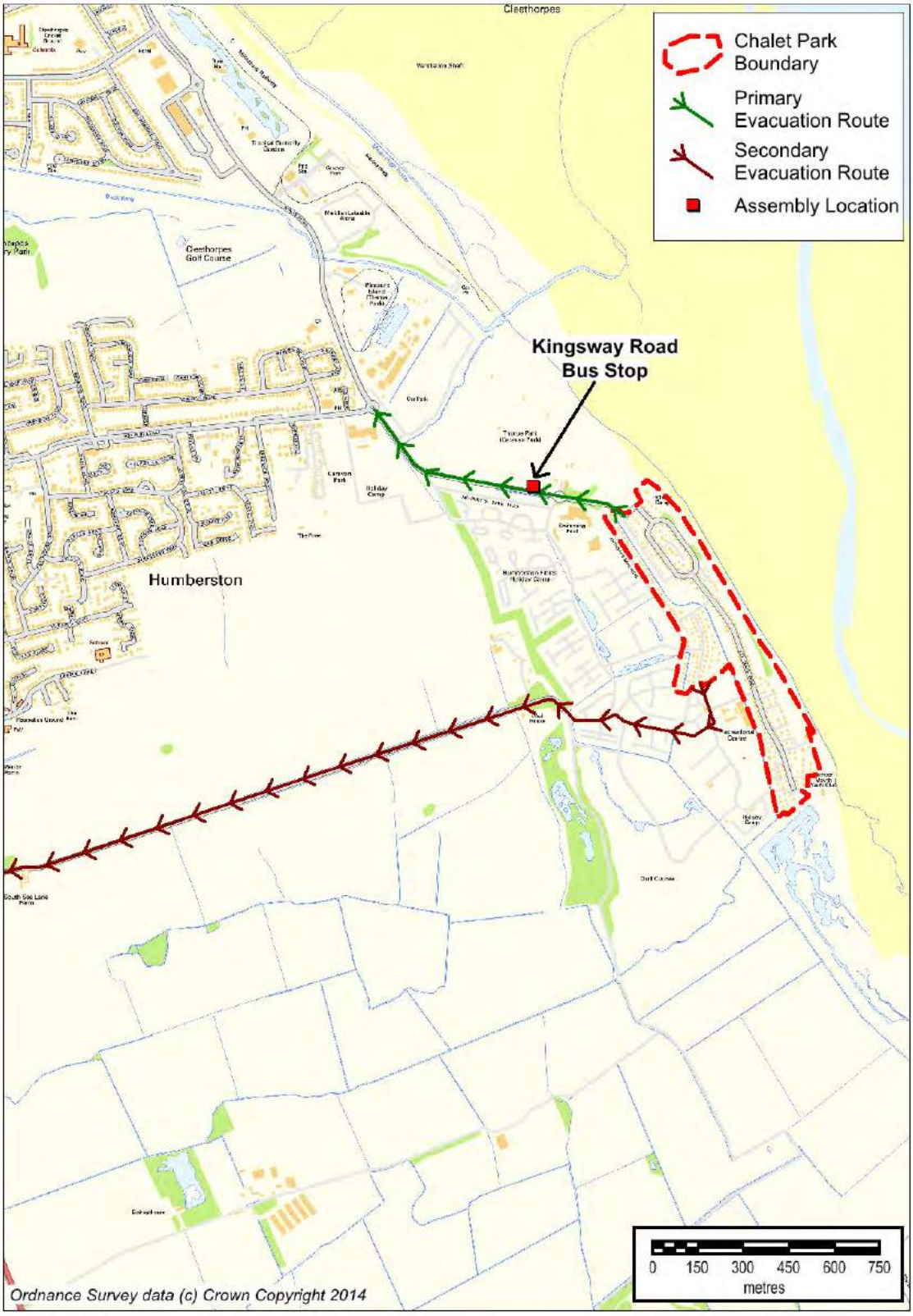
<Distribution list to be completed by NELC>

