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Land South of Hall Gate, Holbeach

Flood Risk Assessment For Ashley King Developments



13401: FRA

Rev B: 10th July 2014

Rev A: June 2014

Original: June 2014

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Flood Risk Assessment
Land South of Hall Gate, Holbeach

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1.0 INTRODUCTION**1.1 TERMS OF REFERENCE**

- 1.1.1 BSP Consulting has been commissioned by Ashley King Developments to undertake a Flood Risk Assessment for the residential development of a site at Land South of Hall Gate, Holbeach.
- 1.1.2 In the preparation of this report, consultations have been undertaken with the Environment Agency (EA). A site visit was made in April 2014, to walk the local area, assess the local topography, and proposed development site constraints.
- 1.1.3 This report should be read in conjunction with BSP report 13401:DS which provides detailed discussion on surface water drainage strategy.
- 1.1.4 This Flood Risk Assessment has been prepared in accordance with the Department for Communities and Local Government (DCLG) publication 'Technical Guidance to the National Planning Policy Framework' while retaining the layout as recommended in the superseded 'Planning Policy Statement 25 (PPS25) Development and Flood Risk'.
- 1.1.5 This report has been produced on behalf of the client, Ashley King Developments, and no responsibility is accepted to any third party for all or any part. This report should not be relied upon or transferred to any other parties without the express written authorisation of BSP Consulting. If any unauthorised third party comes into possession of this report, they rely on it at their own risk and the authors owe them no duty of care or skill.

1.2 NATIONAL PLANNING POLICY FRAMEWORK

- 1.2.1 The National Planning Policy Framework was published on 27 March 2012. This replaces Planning Policy Statement 25: Development and Flood Risk.
- 1.2.2 Technical Guidance to the National Planning Policy Framework has been published and this site specific FRA is written in compliance with this new guidance.
- 1.2.3 The National Planning Policy Framework, and supporting technical guidance, can be downloaded free of charge from the internet at the following link:

<http://www.communities.gov.uk/publications/planningandbuilding/nppf>

2.0 BACKGROUND INFORMATION

2.1 SITE LOCATION, DESCRIPTION AND DETAILS

- 2.1.1 Figure 2.1 below indicates the location of the site; a more detailed site plan is located in Appendix A. A site visit was made in April 2014, to walk the local area, to assess the topography and proposed development site constraints.

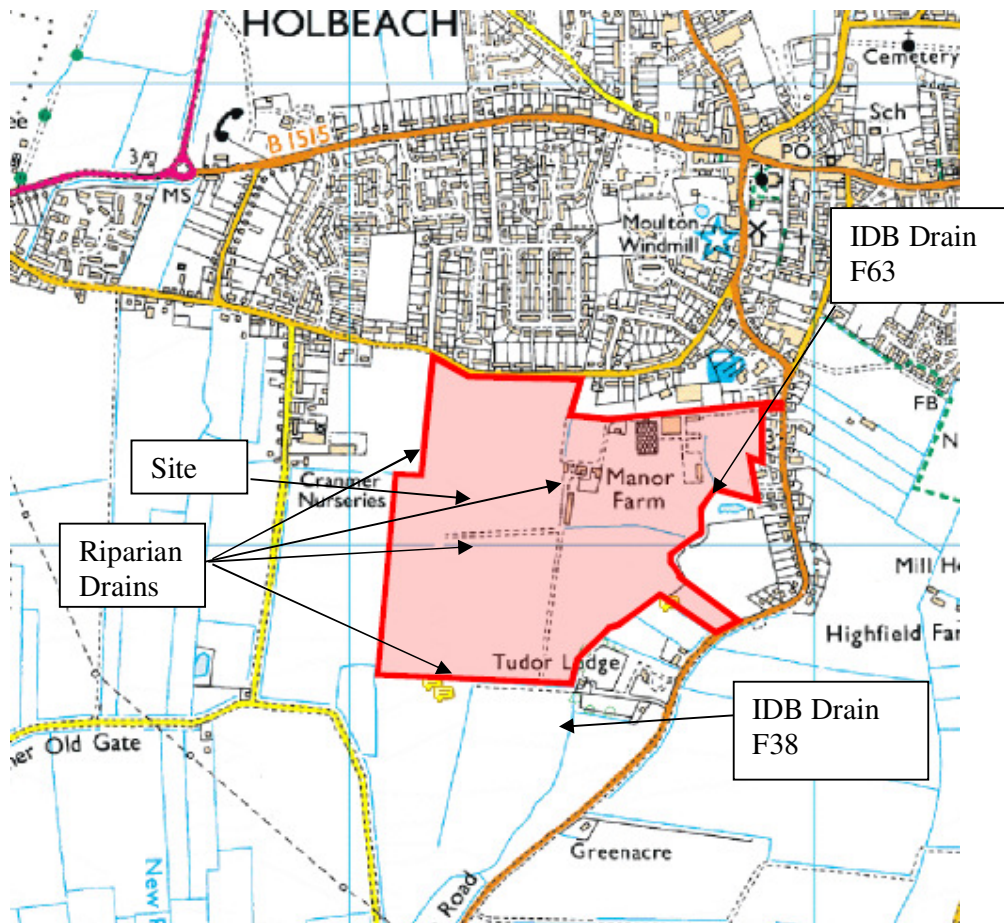


Figure 2.1 Land South of Hall Gate, Holbeach - Site Location Plan

- 2.1.2 The proposed development site occupies approximately 41.1ha. It is predominantly active agricultural land with some structures present in the NNE area of the site. It is located to the south of Hall Gate OS GR 535250E, 323650N.
- 2.1.3 The site is bounded to the north by Hall Gate, to the east by Drain F38 and properties fronting Fen Road to the south and west by riparian drains and further agricultural land.
- 2.1.4 A topographical survey of the site was been carried and a copy of this is included as Appendix B. This shows site levels be very flat at an average of 2.8-3.0m AOD. This is very typical of the area and the extended surroundings to the site are also very flat and at a similar level to the site.

2.1.5 Overall Catchment Context and Local Watercourse Classifications

The site is located within the South Holland Internal Drainage Board Catchment F.

The local catchment is therefore dominated by artificial drains, the main ones of which are as follows:

- | | |
|------------------|---|
| Riparian Drains: | Non Tidal, Low-level Private Land Drains which flow through the site and along its boundaries. Discharge to Main Drain F38. |
| Drain F63: | Non Tidal, Low-level IDB Drain which enters the site from the east as a culvert and discharges to; |
| Drain F38: | Non Tidal, Low-level IDB Drain which flows north to south through the site and along its boundary. |

The locations of the watercourses in relation to the site are shown in Figure 2.1.

2.2 APPROACH TO THE ASSESSMENT

- 2.2.1 The Environment Agency (EA) has provided predicted flood levels for the local area. The South Holland Internal Drainage Board (SHIDB) have provided details of the board maintained ditches in the vicinity of the site. Copies of this correspondence are included within Appendix D. This assessment seeks to draw together the relevant level information from the EA and SHIDB to collate this with the findings of our investigations and discussions to assess the flood risk at this site.

3.0 FLOOD RISK ASSESSMENT

3.1 DEVELOPMENT DESCRIPTION AND PLANNING CONTEXT

- 3.1.1 The proposed development is for c.900 dwellings with associated infrastructure and public open space.
- 3.1.2 A proposed site layout is included as Appendix C.
- 3.1.3 In accordance with NPPF, the proposed residential use falls under the **more vulnerable** category in terms of flood risk.
- 3.1.4 A 21.23ha area of the site is identified in the South East Lincolnshire Local Plan (SHLAA) as HOB002 with potential for development for 425 properties.

3.2 DEFINITION OF THE FLOOD HAZARD

- 3.2.1 The potential sources of flooding in the vicinity of the site are as detailed below:

3.2.2 Fluvial Flood Risk

3.2.3 Riparian Drains

- 3.2.3.1 A series of interconnected, well maintained, engineered, drainage ditches in the vicinity of the site. This network includes a culverted drain which enters the site from the north.
- 3.2.3.2 These arterial watercourses discharge to the IDB Drain network. As such the potential flood risk posed by these riparian drains is controlled by the IDB network and therefore there is no flood risk to the site directly from these drains.

3.2.4 IDB Drains F38 and F63

- 3.2.4.1 These Drains are IDB maintained, low level, watercourses that serves to drain the local catchment.
- 3.2.4.2 Drain F63 has been known to flood in the past as it passes underneath Fen Road. We understand that as a result of this flooding the IDB laid a new culvert from Fen Road in to and through the site connecting this to Drain F38. Since this took place it is understood no further flooding has occurred. The flooding from the drain was minor and did not affect the site itself.
- 3.2.4.3 Drain F63 discharges to F38. Water level within this network of IDB drains is controlled by the Little Holland Pumping Station which lifts water into the IDB South Holland Main Drain 5km south east of the site. As the level of the drains are actively controlled they are not considered to pose a direct risk of flooding to the site.

3.2.5 South Holland Main Drain

- 3.2.5.1 The South Holland Main Drain is a non-tidal high level watercourse which conveys the pumped water from the site catchment to its outfall with the River Nene. This outfall is controlled by Sutton Bridge Sluice Gate which is owned and maintained by South Holland Internal Drainage Board. As the level of the Main Drain actively controlled they are not considered to pose a direct risk of flooding to the site.

3.2.6 Tidal River Nene

- 3.2.6.1 The primary flood risk from the River Nene is due to its tidal condition, this is covered in detail in section 3.2.6 below.

3.2.7 Tidal Flood Risk

- 3.2.8 This is the primary source of flooding for the site and its surroundings due to the relatively low level, as described in section 2.1.4.
- 3.2.9 The Environment Agency have provided a series of tidal levels for the North Sea along this coastline. This is included in Appendix D. The tidal range in the North Sea is large, and storm tide surges are predicted to cause peak tide levels of 6.01mODN at West Lighthouse in the 1 in 200 (0.5%) event.
- 3.2.10 Flood defences are present along the entire east coast. These defences are owned and maintained by the Environment Agency. For further discussion about the height, standard and failure mechanisms of the defences see section 3.6.
- 3.2.11 With 1 in 200 year (0.5%) flood levels around 3m above the site level flooding from the North Sea is the main flood risk for the subject site.

