ENGINEERING

Flood Risk Assessment
for the Proposed Development of
Land to the North of Fleet Road, Holbeach,
With 5 Residential Dwellings

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Flood Risk Assessment
for the Proposed Development of
Land to the North of Fleet Road, Holbeach,
With 5 Residential Dwellings

1 Introduction

1.1 MTC Engineering (Cambridge) Limited has been asked to provide a Flood Risk Assessment in respect of the proposed development of 5 residential dwellings on land to the north of Fleet Road, Holbeach, on behalf P & J McCarthy.

1.2 This Flood Risk Assessment is based on the following information:-

1.2.1 Site survey by Global Surveys Limited.

1.2.2 Environment Agency Modelled and Historical Flooding Data.

1.2.3 Site Inspection by MTC Engineering (Cambridge) Limited.

1.2.4 South Holland District Council Strategic Flood Risk Assessment.

1.2.5 Proposed site layout supplied by Hertford Planning Service.

1.2.6 British Geological Survey information.

1.3 All the comments and opinions contained in this report including any conclusions are based on the information available to MTC Engineering (Cambridge) Limited during our investigations. The conclusions drawn could therefore differ if the information is found to be inaccurate, incomplete or misleading. MTC Engineering (Cambridge) Limited accept no liability should this prove to be the case, nor if additional information exists or becomes available with respect to this site.

1.4 MTC Engineering (Cambridge) Limited makes no representation whatsoever concerning the legal significance of its findings or any other matters referred to in the following report. Except as otherwise requested by the client, MTC Engineering (Cambridge) Limited are not obliged and disclaim any obligation to update the report for events taking place after the Assessment was undertaken.

1.5 This report is a Flood Risk Assessment relating to flooding and drainage issues associated with the proposed development. The information presented and conclusions drawn are based on statistical data and are for guidance purposes only. This report provides no guarantee against flooding of the study site or elsewhere, nor as to the absolute accuracy of water levels, flow rates and associated probabilities quoted.

2 Site Description

2.1 The Site is located on the northern side of Fleet Road (the B1515), to the east of the main body of Holbeach.

2.2 The site is part of an agricultural field which extends to the north of the site boundary.

2.3 To the east the site is bound by some grass paddocks past which lie a couple of residential dwellings on the northern side of Fleet Road and then open agricultural land.

2.4 To the south the site is bound by a small drain which runs in an easterly direction along the northern side of Fleet Road, with Fleet Road immediately to the south of the drain. Fleet Road is raised above adjacent land with levels of about 3.6 metres above Ordnance Datum (AOD) present along the sites southern boundary, with ground levels in the section of the site in which the dwellings are proposed generally being between 2.9 and 3.1 metres AOD. On the southern side of Fleet Road lies existing linear residential development with ground levels again below road levels, and to the rear of this residential development open agricultural land.

2.5 To the west the site is bound by Holbeach Cars, past which lies Fleet Road Industrial Estate and then development of a mainly residential nature in eastern Holbeach.

2.6 The only watercourses in the vicinity of the site are the network of small drains taking surface water from the agricultural land in the vicinity of the site and development of Holbeach, with no other significant surface water features in the vicinity of the site.

2.7 The Wash coastline is just over 10km northeast of the site at its closest point.

2.8 British Geological Survey Mapping indicates that the bedrock geology of the site is the Ampthill Clay Formation, with a superficial geology of Tidal Flat Deposits of clay and silt also present. This type of underlying geology has a low permeability.

3 Sources of Potential Flood Risk

3.1 In accordance with The National Planning Policy Framework all forms of flood risk need to be considered in relation to any development.

3.2 The first form of flood risk to be considered in respect of The National Planning Policy Framework is fluvial flooding.

3.3 The Environment Agency Indicative Flood Risk Map (Appendix 2) indicates that the site lies in Flood Zone 3, with the vast majority of South Holland District shown as lying in Flood Zone 3. The Strategic Flood Risk Assessment indicates a similar pattern of flooding.

3.4 The Flood Zones do however show both tidal and fluvial flood risk, and it is considered that in this instance the site is located in Flood Zone 3 due to a tidal flood risk rather than fluvial flood risk, with tidal flood risks discussed later.

3.5 With regards fluvial flooding, the site lies within the South Holland Internal Drainage Board with the drain along the southern boundary of the site being an ordinary IDB watercourse (DRN201G2307) as shown on the map provided in Appendix 3, which is considered a high priority watercourse (high priority pipeline where culverted), and eventually drains to the Lutton Leam Sluice.

3.6 The primary risk associated with fluvial flooding from this drain is in the event of a blockage occurring, however as a high priority watercourse it is well maintained thus the risk of a blockage is considered to be low, whilst in any such event water would simply build up in the drain before flowing overland in the southern part of the site (as this is lower than the road to the south) and then back into the drain downstream of the blockage.