ANNEX 3: MAPS

Sign Locations Warning of Susceptibility to Flooding

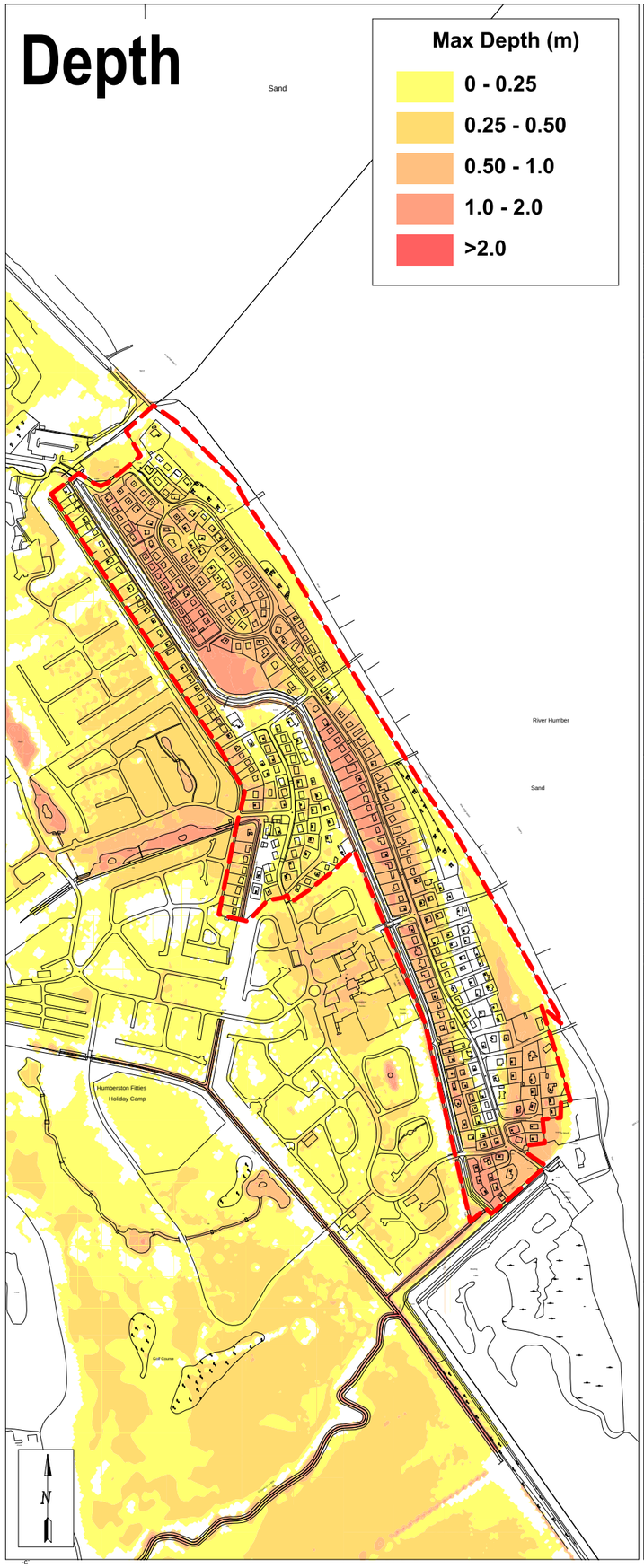


Evacuation Routes



Figures

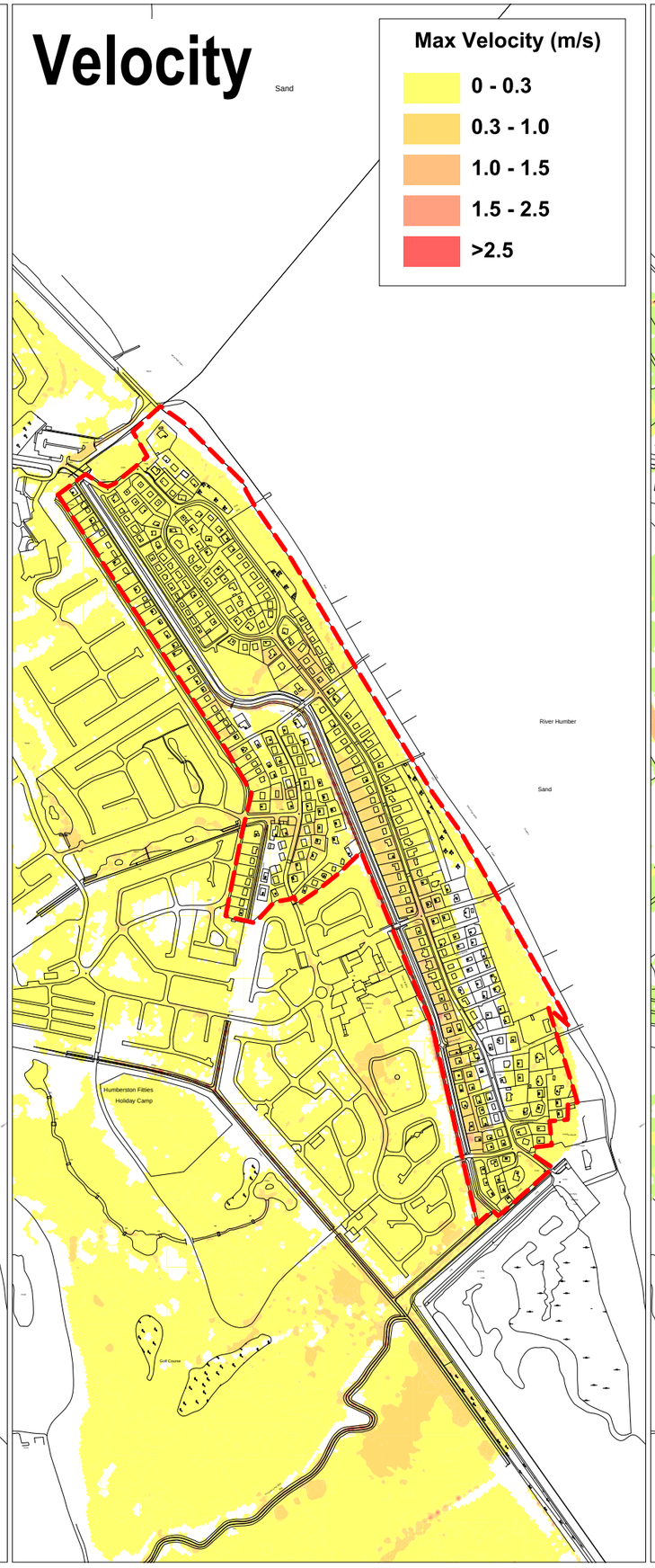
Depth



Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- >2.0

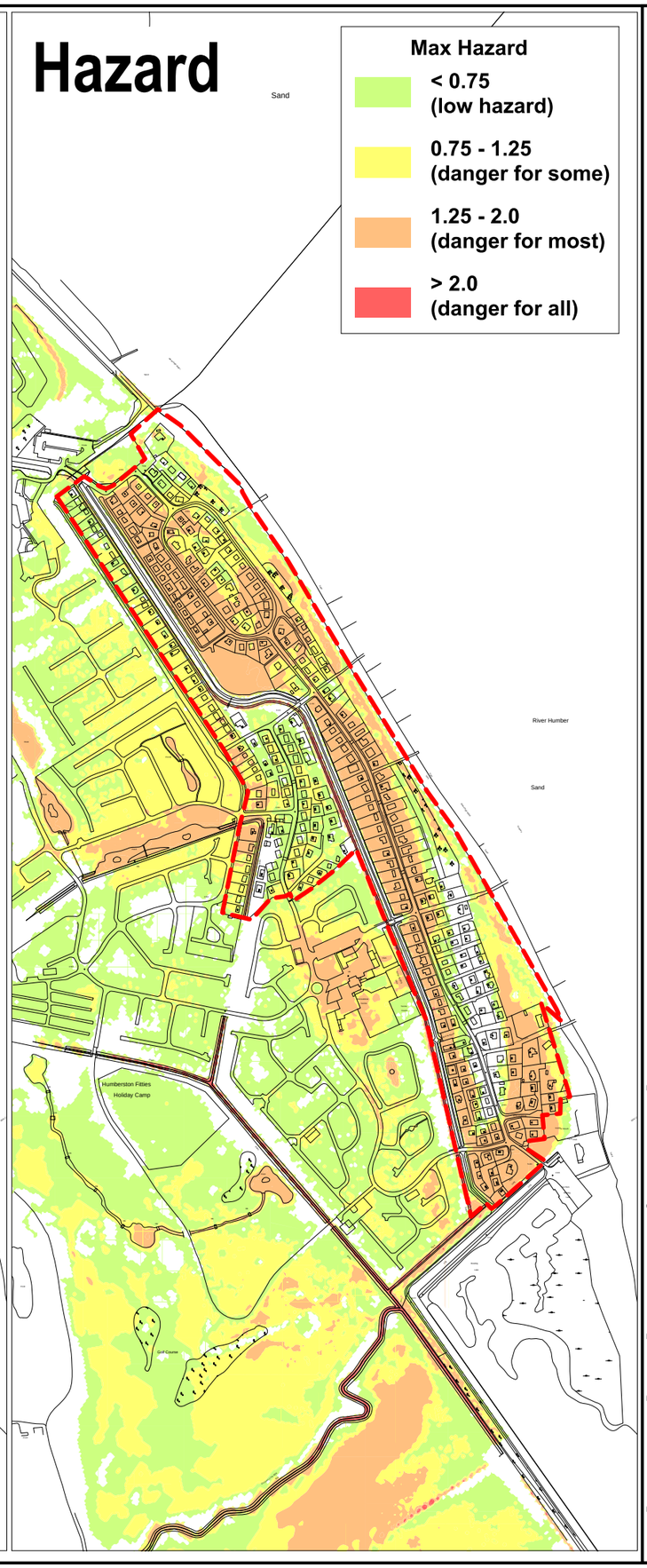
Velocity



Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- >2.5

Hazard



Max Hazard

- < 0.75 (low hazard)
- 0.75 - 1.25 (danger for some)
- 1.25 - 2.0 (danger for most)
- > 2.0 (danger for all)

KEY

Humberston Fitties Chalet Park Boundary

0 50 100 150 200 250 metres

Note: The flood information presented is based on the most up-to-date extreme tide levels provided by the Environment Agency at the time of modelling. Following the winter storms of 2013/14 the Environment Agency is reviewing the extreme tide levels and it is likely that they will increase.

Rev.	Drawn	Chkd.	Rwvd.	Apprvd	Date	Description
B	TSP	IKK	IKK	TPMP	OCT.14	NOTE ADDED
A	TSP	IKK	IKK	TPMP	SEP.14	FIRST ISSUE

Designed by: T PADDISON Date: AUG.2014

Client

NORTH EAST LINCOLNSHIRE COUNCIL

Client Drawing No. | Revision

BLACK & VEATCH
Black & Veatch Limited
Registered Office
Grosvenor House, 6 London Road, Redhill, Surrey, RH1 1LQ, United Kingdom
Tel: +44(0)01737 774155 E-mail: bvl@bv.com

Project

HUMBERSTON FITTIES FLOOD RISK ASSESSMENT

Drawing title:

FLOOD MAPPING OVERTOPPING ANALYSIS PRESENT DAY 1 IN 200 ANNUAL PROBABILITY

Drawing Scale: NOT TO STANDARD SCALE Sheet size: A3

Drawing no. Figure 3.4 | Revision B

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Depth

Sand

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- >2.0

River Humber

Sand

Humberston Fitties Holiday Camp

Golf Course

N

Velocity

Sand

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- >2.5

River Humber

Sand

Humberston Fitties Holiday Camp

Golf Course

Hazard

Sand

Max Hazard

- < 0.75 (low hazard)
- 0.75 - 1.25 (danger for some)
- 1.25 - 2.0 (danger for most)
- > 2.0 (danger for all)

River Humber

Sand

Humberston Fitties Holiday Camp

Golf Course

KEY

Humberston Fitties Chalet Park Boundary

Breach Location

0 50 100 150 200 250

metres

Note: The flood information presented is based on the most up-to-date extreme tide levels provided by the Environment Agency at the time of modelling. Following the winter storms of 2013/14 the Environment Agency is reviewing the extreme tide levels and it is likely that they will increase.