3.2.12 Surface Water Flood Risk

- 3.2.13 The site lies in an area which is generally level and is very well served by drainage infrastructure. The site is therefore not at risk of significant flooding from surface water runoff from adjacent land.

3.2.14 Flood Risk from Ground Water

- 3.2.15 A Phase 2 site investigation has not yet been undertaken on the site. However as the site is located in an area which benefits from significant land drainage measures ground water does not present a significant risk of flooding to the site. This is confirmed below on the EA flood map for ground water flooding.



Figure 3.1 Land South of Hall Gate, Holbeach – Groundwater Flood Mapping

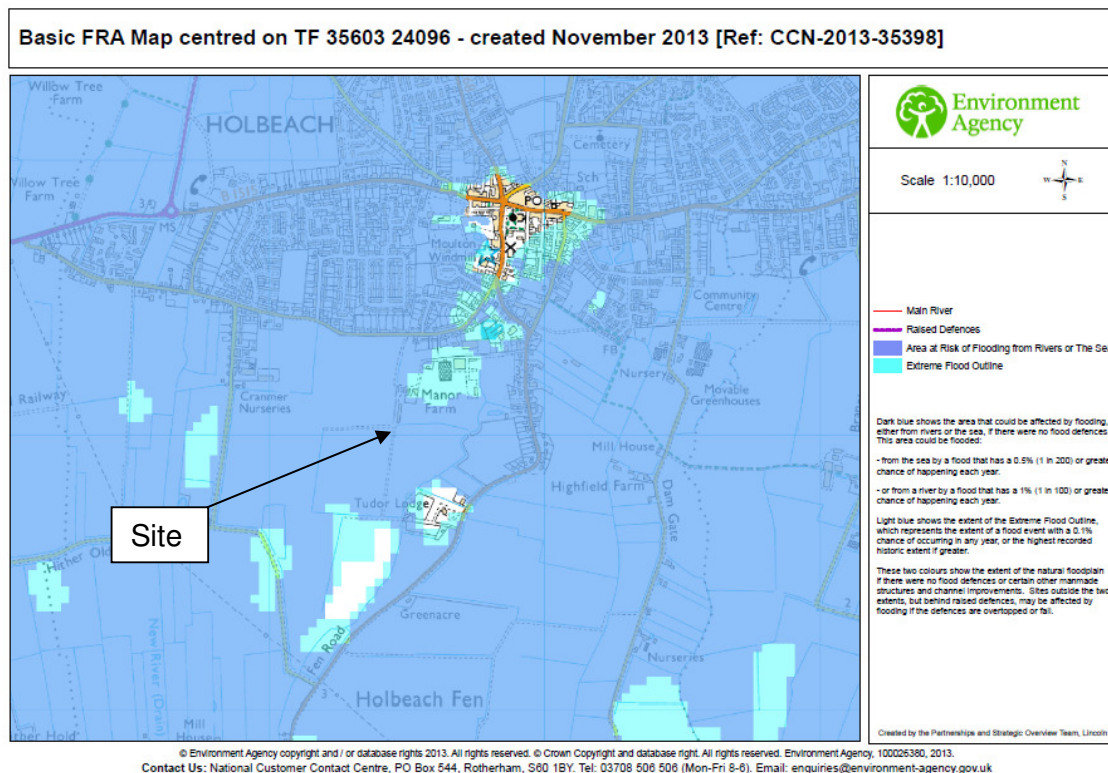
3.2.16 Flood Risk from Sewers and Infrastructure

- 3.2.17 Anglian Water (STW) has adopted sewerage plant within and directly adjacent to the site. This sewerage emanates from the site and it is therefore considered to present minimal risk to the proposed development. A copy of the sewer records is included in Appendix D.
- 3.2.18 It is understood that local highway flooding occurs on Hall Gate itself, this is stated to occur following sustained wet periods where areas of land abutting the highway become saturated. This flooding is localised and is not considered to pose any risk to the development itself.
- 3.2.19 The Environment Agency mapping confirms that the site does not lie in an area that is at risk of flooding from reservoirs.
- 3.2.20 The site is not within close proximity of any wet process industrial works other than the current site use.

- 3.2.21 The sewers and infrastructure flood risk source can therefore be discounted as a significant source of flood risk to the site.

3.3 PROBABILITY

- 3.3.1 The EA have provided us with an extract of their flood map for the local area, a copy of this is included within Appendix D. This indicates that the majority of the site would be at risk of flooding in a 1 in 200 year (0.5%) probability flood event due to overland flooding from the North Sea. This map shows the predicted extent of the natural floodplain, if there were no flood defences or certain other manmade structures. This mapping is reproduced below as Figure 3.2:



- 3.3.2 The Environment Agency has provided information on the standard of the existing defences and has confirmed that they currently offer a 1:150 year standard of protection.
- 3.3.3 In accordance with NPPF, the site should be classified as lying within Flood Zone 3a, High Probability, having an annual probability of tidal flooding greater than 1:200, ignoring the presence of the existing defences.

3.4 CLIMATE CHANGE

- 3.4.1 Climate change is recognised as a factor for consideration in terms of its effects on flood risk. This issue affects the local catchment from fluvial sources in as much as fluvial flood flows are estimated to increase by up to 20% over the next 100 years.

- 3.4.2 This increase in fluvial flood levels may cause an increase in the risk posed to the site from the local watercourses and drains. However as the drains are part of a pumped catchment the increased rainfall will cause the pumps to be used more frequently.
- 3.4.3 The effects of climate change on the flood risk posed by the local watercourses is not felt to pose any increased risk to the subject site.
- 3.4.4 Climate change is also a recognised factor for consideration of flooding risk from tidal sources.
- 3.4.5 The implications of climate change have been taken into account in the modelling work that has been carried out for the EA, presented in Appendix D.

3.5 DETAILED DEVELOPMENT PROPOSALS

- 3.5.1 The proposed development and vulnerability classification are discussed in Section 3.1 above and the proposed site layout plan is included within Appendix C.
- 3.5.2 The technical guidance to the NPPF states that developments such as the proposed residential use is appropriate within Flood Zone 3a subject to the sequential test being passed by the Local Planning Authority.
- 3.5.3 This area of the east coast of England is widely considered to be at risk of flooding from the North Sea. With areas of the site being categorised as Flood Zone 2 this site appears favourable in comparison to much of the land in this region.

3.6 FLOOD RISK MANAGEMENT MEASURES

3.6.1 Existing Flood Defences and Structures

- 3.6.1.1 The coastal defences in the vicinity of the site consist of an earth embankments and are confirmed to offer a 1 in 150 year standard of protection.
- 3.6.1.2 The Environment Agency have stated that the existing coastal defences in the vicinity of the site are good/fair condition. The defences are subject to routine inspection and ongoing maintenance by the Environment Agency.
- 3.6.1.3 For discussion on the possible failure mechanisms for the existing flood defences see section 3.6.2.

3.6.2 Failure Mechanisms

- 3.6.2.1 The regular inspection and maintenance of the defences makes it highly unlikely that they will fail, however the possible failure mechanism are summarised below:

3.6.2.2 Overtopping:

3.6.2.3 It has been described above that the existing defences are currently overtopped by in the 1 in 150 year event and, without any defence improvement works, the significance of the overtopping will increase as described over time.

3.6.2.4 The risk of flooding to the subject site is negligible in the overtopping event alone. The site is located around 10km from the coast and the intervening land is largely flat and contains a system of drainage features which would intercept the moderate volume of water which would come from overtopping alone..

3.6.2.5 Overtopping is the most likely scenario for flooding in the region but not to the site itself.

3.6.2.6 Direct Breaching:

3.6.2.7 Direct breaching of coastal defences most commonly occurs where defences are found in the form of hard defences. Such defences may breach due structural failure of the walls themselves.

3.6.2.8 This mode of failure is uncommon for earth embankments and does not pose a significant risk of flooding to the region or the site.

3.6.2.9 Breaching Due to Overtopping:

3.6.2.10 This mode of failure typically occurs with soft defences when overtopped by significant volumes of water during an extreme storm tide surge. This can lead to erosion of the crest, landward face and landward toe of the defence and so reduce its stability.

3.6.2.11 The likelihood of structural failure is greatly reduced by the level of maintenance the defence has received and the adequacy of its original construction.

3.6.2.12 The EA have provided further information in the form of flood hazard mapping for the breach scenario. This mapping shows the site to fall largely within the Low Hazard flood risk in the 1:200 year 2115 (climate change) event.

3.6.2.13 The breach hazard mapping also includes predictions for the flood depth and velocity in the climate change breach events.

3.6.2.14 In 1:200 year 2115 (climate change) breach scenario the modelled velocity range is 0 to 0.3m/s and the typical predicted water depth is approximately 0-0.3m. Interrogation of this information shows a modelled flood level of **3.180m**AOD. See SK-FRA 002 in Appendix E.

3.6.2.15 As the defences are known to be in good condition the likelihood of direct breaching of the defences is extremely remote. However a residual risk remains from this mode of failure. This residual risk is described further in sections 3.8.2, 3.8.5 and 3.10.

3.6.2.16 Breach due to overtopping is the most likely scenario for flooding primary flood risk at the region. Any flooding of the site from the North Sea is likely to come from the mechanism described above.

3.6.3 Proposed Site Development and Finished Floor Levels (Avoidance)

3.6.3.1 The site lies in a defended area. However it has been shown that the defences do not offer the 1 in 200 year standard of defence at the current time and in the future climate change scenario.

3.6.3.2 The flood level for the site in the 1 in 200 year 2115 (climate change) event has been established as **3.180mAOD** in the breach scenario.

3.6.3.3 Whilst this includes an allowance for climate change minimum finished floor levels should be set a further 450mm above the modelled breach level to mitigate against exceedance and any localised flooding.