3.7 There are no significant other fluvial flood risks to the site and it is considered that the overall fluvial flood risk to the site is low.

3.8 The second source of flood risk to be considered in accordance with The National Planning Policy Framework is flooding from the sea.

3.9 As detailed earlier, it is believed that the sites location in Flood Zone 3 on the Flood Map is associated with tidal rather than fluvial flooding, whilst it should also be noted that the Flood Zones do not take account of flood management measures such as defences, thus indicate a worst case scenario.

3.10 Mapping provided within the Strategic Flood Risk Assessment does however indicate that when the presence of such measures are taken into account the site (and indeed much of the surrounding area within the South Holland District) lies outside of the 1 in 100 year fluvial and 1 in 200 year tidal flood plain, and will remain outside of this past 2055 as confirmed by the map provided in Appendix 4.

3.11 Data has also been obtained from the Environment Agency, with a copy provided in Appendix 5. This confirms that the site will remain dry during an overtopping event and that this will remain the case with allowance for climate change until 2115.

3.12 As such it is considered that the only significant risk of tidal flooding to the site comes in the event of a breach during an extreme tidal event in 2115.

3.13 EA data indicates that in a 1 in 200 year breach event occurring in 2115, it is anticipated that flood water at the site would have a low velocity (0 to 0.3m/s), with the majority of the site having a water depth of between 0 and 0.25m present and slightly lower areas of the site subject to a depth of flooding of between 0.25 and 0.5 metres. Based upon ground levels provided on the topographic survey (Appendix 6) showing site levels of approximately 3.1 metres or less in area of the site where flood water depth is anticipated to be 0 to 0.25 metres the water level at the site is unlikely to exceed about 3.35m AOD in such an event. The flood hazard at the site is classified as either low hazard (less than 0.75) or danger for some (0.75-1.25 with a risk to children, the elderly and the infirm).

3.14 EA data indicates that in a 1 in 1000 year breach event occurring in 2115, water velocities at the site would remain low at 0 to 0.3m/s, although the majority of the site would have a water depth of between 0.25m and 0.50m present. This would increase the hazard across the majority of the site to 0.75 to 1.25 or danger for some. Data indicates that water levels on the site would be up to 0.25m higher than the 1 in 200 year event, and water level at the site is likely to be approximately 3.60 metres AOD in such an event.

3.15 Overall it is considered that the site is at a low risk of flooding from tidal sources, with the only significant risk to the site being that tidal defences are breached, which dependent upon the location of the breach would give rise to a similar risk/hazard across the majority of the South Holland District.

3.16 To ensure that the proposed development is sufficiently protected against the unlikely event of a breach occurring during a tidal event the finished floor levels of the dwellings will be raised to 3.75m AOD which is both 500mm above the highest ground levels on site and 400mm above the maximum likely water level indicated on any part of the site during a 1 in 200 year breach occurring in 2115 which is 3.35m AOD. This is also above the anticipated water level at the site during a 1 in 1000 year breach event occurring in 2115.

3.17 In addition to this to provide further protection in the unlikely event that a flood exceeding the 1 in 1000 year level occurs the proposed dwellings will also be made flood resilient to 600mm above finished floor levels in accordance with guidance from the Department of Communities and Local Government as detailed in Section 4.

3.18 The above measures would ensure that dwellings are flood resilient to a height of at least 4.35m AOD, this would be not only 1.0m above the indicated 1 in 200 year breach event water level, but 750mm above the estimated 1 in 1000 year water level of 3.60m AOD and also 700mm above the floor level of 3.65m AOD that was approved by the Environment Agency in May 2016 at this site as per the letter provided in Appendix 7.

3.19 The third form of flood risk to be considered in respect of The National Planning Policy Framework is flooding from land.

3.20 Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can quickly run off land and result in local flooding. In developed areas, this flood water can be polluted with domestic sewage with foul sewer surcharge and overflow. Local topography and built form can have a strong influence on the direction and depth of flow. The design of development down to a micro level can influence or exacerbate this. Overland flow paths need to be taken into account in development to minimise the risk of flooding from overland flow.

3.21 Land in the vicinity of the site is relatively flat, and mainly permeable agricultural land where significant overland flows are unlikely to develop, and the Environment Agency surface water flood map does not indicate any significant surface water flood risk at the site.

3.22 The overall risk to the site from surface water flooding is considered to be low, and the raised floor levels being used to protect the development against the residual tidal risk during a breach event will provide ample protection against surface water flows.

3.23 The fourth form of flood risk to be considered in accordance with The National Planning Policy Framework is flooding from rising groundwater.

3.24 Groundwater flooding occurs when water levels in the ground rise above surface elevations. It is most likely to occur in low lying areas underlain by permeable rocks (aquifers). These may be extensive, regional aquifers, such as chalk or sandstone, or may be localised sands and river gravels in valley bottoms underlain by less permeable rocks. Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land.