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Project

HUMBERSTON FITTIES FLOOD RISK ASSESSMENT

Drawing title:

FLOOD MAPPING
BREACH ANALYSIS
PRESENT DAY
1 IN 200 ANNUAL PROBABILITY

Drawing Scale: NOT TO STANDARD SCALE | Sheet size: A3

Drawing no. Figure 3.6 | Revision B

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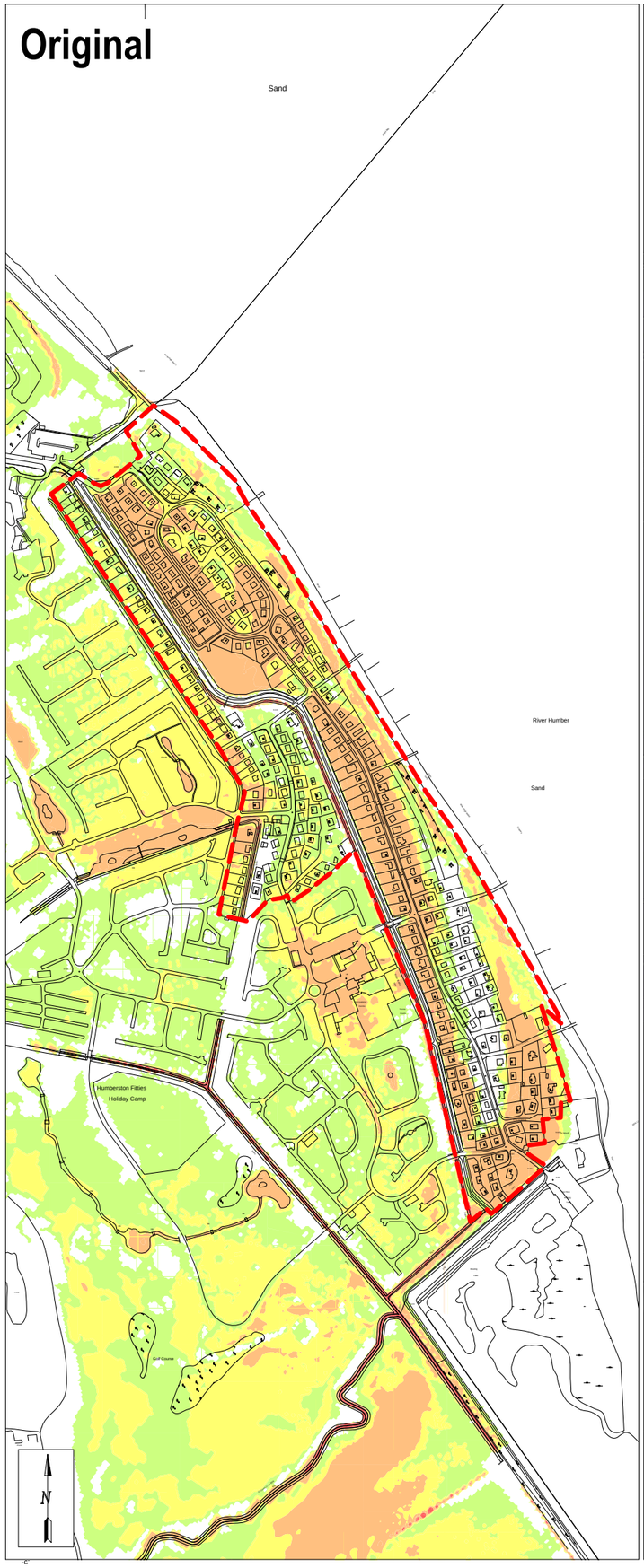

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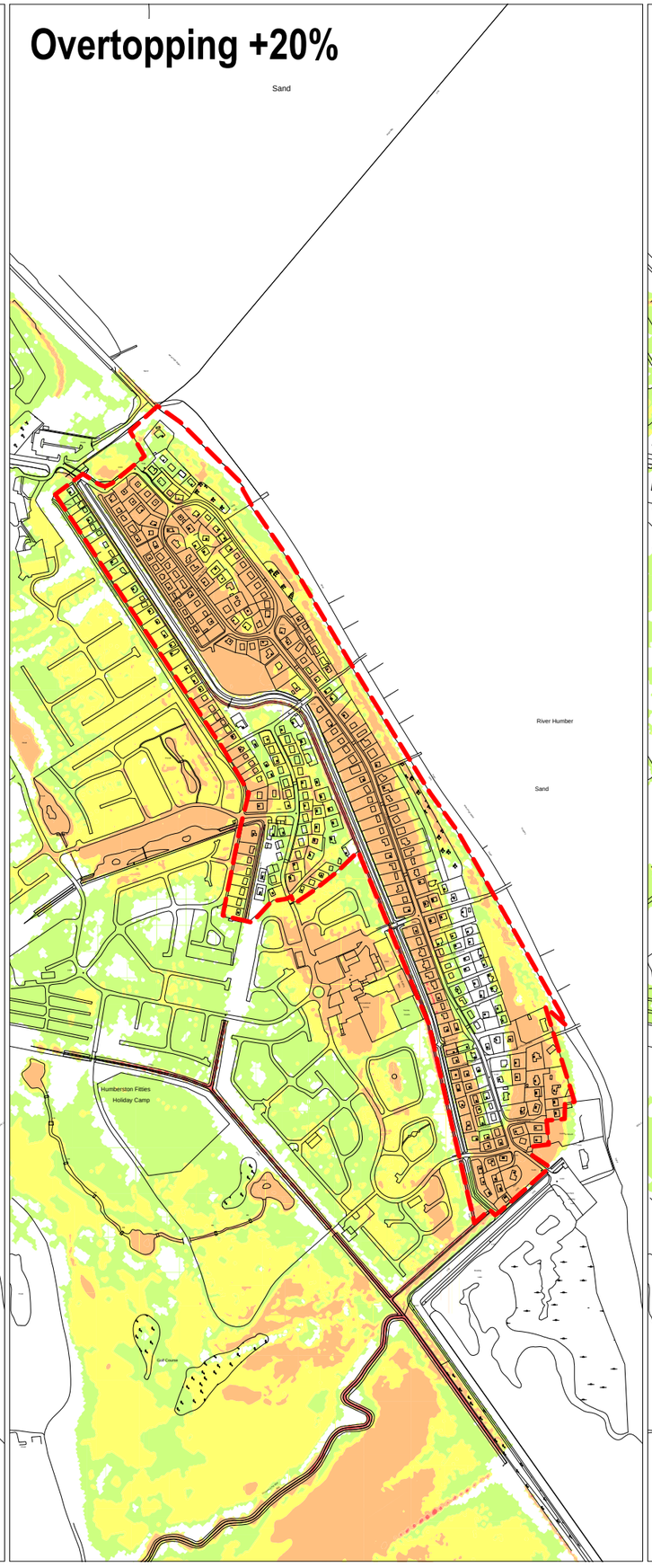