3.6.3.4 As such the proposed minimum finished floor levels should be set at **3.630mAOD**, i.e. lifting FFLs **830mm** over existing site levels in some parts of the site.

3.6.3.5 Where proposed plots are in close proximity to site boundaries and existing structures it may not be possible to lift FFLs by this degree. Where this is not possible floor levels should be set no lower than **3.330mAOD** and flood resilience measures should be used to a levels of **3.780mAOD** as described by the following and specified in Appendix F.

3.6.4 Flood Resilience (Avoidance)

3.6.4.1 As described in section 3.6.2.5 where plots cannot achieve the minimum finished flood level of **3.630mAOD** due to site constraints it is recommended that these dwellings be detailed utilising Flood Resilient Construction methodology.

3.6.4.2 Section 3.6.2.5 flood resilience measures should be installed to a level of **3.780mAOD**.

3.6.4.3 Based upon this flood level and the minimum finished floor level of **3.330mAOD** flood resilience in accordance with the Department for Communities and Local Government document 'Improving the Flood Performance of New Buildings' states that a Water Entry Strategy is recommended as a precautionary measure.

3.6.4.4 A Water Entry Strategy places an emphasis quick and safe reoccupation of a building following a flood event. Use of specific construction techniques and materials is recommended, the full details of which are included with Appendix F. The areas of the building where measures should be incorporated are foundations, floors, walls, fittings and services.

3.6.4.5 Subject to detailing of the buildings in line with Appendix F the structural integrity of the buildings will not be adversely affected by a flood event and reoccupation should be possible with minimum disruption. Approvals should be sought from the building control officer as necessary for the design and detailing of the buildings.

3.6.5 Flood Warning (Reduction)

3.6.5.1 The subject site is located within the Environment Agency Flood Warning Area “Holbeach, Fleet, Gedney and surrounding areas including Holbeach St Johns and Sutton St Edmund”. This means occupants are covered by Floodline Warnings Direct system. This is an elective scheme that requires occupants to register to receive automated warnings in times of heightened flood risk. It is recommended that the prospective occupants are advised to register to receive flood warnings from the EA.

3.6.6 Site Drainage Systems (Alleviation)

3.6.6.1 The preceding work describes the likelihood of flooding of the site from external sources. However, with a site of this scale, it is important to include appropriate consideration of water control as unmanaged discharge of surface water can lead to increased flood risk for others and to the site itself.

3.6.6.2 Site drainage systems should be checked with a factor of 1.3 to allow for the effects of climate change and should be designed in accordance with Part H of the Building Regulations, Sewers For Adoption (6th Edition), CIRIA C697, The Manual for SUDs and other appropriate guidance documents

3.6.6.3 BSP report 13401:DS provides detailed discussion on surface water drainage strategy however key flood prevention measures can be summarised as follows:

3.6.6.4 Source control measures are to be installed as part of the overall landscape architecture of the site and will be used wherever possible to improve water quality and reduce the speed of runoff. These features take the form of swales and open water features.

3.6.6.5 In addition to the source control measures the development proposals include the use of permeable paving, the use of rain gardens to sections of highway and private driveway and French Drains to private areas

3.6.6.6 The ongoing maintenance of all drainage features is considered and, wherever possible, features are to be vesting with a public authority to guarantee ongoing maintenance in perpetuity. This will ensure localised flooding issues do not arise as a result of lack of appropriate maintenance.

- 3.6.6.7 Section 3.2.15 describes a localised flooding issue on Hall Gate. This matter will be considered fully at detailed design stage, with appropriate drainage measure introduced along Hall Gate to improve the drainage along this stretch of public highway.

3.7 OFF SITE IMPACTS

- 3.7.1 The development drainage discharge will be equivalent an agreed greenfield rate from the site, as such no downstream flooding will be caused as a result of the development.
- 3.7.2 As the proposed development is situated behind existing flood defences no functional flood plain will be lost as part of the re-development proposals.

3.8 RESIDUAL RISKS

- 3.8.1 On the basis that the site lies behind flood defences there is a residual risk that the defences could breach. Given that the defences are inspected and maintained by the EA this residual risk is considered to be minimal.
- 3.8.2 Breach of the defences is considered within the work of the Environment Agency. The flood level in an exceedance rainfall event has also been considered in this work. SK-FRA 001 in Appendix E shows the impact of a breach in a 1:1000 year (climate change scenario). The predicted flood levels are interpolated as 3.165mAOD, which is 365mm below the recommended finished floor levels (or 65mm below the absolute minimum FFL, 515mm below the flood resilient construction datum).
- 4.8.3 The proposed surface water drainage system should be designed to accommodate the 1 in 30 year rainfall event without any surface water flooding and should be capable of retaining the 1 in 100 year plus climate change storm event on site without flooding any buildings. The depth of the flood water should be considered in detailed design to ensure that they do not pose a hazard on site.
- 4.8.4 In the event of a failure of the proposed drainage system, flood flow routes through the proposed development should be included at the detailed design stage. This will require consideration of the proposed finished floor and external levels, such that potential flood waters can flow away from the site with the local topography without entering the proposed or existing buildings.
- 4.8.5 The investigations carried out as part of this flood risk assessment and flood risk management measures proposed have demonstrated that the development will be safe, without increasing flood risk elsewhere and will, where possible, assist in reducing flood risk overall by reducing surface water discharge from the site.

5.0 RECOMMENDATIONS

5.1 The following recommendations are made to ensure flood risk at this site is minimised:

- Finished floor levels on the site should be set to a minimum of **3.630m** AOD, to elevate property 450mm above predicted 1:200 year climate change breach level.
- Where (locally) these finished floor levels cannot be achieved the minimum FFL should be **3.380m**AOD and flood resilience measures should be employed above this level to a datum of **3.780m**AOD
- Prospective occupants of each phase should register to receive flood warnings from the EA.
- Flood flow routes through the proposed development should be included at the detailed design stage to prevent flood risk to buildings in the event of a failure of the proposed drainage system.
- Sustainable drainage systems should be employed across the site to improve water quality, limit run of rate and volume.
- Appropriate drainage measure should be introduced along Hall Gate to improve the drainage along this stretch of public highway as part of forming the site access.

Disclaimer

We would note that all comments made in this report are based on the sources stated in Section 1.1. This report and its recommendations are intended for the use of Ashley King Developments for the above site only.

Appendix A Detailed Site Location Plan



Architects Project Managers Quantity Surveyors
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Project	Land South of Hall Gate, Holbeach, Lincolnshire
Client	Ashtons Development Ltd
Sheet title	Location Plan @ A3
Ref	2004 - 010
Scale	1:5000 @ A3
Date	May 2004
Drawn	PC
Checked	

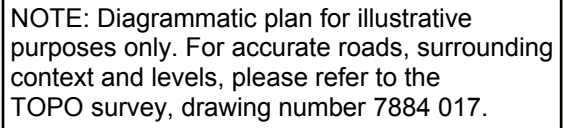
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0 50m 100m 150m 200m

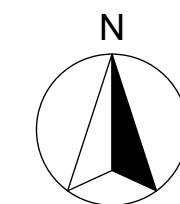
Appendix B
Topographical Survey



Appendix C
Proposed Site Layout
7884 021 Indicative Site Layout



Date:



All dimensions to be checked on site. Do not scale off drawing. This drawing is the copyright of the Architect, and not to be reproduced without their permission.
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Appendix D
Correspondence Received

Fesar Ali
f.ali@bsp-consulting.co.uk

Our ref: CCN-2013-35398
Your ref:

Date: 4 November 2013

Dear Fesar

Basic Flood Risk Assessment Data Request for the proposed development at Hall Gate, Holbeach TF 35603 24096

Thank you for your request of 10th October 2013 to use Environment Agency data, Product 3 & 8, in the development of the Flood Risk Assessment (FRA) for the above site. The information is attached.

If you have requested this information to help inform a development proposal, then you should note the detail in the attached advisory text on the use of Environment Agency Information for Flood Risk Assessments / Flood Consequence Assessments.

Flood Map

The attached map includes the current Flood Map for your area. The Flood Map indicates the area at risk of flooding, **assuming no flood defences exist**, for a flood event with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding. It also shows the extent of the Extreme Flood Outline which represents the extent of a flood event with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

The Flood Map only indicates the extent and likelihood of flooding from rivers or the sea. It should also be remembered that flooding may occur from other sources such as surface water sewers, road drainage, etc.

History of Flooding

With regards to the history of flooding I can advise that we do not have any records of flooding in this area. It is possible that other flooding may have occurred that we do not have records for, and other organisations, such as the Local Authority or Internal Drainage Boards, may have records.

Tidal Flood Levels

Please find attached available **tidal** flood levels as requested. These levels have an assessment date of 2006, which should be used in any consideration of future increases due to climate change. The levels are in metres above Ordnance Datum Newlyn (mODN) and are valid for 12 months from the date of issue.

Tidal Defence Information

The tidal defences protecting this site consist of earth embankments. They are in good/fair condition and provide protection against a flood event with a 0.67% chance

Contd.../

of occurring in any year (1 in 150). We inspect these defences regularly to ensure that any potential defects are identified early.

Land Drainage

The information provided is limited to flood risk from the sea and rivers with catchment areas greater than 3km². The property is in an area of extensive land drainage which may pose an additional risk of flooding. Further information should be sought from the South Holland Internal Drainage Board (tel: 01553 819600).

Hazard Mapping – Breaching

Enclosed with this letter is a plan showing the location of the breaches we have modelled, together with two plans showing the maximum values of flood depth, velocity and hazard rating (danger to people) for the following scenarios:

- Year 2115 0.5% (1 in 200) chance event
- Year 2115 0.1% (1 in 1000) chance event

Your site is not affected by overtopping or for the present day (2006) breach scenarios.

Please note that the modelling completed to date, and hence the overtopping represented on the maps, does not include overtopping along the following tidal rivers: Witham Haven (upstream of Hobhole) and Welland (upstream of Fosdyke Bridge).