3.25 Geological Mapping indicates the site to be underlain by a bedrock geology of the Ampthill Clay Formation, with a superficial geology of Tidal Flat Deposits of clay and silt also present.

3.26 This type of underlying geology has a low permeability and there would be no significant groundwater present likely to give rise to flooding in the vicinity of the site.

3.27 The fifth form of flood risk to be considered in accordance with the National Planning Policy Framework is the risk of flooding from blocked, overloaded, or burst sewers and water mains.

3.28 Any flows from a blocked, overloaded or burst sewer or water main on Fleet Road would be directly into the drain along the northern side of the road rather than coming north onto the site, and it is not anticipated that the site is at any significant risk of flooding from these sources.

3.29 The last form of flood risk to be considered in accordance with the National Planning Policy Framework is flooding from reservoirs, canals or other artificial sources.

3.30 There are no significant artificial sources of flood risk in the vicinity of the site and it is not considered that the site is at any significant risk of flooding from any artificial source. The Environment Agency Reservoir Flood Risk Map does not indicate that the site is at risk of flooding from any artificial source.

4 The Proposed Development

4.1 The proposal involves the development of 5 dwellings along the Fleet Road frontage of the existing agricultural field within which the site lies, as indicated by the proposed site layout (Appendix 8).

4.2 As detailed in Section 3 the only significant source of flood risk to the site is considered to be in the unlikely event that a breach of defences occurs during an extreme tidal event.

4.3 To ensure that the proposed dwellings and occupants are adequately protected during such an event the minimum floor level of the dwellings will be at 3.75m AOD, which is 400mm above the likely water level at the site during a breach occurring during a 1 in 200 year event with allowance for climate change to 2115 (Paragraph 3.13) and also above the likely water level at the site during a 1 in 1000 year breach event in 2115.

4.4 To provide further protection in the unlikely event that a flood exceeding the 1 in 1000 year level occurs the proposed dwellings will also be made flood resilient in accordance with guidance from the Department of Communities and Local Government. The measures used will include:

- The walls will be constructed using materials which keep their shape in the event of a flood to 600mm above the finished floor level and either a waterproof render/plaster or a sacrificial section of plasterboard used for at least 600mm above floor level to minimise the impact of any flooding that does occur.
- All electrical sockets and incoming service meters will be located at least 600mm above the ground floor level.

4.5 The above measures provide resilience to a level of 700mm above the floor level of 3.65m AOD approved by the Environment Agency in 2016 with no flood resilient construction above 3.65m AOD as per the letter provided in Appendix 7. No further flood resistant or resilient construction is considered necessary in this instance.

4.6 All access points across the watercourse along the southern boundary of the site will be designed to ensure no loss of flow capacity or storage volume in the drain, with full approval of the culverts to be obtained from South Holland IDB following detailed design of the site accesses and prior to any works commencing on site.

4.7 No permanent above ground structures (buildings) are located within 9 metres of the top of the northern bank of the drain, and the vehicular accesses to the dwellings will not inhibit access to the watercourse for maintenance. All relevant consent for works in the vicinity of a Board watercourse will be obtained from the South Holland IDB prior to commencement of work on site.

4.8 No flood storage compensation is required as the site lies within the defended tidal flood plain only and outside of the fluvial flood plain.

4.9 Post development the impermeable area of the site will be approximately 1620m^2. This consists of approximately 875m^2 of private/shared access areas and 745m^2 of roof areas associated with dwellings and garages as shown on the indicative drainage layout (Appendix 8).

4.10 In line with the surface water drainage discharge hierarchy the preferable option for discharge of surface water involves discharge into the ground (infiltration) however in this instance this is not possible due to the underlying clay geology which has a very low permeability.

4.11 The second option in line with the drainage hierarchy involves discharge to an open watercourse, thus a positive system discharging to the adjacent drain at greenfield rate will be provided.

4.12 The QBAR greenfield run off rate from the post development area of 0.162Ha is 0.2 litres per second (l/s) as per the Micro Drainage calculations provided in Appendix 9, with the 1 year, 30 year and 100 year discharge rates being 0.2l/s, 0.6l/s, and 0.8 l/s respectively.

4.13 Due to the blockage risks associated with the use of small diameter flow controls (it is not advised to use hydrobrakes below a 75mm diameter) it is not feasible to reduce discharge rates below 2 litres per second.

4.14 Discharge from the site will therefore be restricted to a maximum rate of 2 litres per second, with a contribution fee paid to South Holland Internal Drainage for a part attenuated discharge to their system at a maximum rate of 2 liters per second, in order that additional storage can be provided in their system to accommodate the slight increase in discharge from the site. Discharge consent to be applied for from the IDB (via the Water Management Alliance who deal with consent applications on behalf of the IDB) and approved prior to any work commencing work on site.