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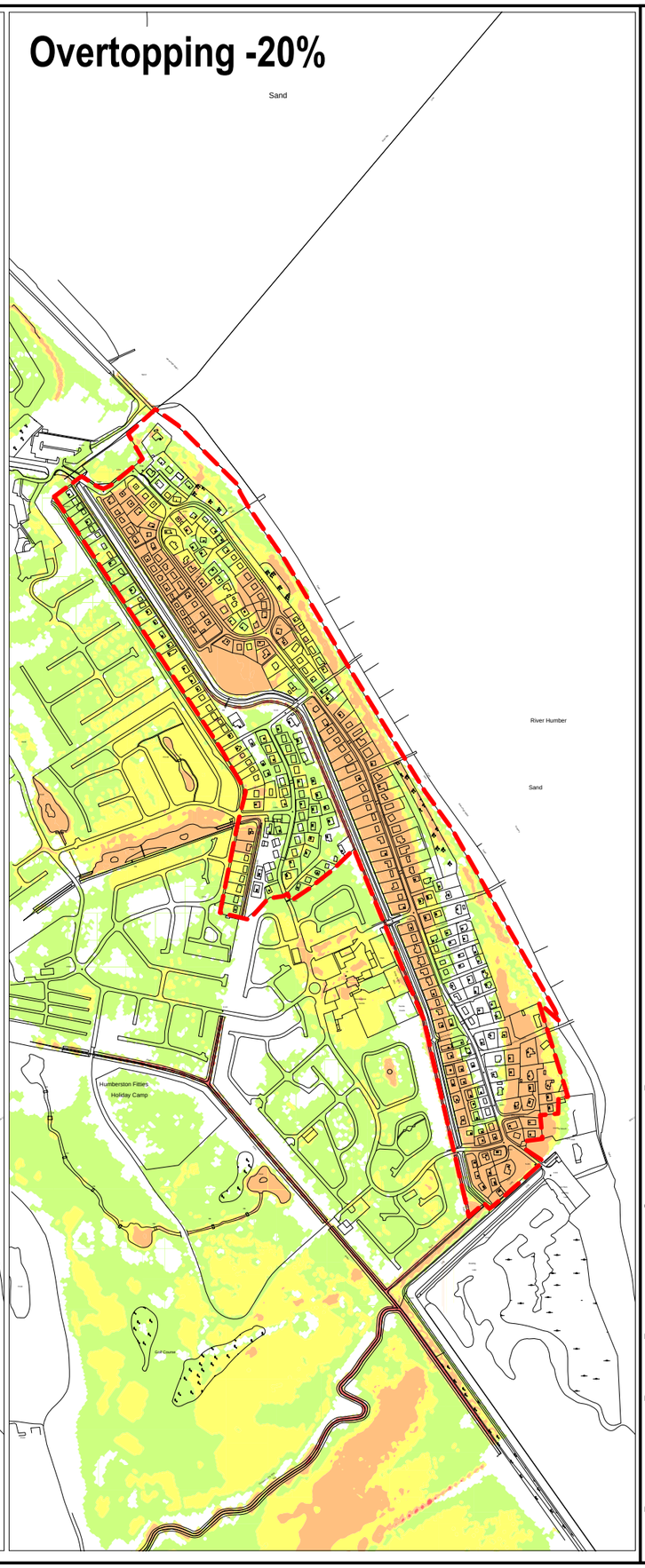

KEY

Humberston Fitties Chalet Park Boundary

Max Hazard

- < 0.75 (low hazard)
- 0.75 - 1.25 (danger for some)
- 1.25 - 2.0 (danger for most)
- > 2.0 (danger for all)

0 50 100 150 200 250

metres

Note: The flood information presented is based on the most up-to-date extreme tide levels provided by the Environment Agency at the time of modelling. Following the winter storms of 2013/14 the Environment Agency is reviewing the extreme tide levels and it is likely that they will increase.

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Project

HUMBERSTON FITTIES FLOOD RISK ASSESSMENT

Drawing title:

OVERTOPPING MODEL SENSITIVITY ANALYSIS DISCHARGE RATES

Drawing Scale: NOT TO STANDARD SCALE | Sheet size: A3

Drawing no. Figure 3.7 | Revision B

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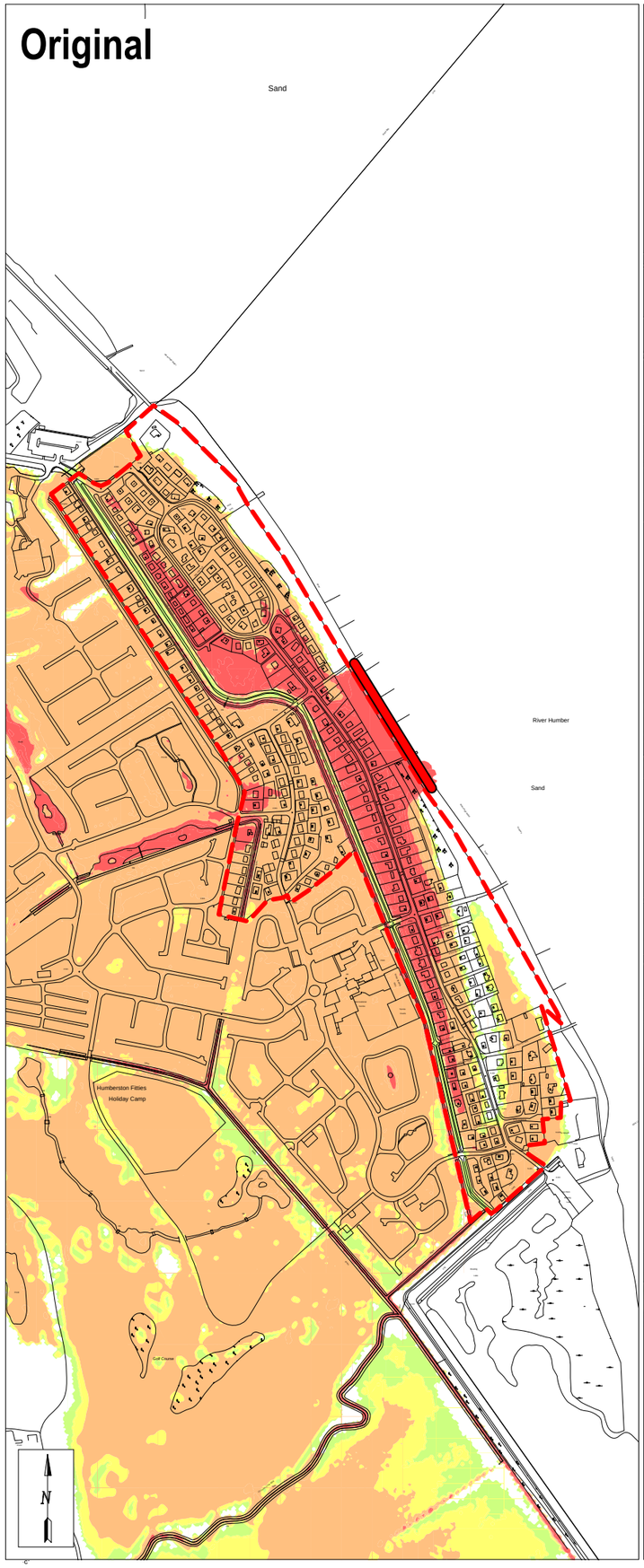
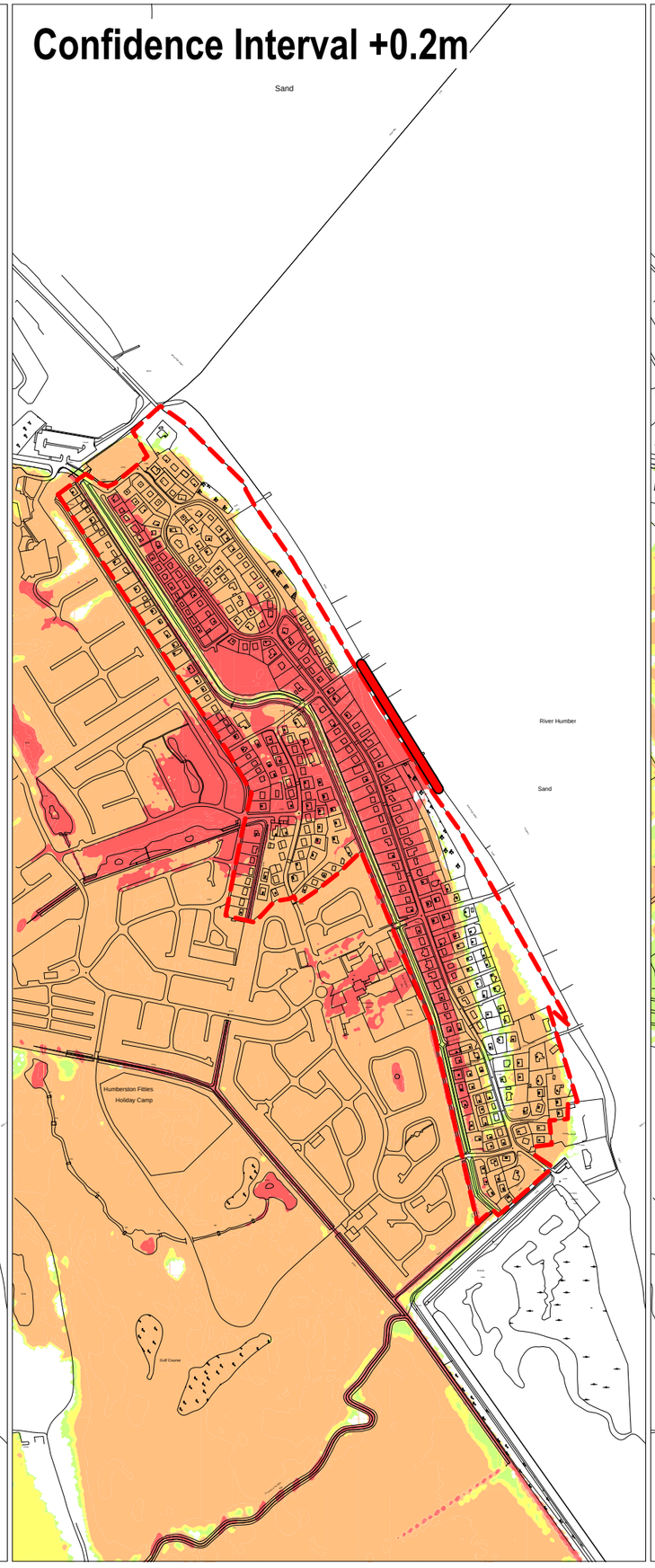
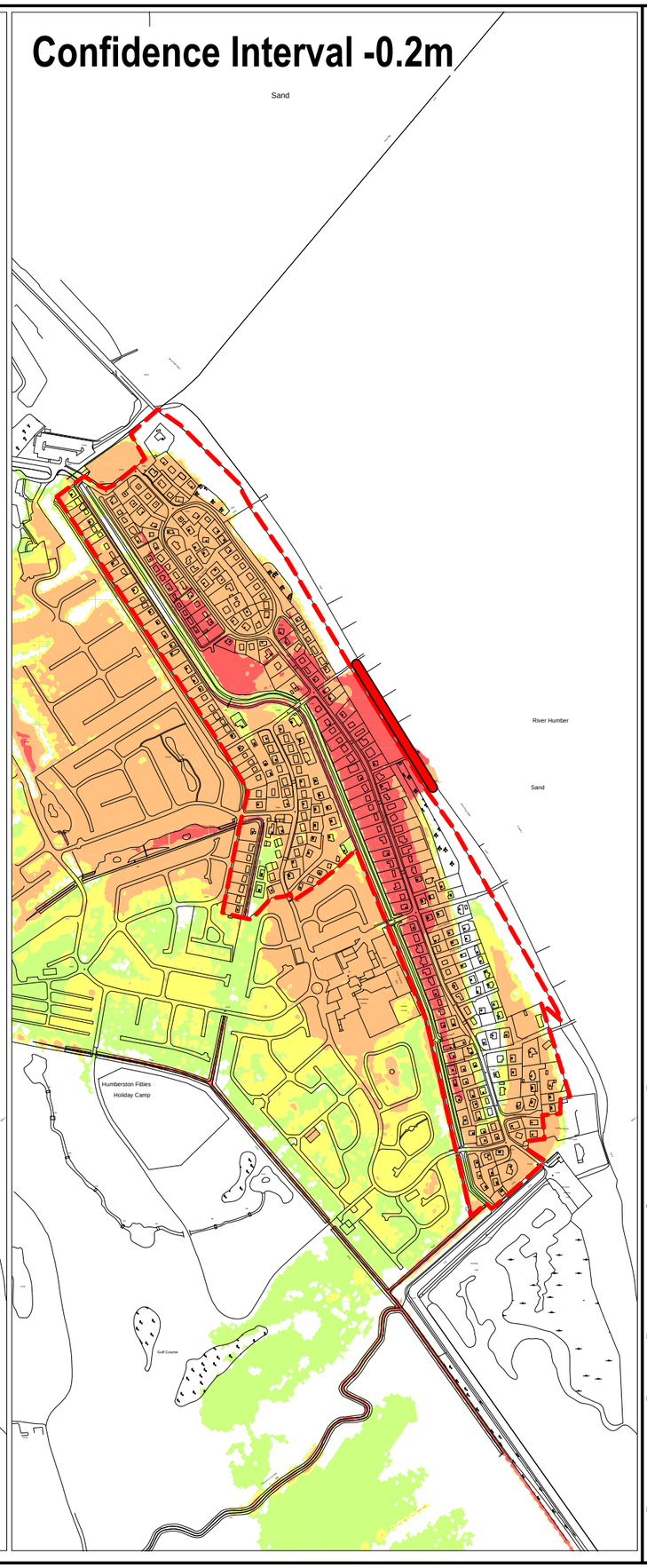


Confidence Interval +0.2m



Confidence Interval -0.2m



KEY

Humberston Fitties Chalet Park Boundary

Breach Location

Max Hazard

- < 0.75 (low hazard)
- 0.75 - 1.25 (danger for some)
- 1.25 - 2.0 (danger for most)
- > 2.0 (danger for all)

0 50 100 150 200 250

metres

Note: The flood information presented is based on the most up-to-date extreme tide levels provided by the Environment Agency at the time of modelling. Following the winter storms of 2013/14 the Environment Agency is reviewing the extreme tide levels and it is likely that they will increase.

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HUMBERSTON FITTIES FLOOD RISK ASSESSMENT

Drawing title:

BREACH MODEL SENSITIVITY ANALYSIS SWL CONFIDENCE

Drawing Scale: NOT TO STANDARD SCALE | Sheet size: A3

Drawing no. Figure 3.8 | Revision B

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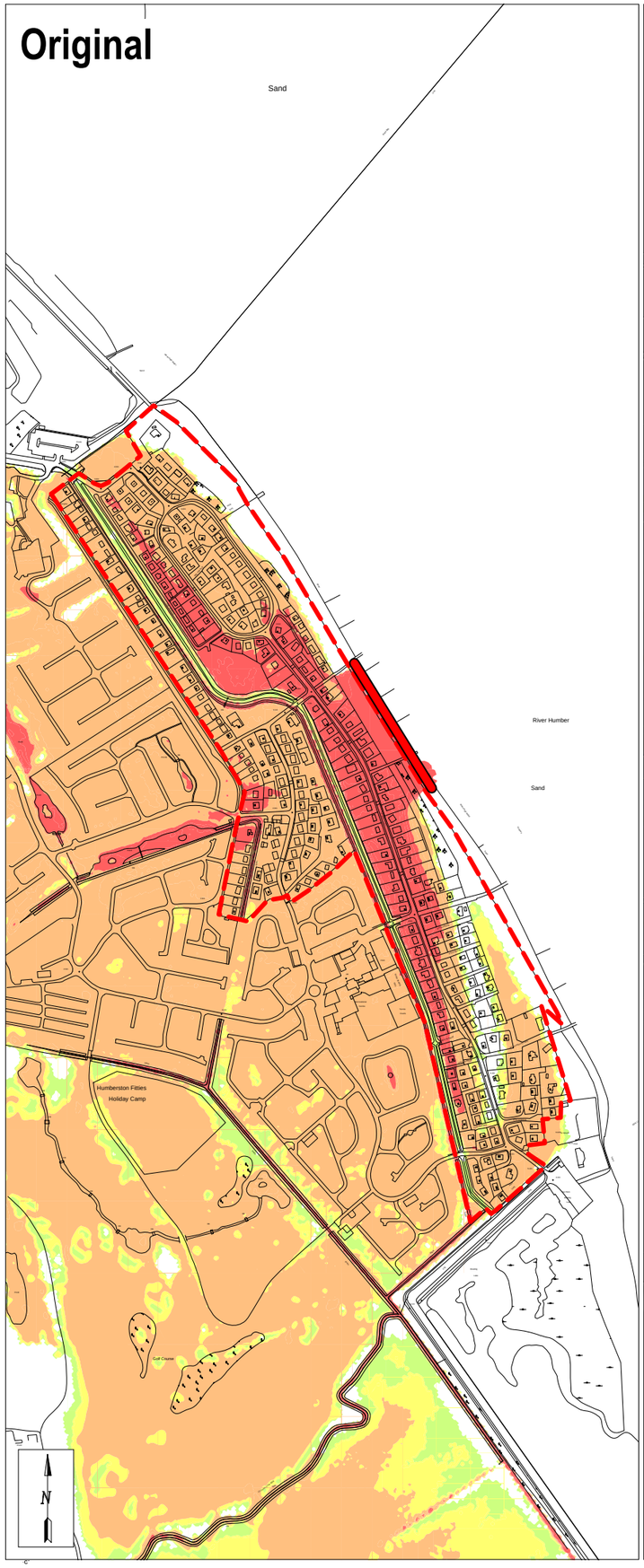
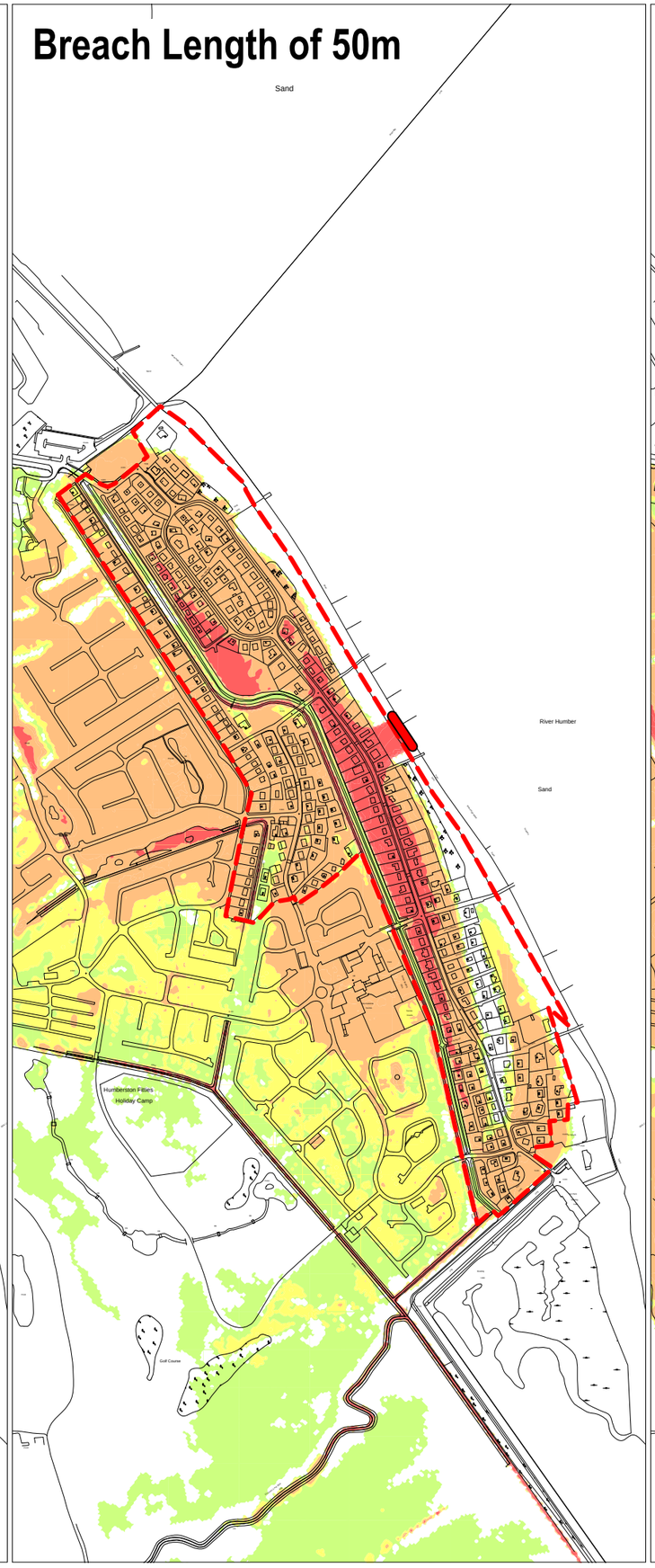
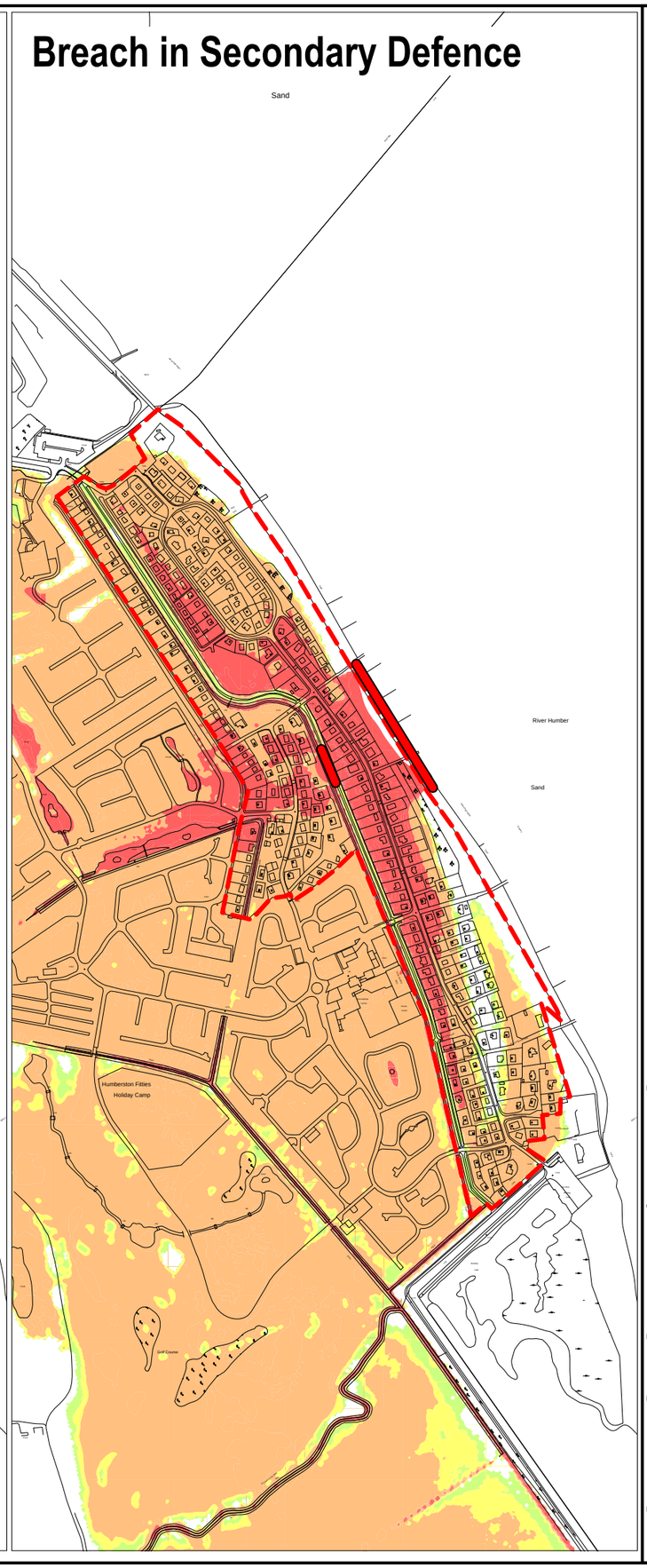