It is important that you read the contextual notes on the maps.

This information is provided subject to the enclosed notice, which you should read.

If you have any queries or would like to discuss the content of this letter further please contact Lisa Killick using the telephone/email details below. Please quote our CCN reference number in all correspondence where data is referenced, including the Flood Risk Assessment.

Yours sincerely



FOR John Ray

Coastal Partnerships & Strategic Overview Team Leader

Direct dial 01522 785027

Direct fax 01522 785018

Direct e-mail lisa.killick@environment-agency.gov.uk

Enc.

FRA Advisory Text

Basic FRA Map

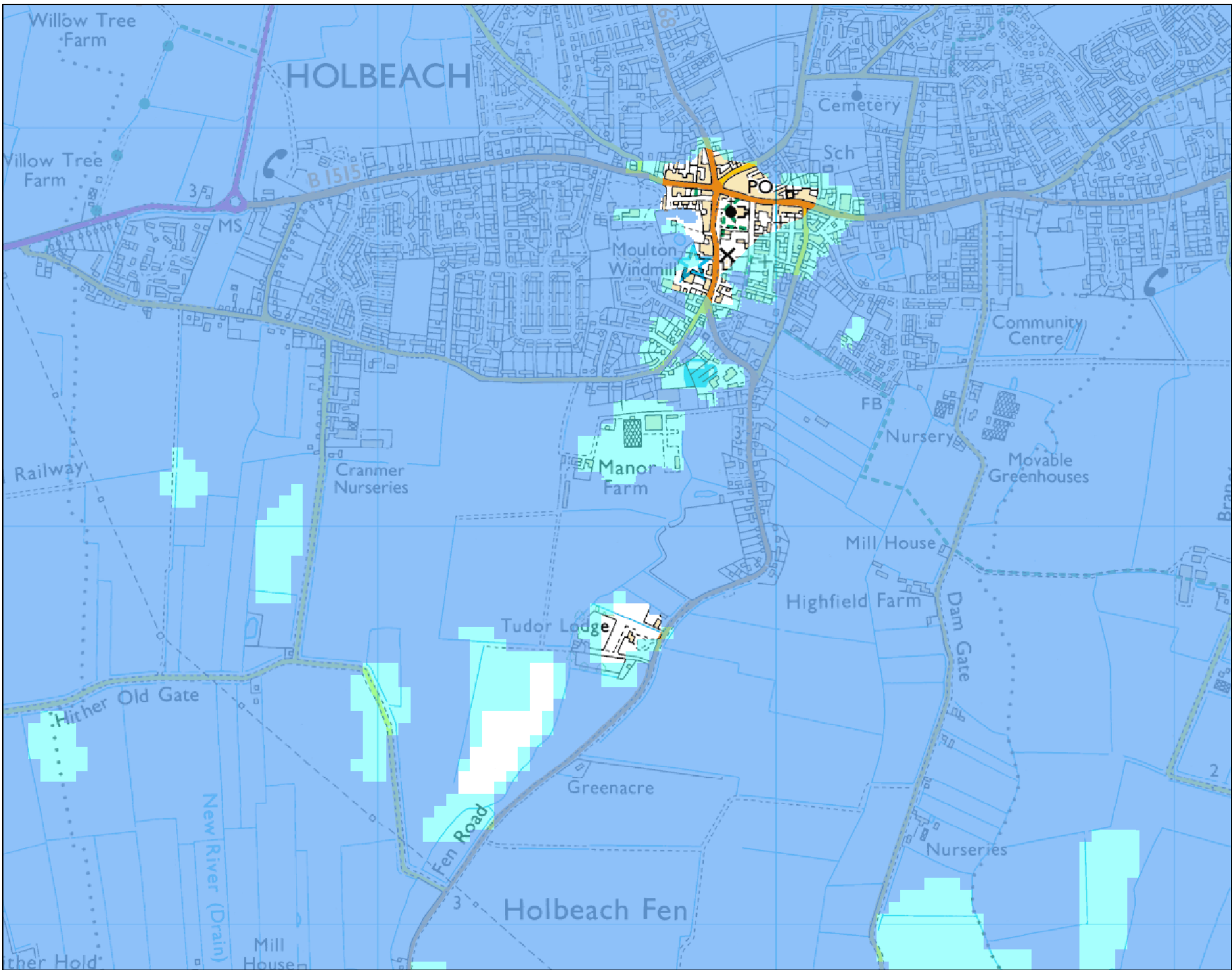
Northern Area Tide Levels

Breach Location Plan

Breach Hazard Maps x 2

Standard Notice

Basic FRA Map centred on TF 35603 24096 - created November 2013 [Ref: CCN-2013-35398]



Scale 1:10,000



- Main River
- Raised Defences
- Area at Risk of Flooding from Rivers or The Sea
- Extreme Flood Outline

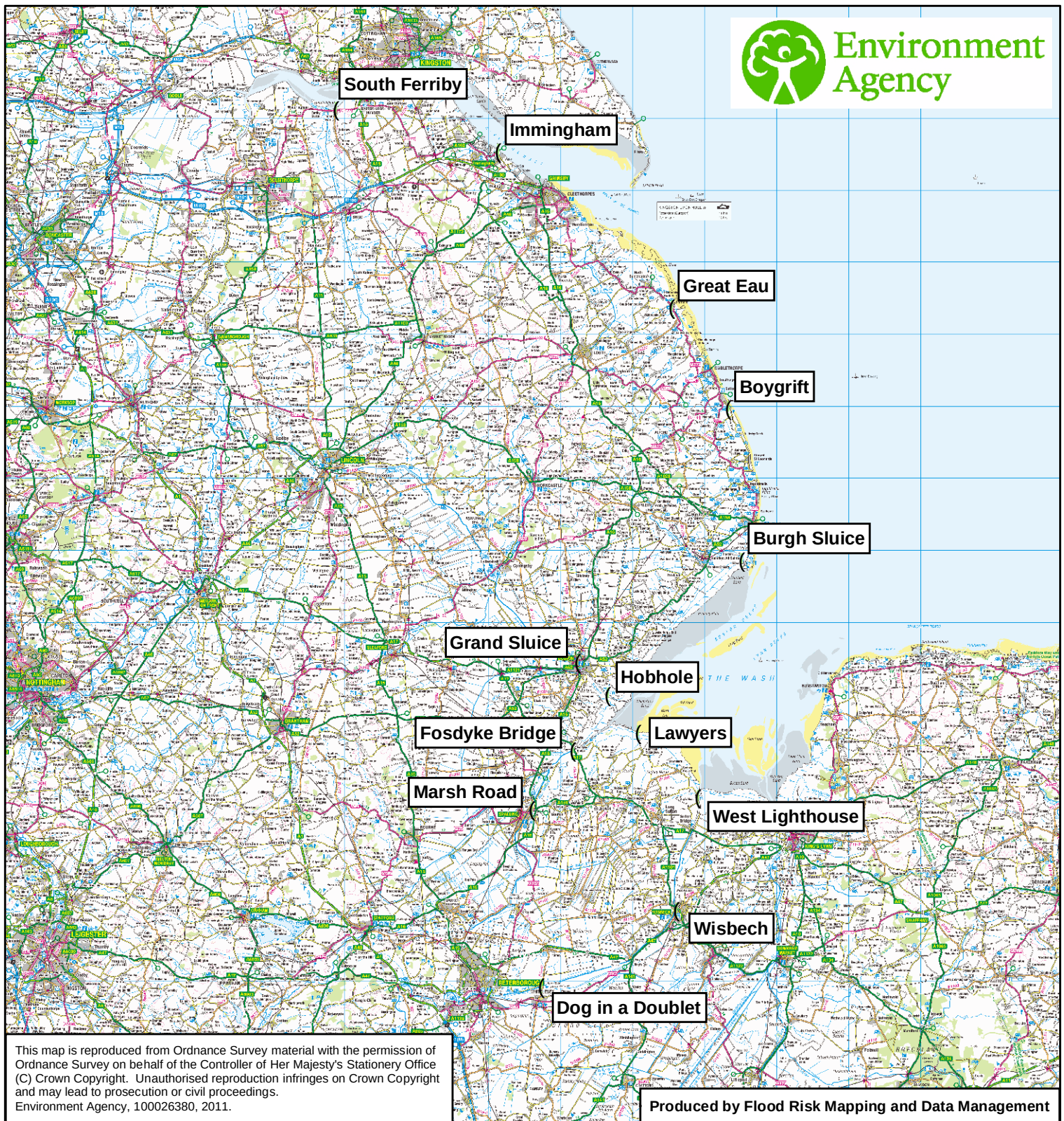
Dark blue shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded:

- from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year.
- or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.