4.15 In line with current Environment Agency guidance, the upper end allowance for the climate change increase that should be considered to rainfall events through to 2115 is 40%. The upper end allowance is the 90th percentile, meaning that there is a 90% chance that the actual increase to rainfall will be lower than this value. The central allowance for climate change to rainfall by 2115 is 20% (the 50th percentile, meaning that there is a 50% chance that the actual increase to rainfall will be above this and 50% chance it will be below this increase).

4.16 Attenuation for rainfall prior to discharge will be provided beneath the permeable access areas to the dwellings, which occupy an area of 825m^2. Micro Drainage calculations (Appendix 10) indicate that an attenuation volume of 82.5m^3 is required in the base of the permeable paving to successfully reduce the discharge rate from the site during a 1 in 100 year rainfall event with the upper end (40%) allowance for climate change to a maximum rate of 2 litres per second.

4.17 Based upon a void space of 30% in the base of the permeable paving, this would require a depth of 350mm which is similar to the base depth that will likely be required for structural reasons and can easily be accommodated on site.

4.18 Permeable paving is a preferred SuDS technique as in addition to providing attenuation for surface water it also provides a phase of pollution treatment. As sufficient attenuation will be provided by means of the permeable paving no further SuDS systems such as ponds or swales are required in this instance.

4.19 Adequate pollution treatment in accordance with requirements will be provided to all surface water discharge from the site.

4.20 Drainage from all private road and parking/access areas being initially through permeably paving which provides a filtration system removing pollutants such as hydrocarbons as is considered as first treatment stage. A second treatment stage will be provided to discharge from all trafficked areas by means of the membrane (such as Terram) in which the storage beneath the permeably paved areas is wrapped, removing further pollutants from discharge and ensuring that surface water from these areas is suitably treated prior to discharge.

4.21 Surface water from roofs is considered a clean discharge and will be directly to the base of the permeable paving areas, with one treatment stage provided as water is filtered through the membrane such as Terram in which the storage blanket will be wrapped prior to discharge.

4.22 The detailed surface water drainage design will only be undertaken at the detailed design phase once conditional planning approval has been granted and a final site layout is available, however this Sustainable Drainage Strategy and the calculations provided clearly demonstrate that such systems can be used to successfully drain the proposed development at an appropriately restricted discharge rate in line with the requirements. It is therefore appropriate to apply a surface water drainage condition to any planning approval granted.

5 Assessment

5.1 The proposal involves the development of 5 residential dwellings along the Fleet Road frontage of an agricultural field in the east of Holbeach as indicated on the proposed site layout.

5.2 Under Table 2 of the Technical Guidance to the National Planning Policy Framework the proposed residential use is classified as a "more vulnerable" use.

5.3 The site is within Flood Zone 3a, due to the undefended risk of tidal flooding occurring, with no significant fluvial flood risk to the site. In accordance with the National Planning Policy Framework development of a "more vulnerable" nature is appropriate in Flood Zone 3a subject to passing the Sequential Test and Exception Test. The proposed development passes both of these tests as detailed below:

5.4 Sequential Test

5.4.1 The aim of the Sequential Test is to where possible steer new development to areas at the lowest probability of flooding (Flood Zone 1), as stated in Paragraph 101 of the National Planning Policy Framework, and only locate development in Flood Zones 2 and 3 where this is not possible.

5.4.2 The vast majority of South Holland District is classed as Flood Zone 3 due to the risk of tidal flooding occurring in the event that tidal defences are breached, with virtually all areas of the district that fall outside of Flood Zone 3 being either already developed or unsuitable for development for reasons such as lying in unsustainable rural locations where residential development would not be permitted for various reasons.

5.4.3 The site is at a much lower risk of flooding that the Flood Map indicates, as the site is actually defended against tidal flooding, with modelling indicating that the site is only at risk should defences be breached during an extreme tidal event and is not at risk during an overtopping event.

5.4.4 There are no significant fluvial flood risks to the site, and as such the site is at a lower risk of flooding than other parts of the district lying in Flood Zone 3 that are either also at risk of tidal flooding during an overtopping event (rather than just a breach event), lie within a rapid inundation zone, or that lie in a fluvial flood risk area as well as tidal flood risk area. The site is therefore considered sequentially preferable to potential sites located in such areas.

5.4.5 Breach mapping indicates that the hazard to the site during a 1 in 200 year tidal breach event occurring in 2115 would generally be classed as either a low hazard or danger for some only (children, the elderly and the infirm), and as danger for some during a 1 in 1000 year tidal breach event during 2115. The site therefore is considered sequentially preferable to areas where breach events would give rise to a hazard classified as danger to most or danger to all.