Breach Length of 50m



Breach in Secondary Defence



KEY

Humberston Fitties Chalet Park Boundary

Breach Location

Max Hazard

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- 0.75 - 1.25 (danger for some)
- 1.25 - 2.0 (danger for most)
- > 2.0 (danger for all)

0 50 100 150 200 250

metres

Note: The flood information presented is based on the most up-to-date extreme tide levels provided by the Environment Agency at the time of modelling. Following the winter storms of 2013/14 the Environment Agency is reviewing the extreme tide levels and it is likely that they will increase.

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Project

HUMBERSTON FITTIES FLOOD RISK ASSESSMENT

Drawing title:

BREACH MODEL SENSITIVITY ANALYSIS BREACH LENGTH & SECONDARY BREACH

Drawing Scale: NOT TO STANDARD SCALE | Sheet size: A3

Drawing no. Figure 3.9 | Revision B

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Depth

Sand

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- >2.0

River Humber

Sand

Humberston Fitties
Holiday Camp

Golf Course

N

Velocity

Sand

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- >2.5

River Humber

Sand

Humberston Fitties
Holiday Camp

Golf Course

Hazard

Sand

Max Hazard

- < 0.75 (low hazard)
- 0.75 - 1.25 (danger for some)
- 1.25 - 2.0 (danger for most)
- > 2.0 (danger for all)

River Humber

Sand

Humberston Fitties
Holiday Camp

Golf Course

KEY

Humberston Fitties Chalet Park Boundary

0 50 100 150 200 250

metres

Note: The flood information presented is based on the most up-to-date extreme tide levels provided by the Environment Agency at the time of modelling. Following the winter storms of 2013/14 the Environment Agency is reviewing the extreme tide levels and it is likely that they will increase.

Rev.	Drawn	Chkd.	Rwd.	Apprvd	Date	Description
B	TSP	IKK	IKK	TPMP	OCT.14	NOTE ADDED
A	TSP	IKK	IKK	TPMP	SEP.14	FIRST ISSUE

Designed by: T PADDISON Date: AUG.2014

Client

NORTH EAST LINCOLNSHIRE COUNCIL

Client Drawing No. | Revision

BLACK & VEATCH
Black & Veatch Limited
Registered Office
Grosvenor House, 6 London Road, Redhill, Surrey, RH1 1LQ, United Kingdom
Tel: +44(0)01737 774155 E-mail: bvl@bv.com

Project

HUMBERSTON FITTIES
FLOOD RISK ASSESSMENT

Drawing title:

FLOOD MAPPING
OVERTOPPING ANALYSIS
YEAR 2055
1 IN 200 ANNUAL PROBABILITY

Drawing Scale: NOT TO STANDARD SCALE | Sheet size: A3

Drawing no. Figure 3.10 | Revision B

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Depth

Sand

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- >2.0

River Humber

Sand

Humberston Fitties
Holiday Camp

Golf Course

N

Velocity

Sand

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- >2.5

River Humber

Sand

Humberston Fitties
Holiday Camp

Golf Course

Hazard

Sand

Max Hazard

- < 0.75 (low hazard)
- 0.75 - 1.25 (danger for some)
- 1.25 - 2.0 (danger for most)
- > 2.0 (danger for all)

River Humber

Sand

Humberston Fitties
Holiday Camp

Golf Course

KEY

Humberston Fitties Chalet Park Boundary

Breach Location

0 50 100 150 200 250

metres

Note: The flood information presented is based on the most up-to-date extreme tide levels provided by the Environment Agency at the time of modelling. Following the winter storms of 2013/14 the Environment Agency is reviewing the extreme tide levels and it is likely that they will increase.

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FLOOD RISK ASSESSMENT

Drawing title:

FLOOD MAPPING
BREACH ANALYSIS
YEAR 2025
1 IN 200 ANNUAL PROBABILITY

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Drawing no. Figure 3.11 | Revision B