Light blue shows the extent of the Extreme Flood Outline, which represents the extent of a flood event with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

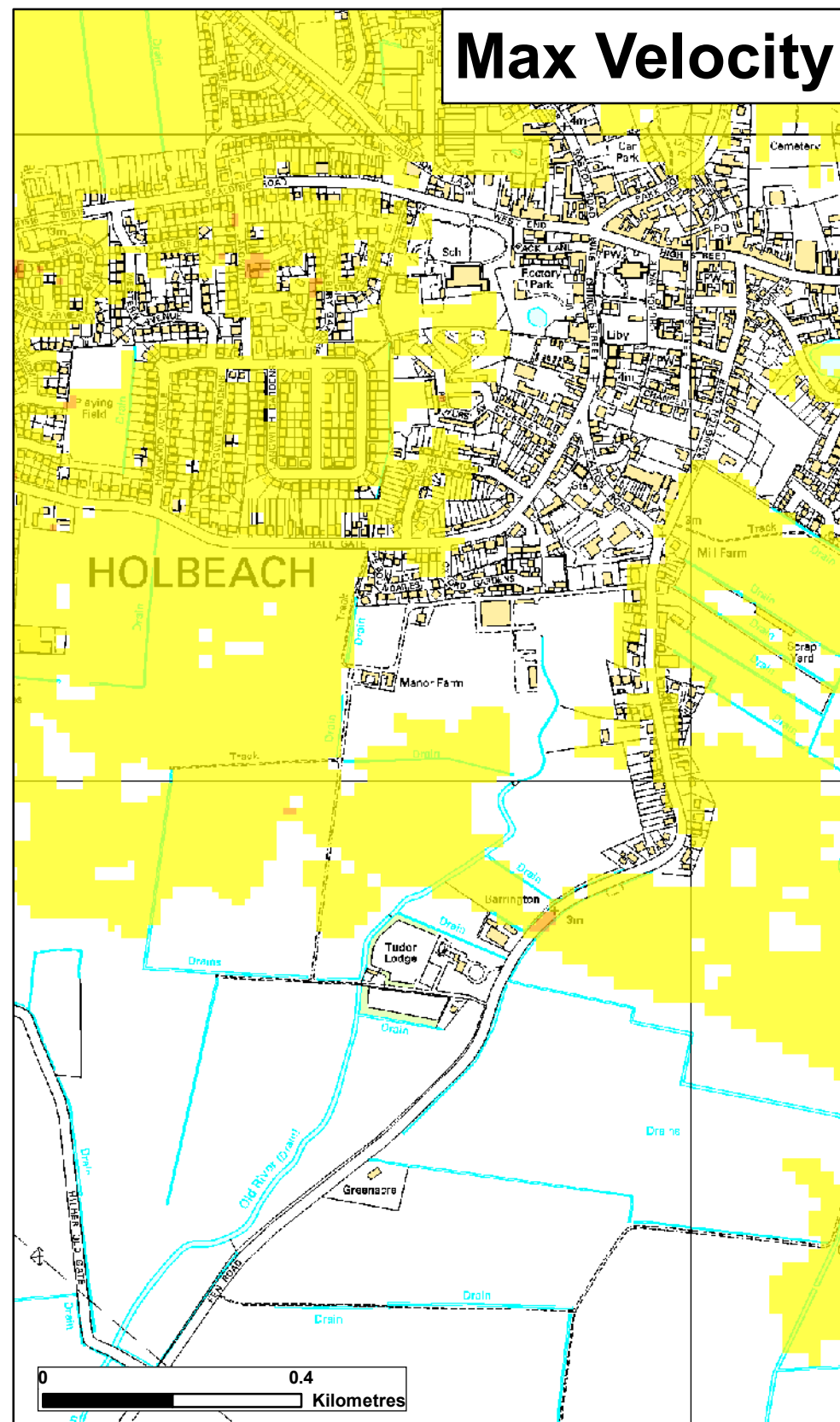
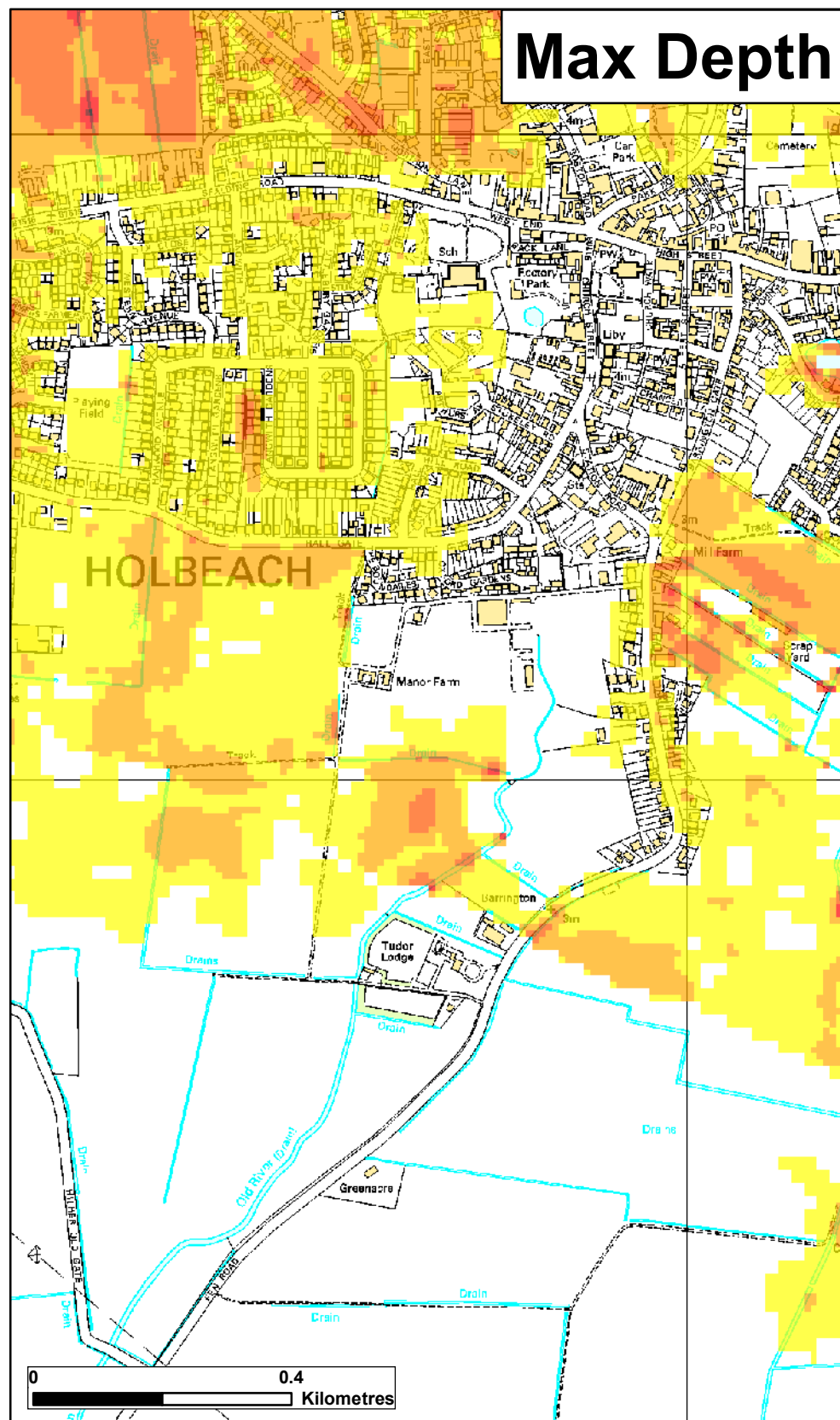
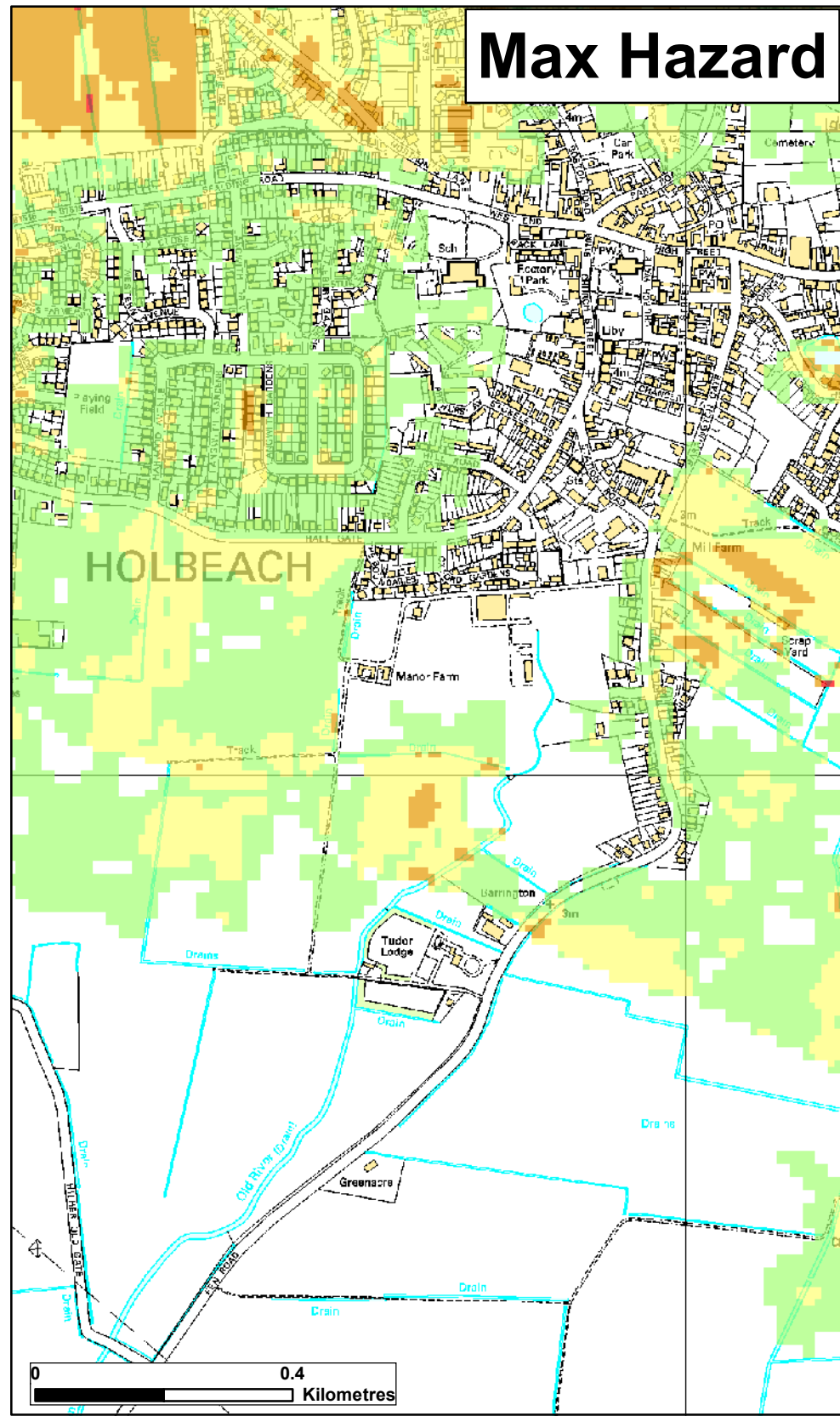
These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements. Sites outside the two extents, but behind raised defences, may be affected by flooding if the defences are overtopped or fail.