5.4.6 Given the classification of the majority of the district in Flood Zone 3, the above analysis demonstrates that when more detailed assessment is considered the site is actually at a lower risk of flooding that most of the district (tidal breach event only) whilst occupants would only be subject to a low hazard in the event that flooding were to occur. It is therefore considered that the Sequential Test is passed on these grounds.

5.5 Exception Test

5.5.1 The aim of the Exception Test is to demonstrate that potential development gives rise to wider sustainability benefits to the local community that outweigh the risk of flooding, and that the proposed development will be safe and not increase the risk of flooding elsewhere as set out in Paragraph 102 of the National Planning Policy Framework.

5.5.2 Additional housing is required in the district and provision of residential development at one of the main urban centres of the district is more sustainable that potential alternative sites in rural areas in terms of access to services, facilities, public transport, employment, and schools. The first part of the Exception Test is therefore passed.

5.5.3 This Flood Risk Assessment takes into account the vulnerability of users, demonstrates that the development will be safe for its lifetime, and that the proposal will not increase the off-site risk of flooding. The proposed development therefore passes the second part of the Exception Test.

5.5.4 Both parts of the Exception Test are therefore passed, thus the proposed development is considered acceptable when considered against the Exception Test.

5.6 All the sources of flood risk to the proposed development have been considered in Section 3, and there are no significant risks of flooding to the site other than the unlikely event of tidal defences being breached during an extreme tidal event.

5.7 Breech Hazard mapping indicates that the maximum likely water level at the site during a 1 in 200 year breach event occurring in 2115 is about 3.35 metres AOD. At 500mm above the highest ground levels in the vicinity of the dwellings the minimum floor level of the dwellings will be 3.75 metres AOD. This is 400mm above the estimated 1 in 200 year breach level, whilst flood resilient construction in accordance with the Department of Communities and Local Government will also be provided to 600mm above finished floors levels as detailed in Paragraph 4.4.

5.8 The above measures ensure that dwellings are flood resilient to 1000mm and 750mm above the both the 1 in 200 and 1 in 1000 year breach event water level which is considered to provide sufficient protection to dwellings and occupants during any likely tidal breach event, and 700mm above the finished floor level of 3.65m AOD previously approved by the Environment Agency with no flood resilient construction.

5.9 There are no other significant flood risks to the site that would have a worse impact upon the site than the tidal breach events used to set minimum floor levels.

5.10 The minimum floor level of 3.75m AOD and flood resilient construction will adequately protect the proposed dwellings against flooding for the lifetime of the development and no further flood resistant or resilient measures are required.

5.11 Even in a 1 in 1000 year tidal breech event in 2115 the flood hazard at the site and on Fleet Road travelling west into Holbeach is either low or danger for some only, thus most residents (with the possible exception of children, the elderly and the infirm) would remain able to safely access the site, whilst the dwellings themselves would provide a safe place of refuge for any occupant unable to safely access the site.

5.12 No above ground development is to take place within 9 metres of the top of bank of the adjacent watercourse, and all relevant Internal Drainage Board consents for both the access culverts and parking/access to be provided in the vicinity of the drain will be obtained prior to commencing work on site.

5.13 Surface water drainage from the proposed development will continue to be to the adjacent watercourse as at present, with the maximum post development discharge rate being 2 litres per second during a 1 in 100 year rainfall event with a 40% allowance for climate change (the upper end allowance). It is not feasible to restrict discharge rates below this due to the blockage risks associated with the use of low diameter flow controls thus a part attenuated discharge fee will be paid to the IDB to accommodate the slight increase in discharge from the site.

5.14 Approximately 82.5m^3 of attenuation is required to achieve a discharge rate of 2l/s from the proposed development, with this to be provided in the base of the permeable drive/access areas. Adequate treatment will also be provided to all surface water prior to discharge from the site.

5.15 It has been clearly demonstrated that the site can be successfully drained in accordance with requirement, and the full detailed surface water drainage design will take place only once conditional approval has been granted, and secured by planning condition.

5.16 The proposed development is adequately protected against flooding, will be safe for occupants, and will not increase the off-site risk of flooding.

6 Conclusion

6.1 The proposal involves the erection of 5 residential dwellings on land to the north of Fleet Road in eastern Holbeach.

6.2 The site lies in Flood Zone 3, although this does not take the impact of defences into account and the only significant flood risk to the site is that defences are breached during an extreme tidal event.

6.3 Both the Sequential and Exception Test are passed as detailed in Sections 5.4 and 5.5.

6.4 The finished floor level of the proposed dwellings will be set 500mm above the highest ground levels in the vicinity of the dwellings which is equivalent to a minimum height of 3.75 metres AOD.

6.5 This provides 400mm freeboard against the maximum anticipated water level at the site during a 1 in 200 year breach event occurring in 2115, and is also above the anticipated water level should a breach of defences occur during a 1 in 1000 year tidal event in 2115, whilst flood resilient construction in accordance with the Department of Communities and Local Government will be provided to a height of 600mm above finished floor levels as detailed in Paragraph 4.4.