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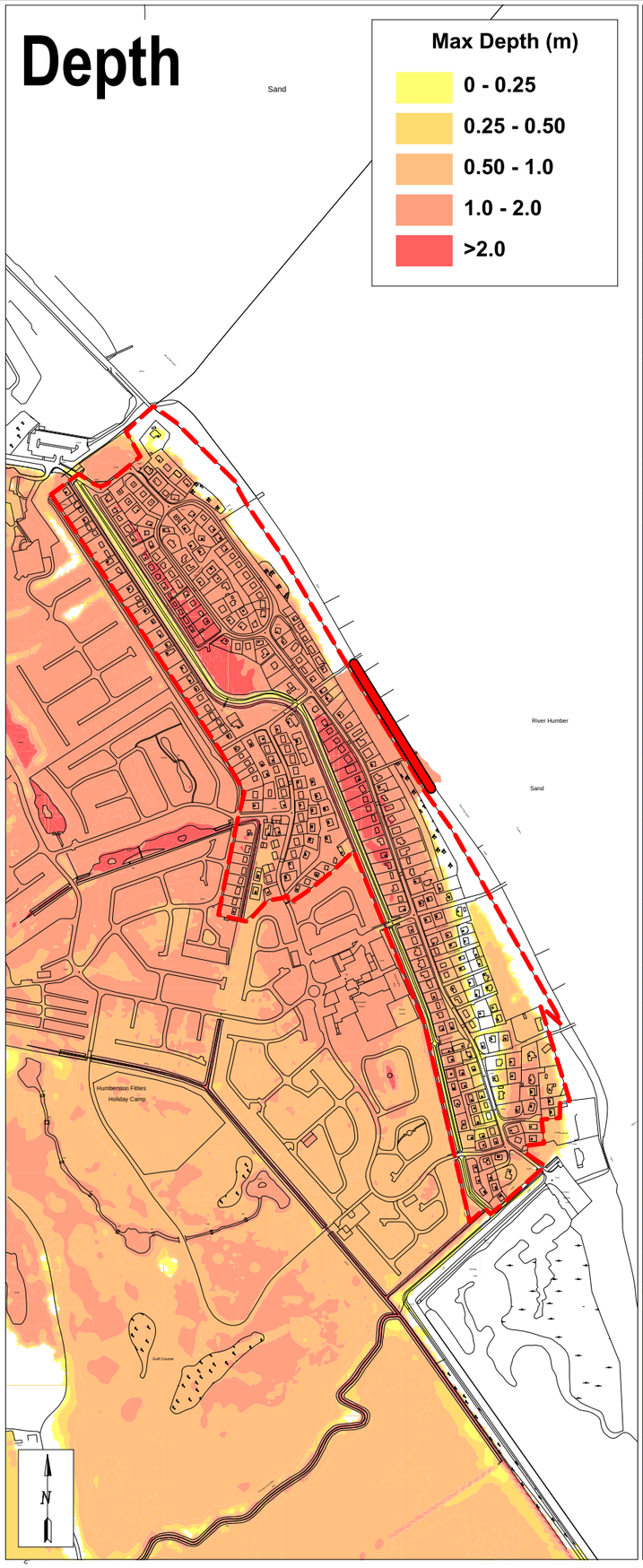
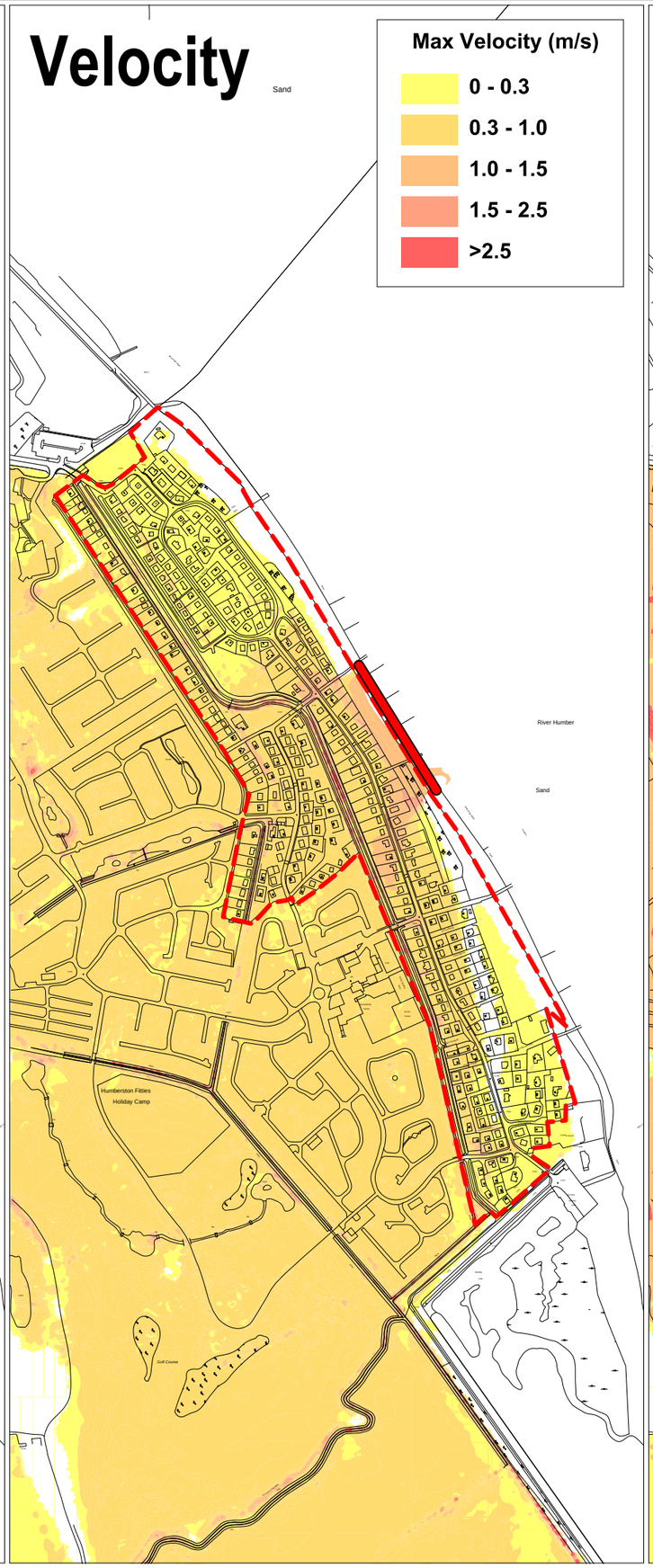
Depth

Max Depth (m)
- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- >2.0



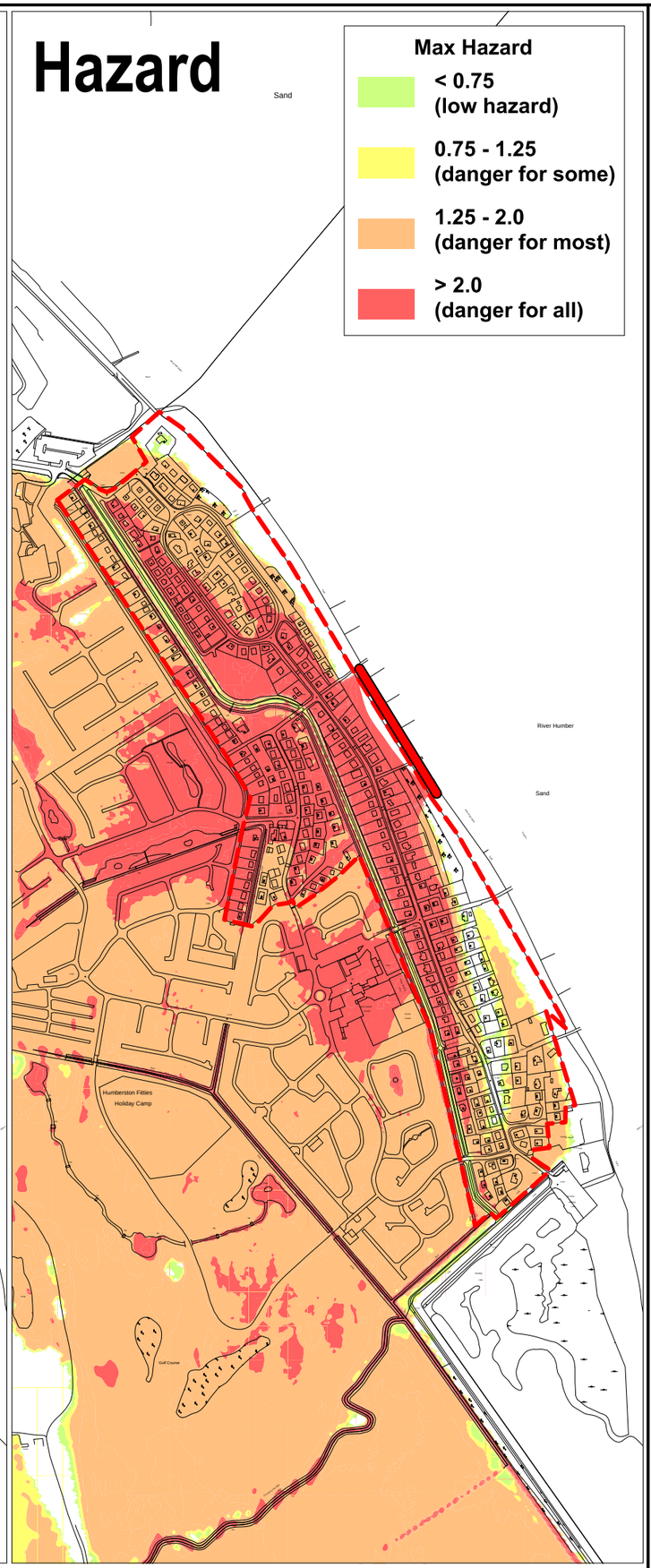
Velocity

Max Velocity (m/s)
- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- >2.5



Hazard

Max Hazard
- < 0.75 (low hazard)
- 0.75 - 1.25 (danger for some)
- 1.25 - 2.0 (danger for most)
- > 2.0 (danger for all)



KEY

Humberston Fitties Chalet Park Boundary

Breach Location

0 50 100 150 200 250
metres

Note: The flood information presented is based on the most up-to-date extreme tide levels provided by the Environment Agency at the time of modelling. Following the winter storms of 2013/14 the Environment Agency is reviewing the extreme tide levels and it is likely that they will increase.

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BREACH ANALYSIS
YEAR 2055
1 IN 200 ANNUAL PROBABILITY

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Drawing no. Figure 3.12 | Revision B

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