Created by the Partnerships and Strategic Overview Team, Lincoln



Still Water Tidal Levels mODN - Northern Area Tidal Model Analysis 2006

Location	Easting	Northing	100% (1 in 1)	10% (1 in 10)	4% (1 in 25)	2% (1 in 50)	1% (1 in 100)	0.5% (1 in 200)	0.1% (1 in 1000)
South Ferriby	498772	421418	4.90	5.29	5.45	~	~	5.55	5.63
Immingham	521381	415464	4.08	4.49	4.65	4.76	4.88	5.05	5.34
Great Eau	545500	393800	3.80	4.19	4.34	4.46	4.57	4.69	4.96
Boygrift	553300	379800	3.84	4.24	4.41	4.53	4.65	4.77	5.05
Burgh Sluice	555190	358620	4.26	4.45	4.63	4.76	4.90	5.03	5.34
Hobhole	536610	339940	4.82	5.30	5.49	5.64	5.78	5.93	6.27
Lawyers	540750	334550	4.84	5.32	5.51	5.66	5.80	5.95	6.29
West Lighthouse	549150	325750	4.88	5.37	5.57	5.71	5.86	6.01	6.35
Grand Sluice	532400	344500	4.88	5.33	5.51	5.65	5.78	5.93	~
Fosdyke Bridge	531700	332200	4.91	5.38	5.56	5.71	5.85	5.99	~
Marsh Road	526000	324000	5.04	5.44	5.60	5.73	5.85	5.98	~
Wisbech	546100	310000	4.83	5.25	5.41	5.53	5.66	5.78	~
Dog in a Doublet	527300	299300	3.67	4.00	4.13	4.22	4.32	4.42	~



★ Modelled Breach Locations - see also the accompanying plan "Location of Modelled Breaches"					
Max Hazard (Flood Risk to People : FD2320)		Max Depth (m)		Max Velocity (m/s)	
Less than 0.75 (Low Hazard)		0 - 0.25		0 - 0.3	
Between 0.75 and 1.25 (Danger for Some)		0.25 - 0.50		0.3 - 1.0	
Between 1.25 and 2.0 (Danger for Most)		0.50 - 1.0		1.0 - 1.5	
Greater than 2.0 (Danger for All)		1.0 - 2.0		1.5 - 2.5	
		2.0 +		2.5 +	
Date Printed	November 2013	Scenario year	2115	Scenario Annual Chance	0.5% (1 in 200)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

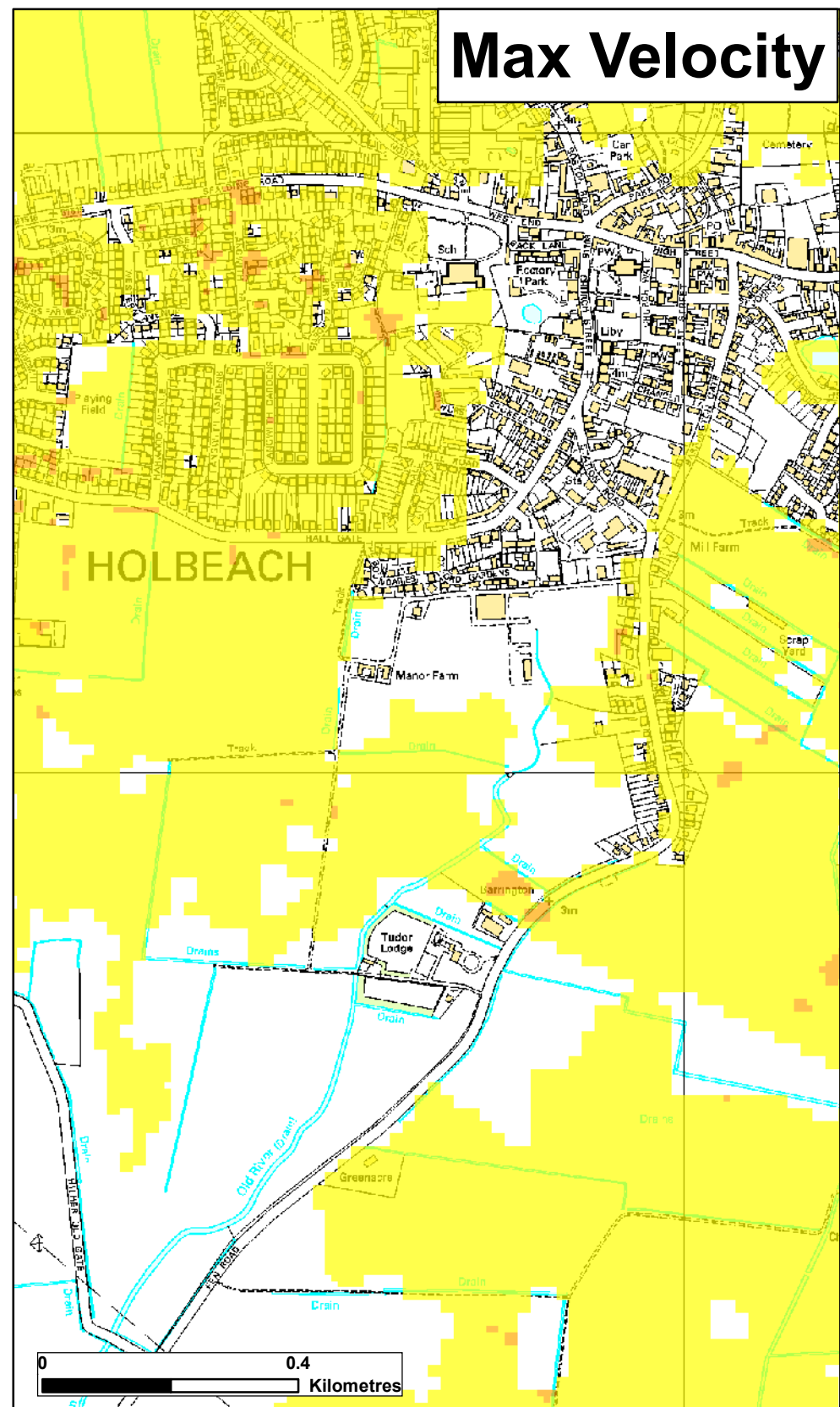
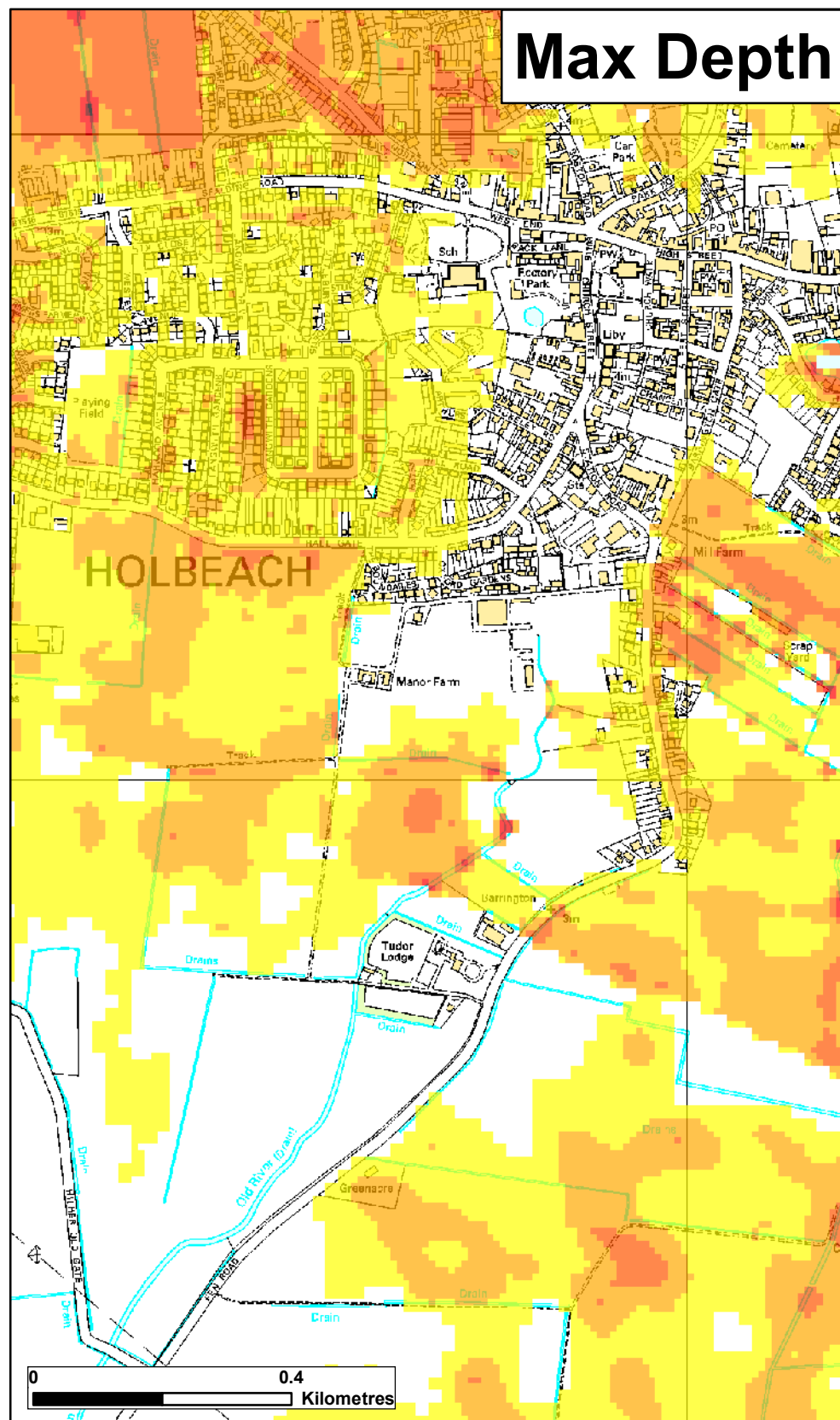
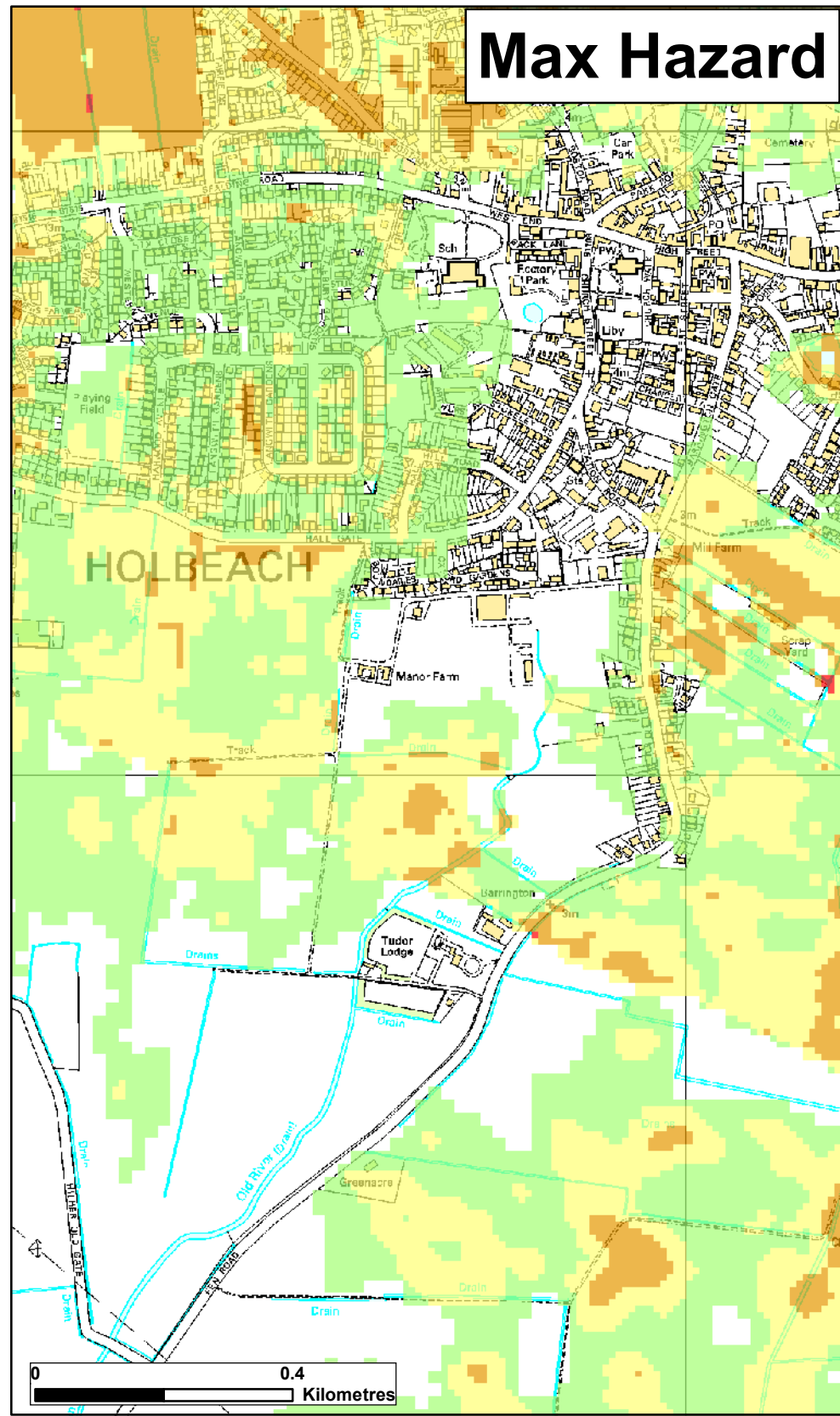
The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