6.6 If a breach event were to occur, the hazard at the site and on Fleet Road would be low danger or danger for some only, thus all occupants with the possible exception of children, the elderly, and the infirm would be able to access the proposed site during a breach event. The dwellings will provide safe refuge for any occupant unable to safely enter or exit the site.

6.7 Surface water drainage will be to the adjacent drain, with discharge restricted to 2 litre per second during all rainfall events upto and including a 1 in 100 year plus 40% allowance for climate change. Full detailed surface water drainage design will be provided once conditional approval has been granted.

6.8 Adequate pollution treatment will be provided to all surface water prior to discharge.

6.9 All relevant consents will be applied for and obtained from South Holland IDB for the access culverts and works within 9 metres of the watercourse and proposed discharge from the site to the IDB system and relevant fees paid prior to commencement of work on site.

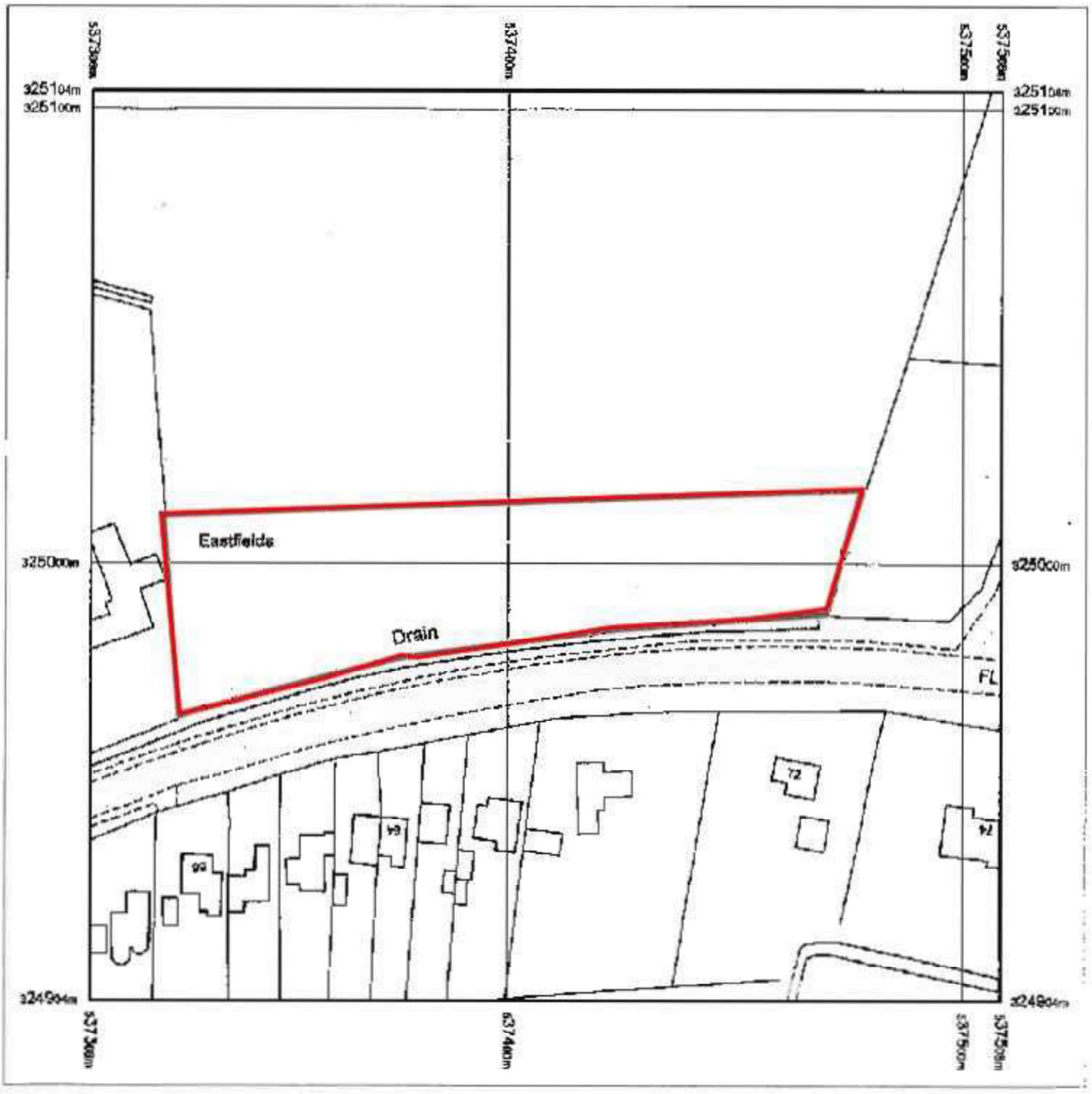
6.10 The proposed development will not have any adverse impact in terms of off-site flood risk and there are no flood risk or drainage related grounds on which to object to the proposed development of 5 residential dwellings on land on the northern side of Fleet Road, Holbeach.

APPENDIX 1

SITE LOCATION PLAN

Ordnance Survey

OS Sitemap™



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The representation of a road, track or path is no evidence of a right of way.

The representation of features as lines is no evidence of a property boundary.

Metres
0 20 40

Scale 1:1250

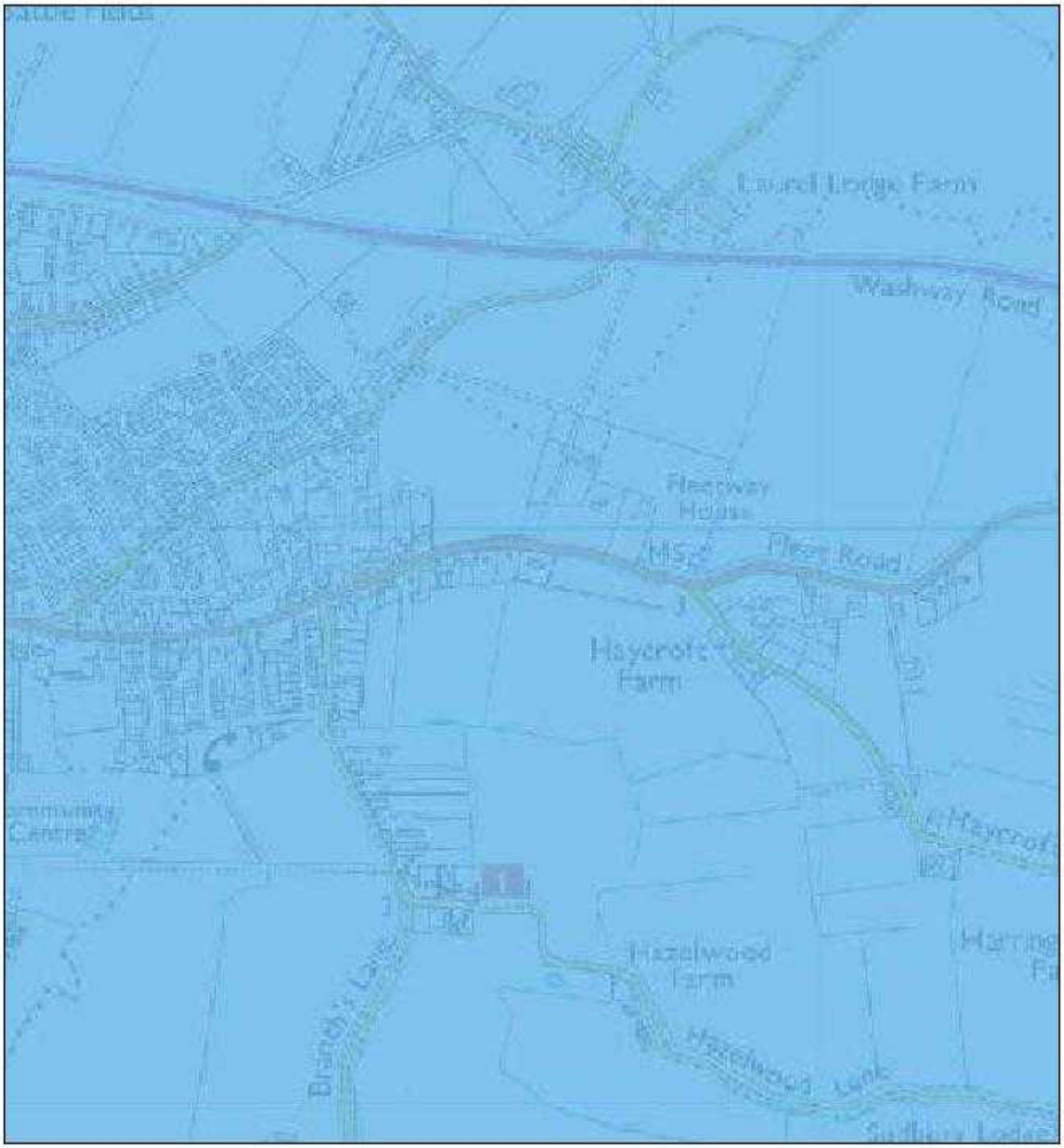
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Further information can be found on the OS Sitemap information leaflet or the Ordnance Survey web site:
www.ordnancesurvey.co.uk