Northern Area Tidal Breach Hazard Mapping

Map Centered on TF 35603 24096

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★ Modelled Breach Locations - see also the accompanying plan "Location of Modelled Breaches"					
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	Greater than 2.0 (Danger for All)		1.0 - 2.0		1.5 - 2.5
			2.0 +		2.5 +
Date Printed	November 2013	Scenario year	2115	Scenario Annual Chance	0.1% (1 in 1000)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

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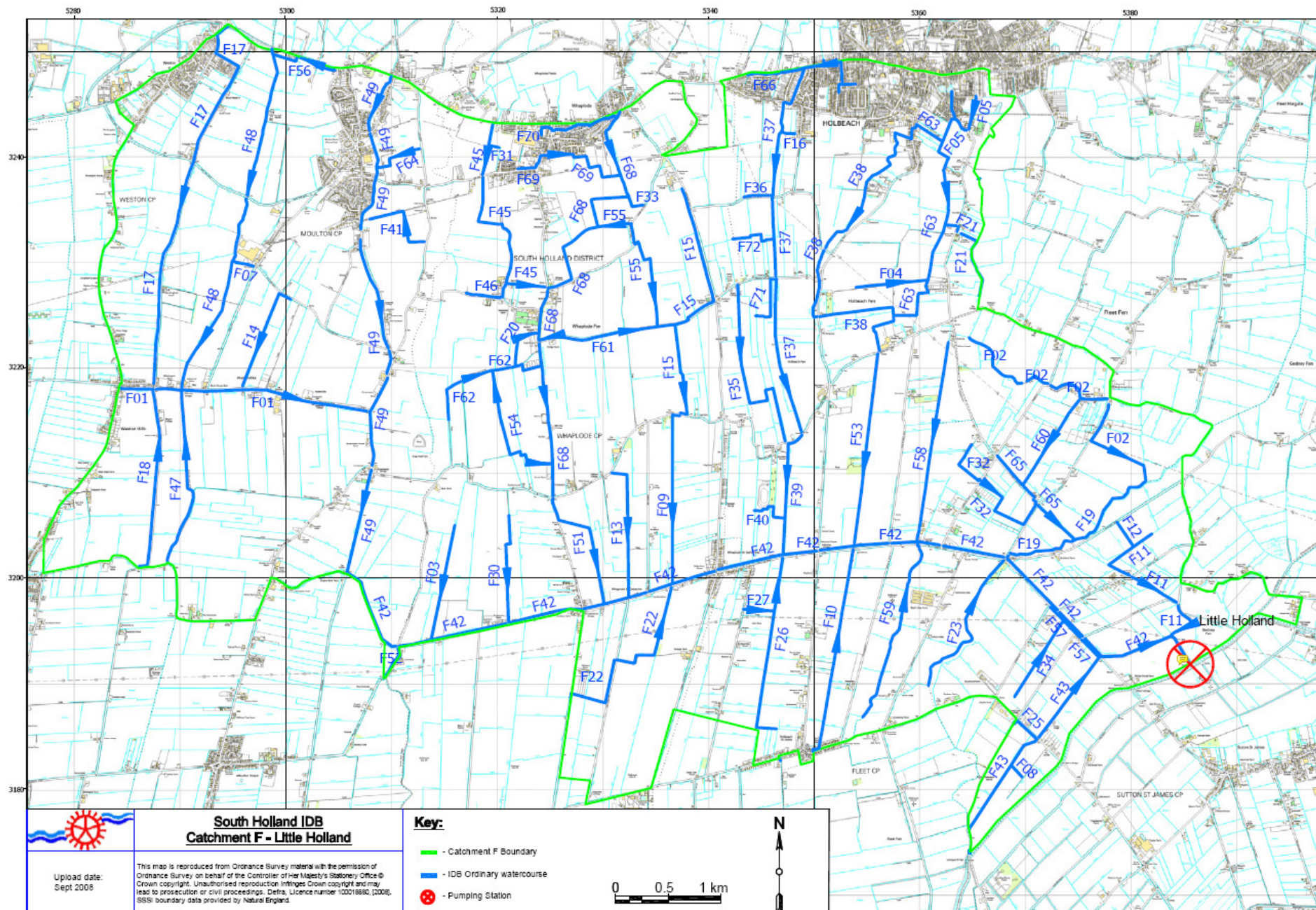


Environment Agency

Northern Area Tidal Breach Hazard Mapping

Map Centered on TF 35603 24096

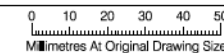
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Appendix E Breach Overlay Drawings

13401/SKFRA 001 – Breach Flooding Levels 1 in 1000 Annual Chance

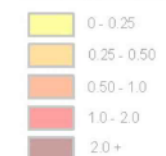
13401/SKFRA 002 – Breach Flooding Levels 1 in 2000 Annual Chance



General Notes

- DO NOT SCALE.
- This drawing is to be read in conjunction with all other relevant drawings and details.
- Should there be any conflict between the details indicated on this drawing and those indicated on other drawings the Engineer should be informed PRIOR to construction on site.
- Until technical approval has been obtained from the relevant Authority, it should be understood that all drawings issued are Preliminary and NOT for construction. Should the contractor commence site work prior to such approval being given, it is entirely at his own risk.
- All dimensions are in millimetres unless otherwise stated.
- The BSP Hazard Identification and Risk Assessment information for this project must be reviewed and understood by the contractor PRIOR to the commencement of any works on site.

Max Depth (m)



Scenario year 2115

Date Printed November 2013

Scenario Annual Chance 0.1% (1 in 1000)

Rev. Description Date, Drawn Appr.

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Drawing Status

INFORMATION

Client RG&P

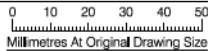
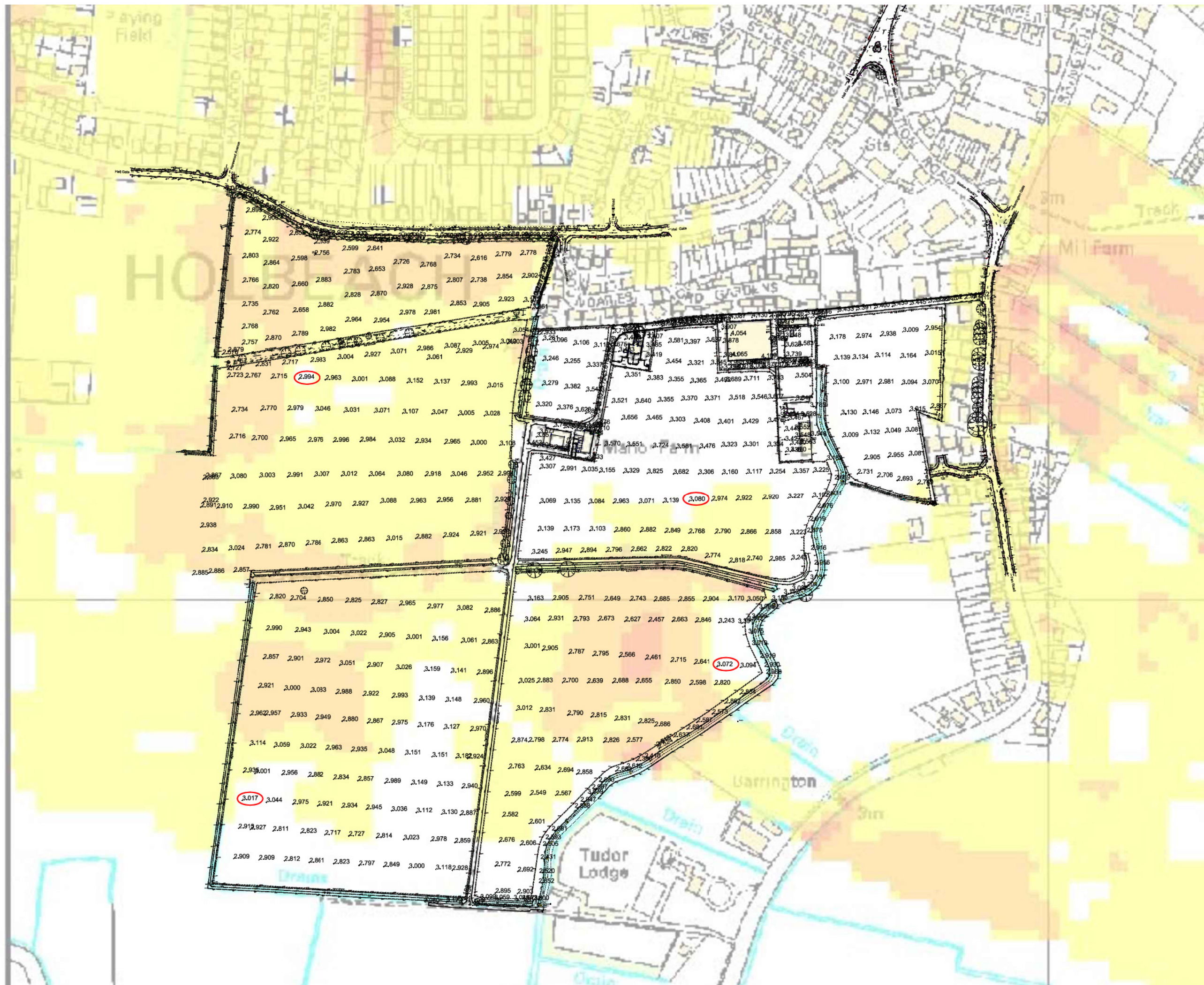
Project Title Land at Holbeach

Drawing Title
Breach Flooding Levels
Topographical Survey Overlay

Drawn By: MV Checked By: IA Scale: NTS

Project Engineer: MWR Approved By: MV Date: April 2014

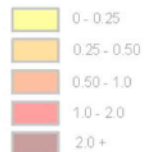
Drawing Number: 13401/SK-FRA 001 Revision: /



General Notes

1. DO NOT SCALE.
2. This drawing is to be read in conjunction with all other relevant drawings and details.
3. Should there be any conflict between the details indicated on this drawing and those indicated on other drawings the Engineer should be informed PRIOR to construction on site.
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5. All dimensions are in millimetres unless otherwise stated.
6. The BSP Hazard Identification and Risk Assessment information for this project must be reviewed and understood by the contractor PRIOR to the commencement of any works on site.

Max Depth (m)



Scenario year 2115

Date Printed November 2013

Scenario Annual Chance 0.5% (1 in 200)

Rev. Description Date Drawn Appr.

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Drawing Status

INFORMATION

Client

RG&P

Project Title

Land at Holbeach

Drawing Title

Breach Flooding Levels
Topographical Survey Overlay

Drawn By: MV Checked By: IA Scale: NTS

Project Engineer: MWR Approved By: MV Date: April 2014

Drawing Number: 13401/SK-FRA 002 Revision: /

Appendix F Flood Resilience Specification

Water Entry Strategy

The recommendations stated below are taken from the Department for Communities and Local Government document 'Improving the Flood Performance of New Buildings'. Where a flood level is referred to, this should be taken as the minimum resilience level of **3.780m**AOD. These recommendations should be read in accordance with the BSP Flood Risk Assessment, Ref: 13401/FRA.

Foundations

Durable materials should be specified that will not be affected by water and construction methods and materials should be used that promote easy draining and drying. Standard methods and good quality building materials will generally comply with these requirements but good workmanship is essential.

Floors

A ground bearing floor slab is the preferred option for flood resilience, however should a suspended floor be required for this development extra attention to detail will be required. The following will need to be considered in the design of the floor:

- Easy access for cleaning the void below the suspended floor should be allowed for. To aid this process, the sub floor should slope to an identified low point and be provided with suitable access. If cleaning is required, floor finishes may need to be removed to provide access to the sub-floor space and therefore cheaper, sacrificial, finishes would be the best option.
 - Alternatively, external access to the sub-floor space can be considered as a design option.
 - Hardcore and blinding: good compaction should be achieved to reduce the risk of settlement and consequential cracking.
 - Damp Proof Membranes should be included in any design to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping. Effective methods of joining membrane sections are: overlaps of 300mm or taping with mastic tape with an overlap of 50mm minimum. Care should be taken not to stretch the membrane in order to retain a waterproof layer.
 - Floor insulation should be of the closed-cell type to minimise the impact of flood water. It is recommended that insulation be placed above the floor slab (and underneath the floor finish).
 - Floor finishes: There are two possible approaches that depend on an assessment of the likely frequency of flooding and cost of material and installation: Use of sacrificial materials or reliance on high quality durable materials.
-

1. Sacrificial floor finishes can include timber flooring and soft furnishings such as carpets.
 2. Materials that are likely to withstand exposure to floodwater without significant deterioration are ceramic or concrete-based floor tiles, marble or stone. All tiles should be set on a bed of sand and cement render and water resistant grout should be used.
- Concrete screeds above polystyrene or polyurethane insulation should be avoided as they hinder drying of the insulation material due to the relative impermeability.
 - Suitable materials for skirting boards include ceramic tiles and PVC. Ceramic tiles are likely to be more economically viable and environmentally acceptable. Replacement timber may be a suitable option, for cases where a strategy to use of sacrificial materials is adopted.
 - Under floor services using ferrous materials should be avoided.

Walls

A cavity masonry/blockwork wall is envisaged for this development. The following will need to be considered in the design of these walls:

- Use good quality facing bricks for the external face of cavity walls. Do not use soft bricks, such as hand-made clay bricks, which can easily crumble when subjected to water.
 - Concrete blocks are recommended for the inner leaf (not aircrete).
 - External renders should not be used as they provide a barrier to water penetration and may induce excessive differences in depth between outside and inside of the property resulting in possible structural problems.
 - Cavity insulation should incorporate rigid closed cell materials as these retain integrity and have low moisture take-up. Other common types, such as mineral fibre batts, are not generally recommended as they can remain wet several months after exposure to flood water which slows down the wall drying process. Blown-in insulation can slump due to excessive moisture uptake, and some types can retain high levels of moisture for long periods of time (under natural drying conditions).
 - Internal cement renders should be avoided as these can prevent effective drying.
 - Use standard gypsum plasterboard up to the predicted flood level (plus freeboard of 50mm) as a sacrificial material. For this purpose, the use of a dado rail to separate the above and below flooded area may be useful. Splash proof boards do not necessarily offer better protection against flood waters, which may remain for some time and exert pressure on the board. Above predicted flood level (plus freeboard) the use of plasterboard or internal cement renders is appropriate.
-

Fittings

- Although a sacrificial approach can be adopted whereby fittings are designed to be replaced after a flood, it is advisable to specify durable fittings that are not appreciably affected by water and can be easily cleaned (e.g. use of plastic materials or stainless steel for kitchen units). The cost of these units may need to be balanced against the predicted frequency of flooding. Avoid wood fibre based carcasses and use easily removable solid wood doors and drawers.
- Place fittings (e.g. electrical appliances, gas oven) as high as practical above floor to minimise the risk of being affected by flood water.
- When allowing water in, it is important to provide means for effective drainage and cleaning. Providing gaps behind kitchen units will facilitate drainage and will allow access for forced drying, if proved to be necessary.

Services

- Closed cell insulation should be used for pipes which are below the predicted flood level.
 - Water, electricity and gas meters should be located above predicted flood level.
 - Electrical sockets should ideally be installed above flood level for ground floors to minimise damage to electrical services and allow speedy re-occupation. Where sockets above flood level would cause a short circuit from trailing cables, sacrificial sockets may be inserted below flood level. These would need to be minimised and easily replaced.
 - Electric ring mains should ideally be installed at first floor level with drops to ground floor sockets and switches.
 - Boiler units and ancillary devices should be installed above predicted flood level and preferably on the first floor of two-storey properties. Underfloor heating should be avoided on ground floors and controls such as thermostats should be placed above flood level.
 - Communications wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage. Any proposed design solution for flood insulation on all potentially vulnerable wiring should be discussed with the relevant service providers.
-