APPENDIX 2

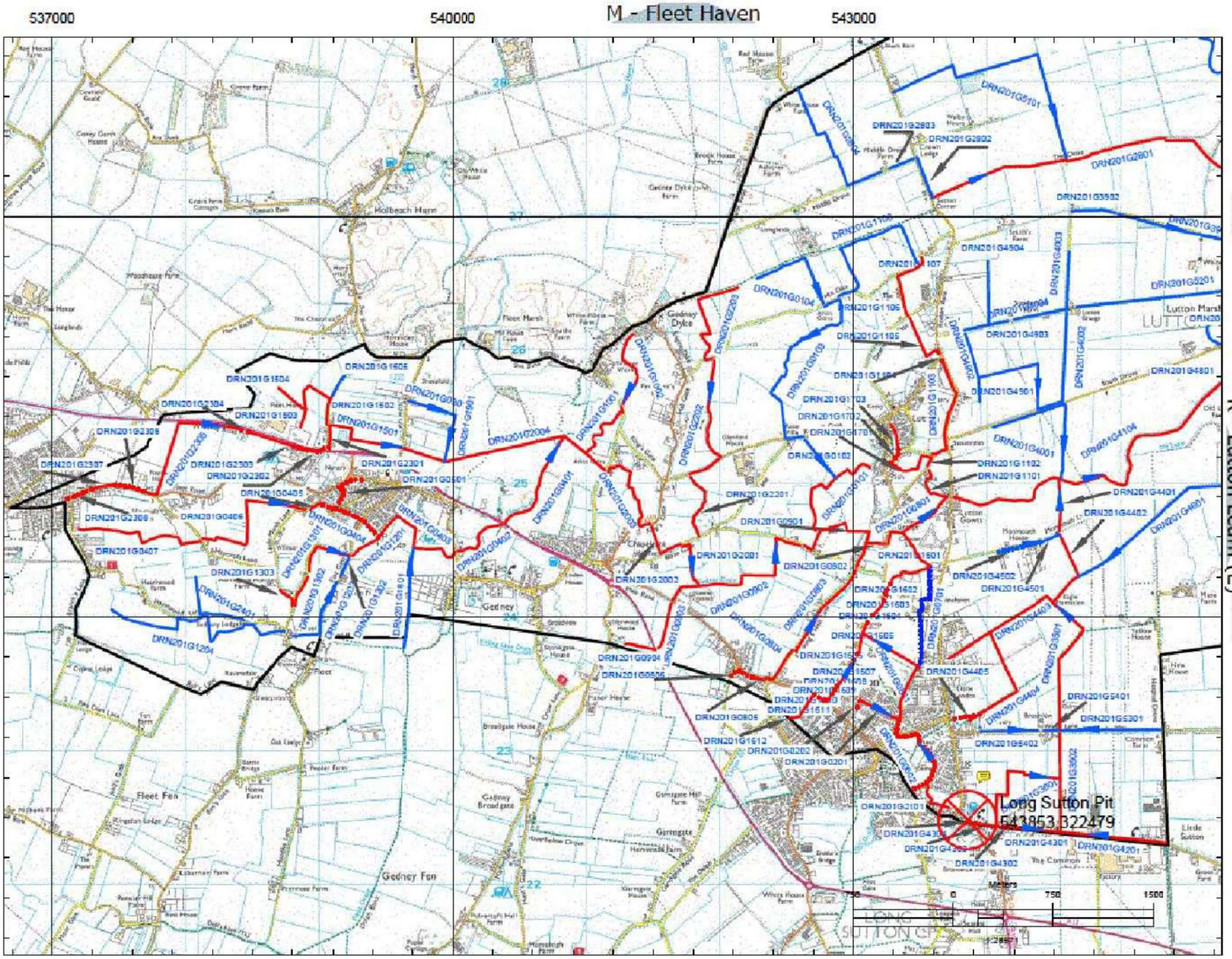
ENVIRONMENT AGENCY FLOOD RISK MAP

ENVIRONMENT AGENCY
INDICATIVE FLOOD RISK MAP
FLEET ROAD, HOLBEACH



APPENDIX 3

IDB BOARD MAP



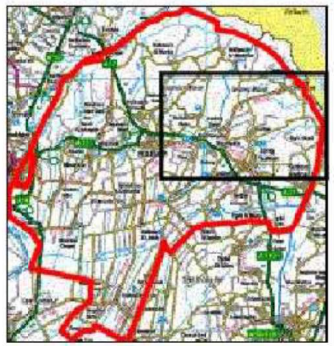
Lutton Leam (W)

South Holland Drainage Board

LEGEND

- Catchment Boundary
- High Priority Watercourse
- IDB Ordinary Watercourse
- High Priority Pipeline
- Ordinary Pipeline
- Water Control Structure
- Pumping Station
- Inland Sluice
- Tidal Sluice

KEY MAP



N

SCALE	SHEET NUMBER
Best fit	CMT201G
PLOT DATE	
05/01/2016	

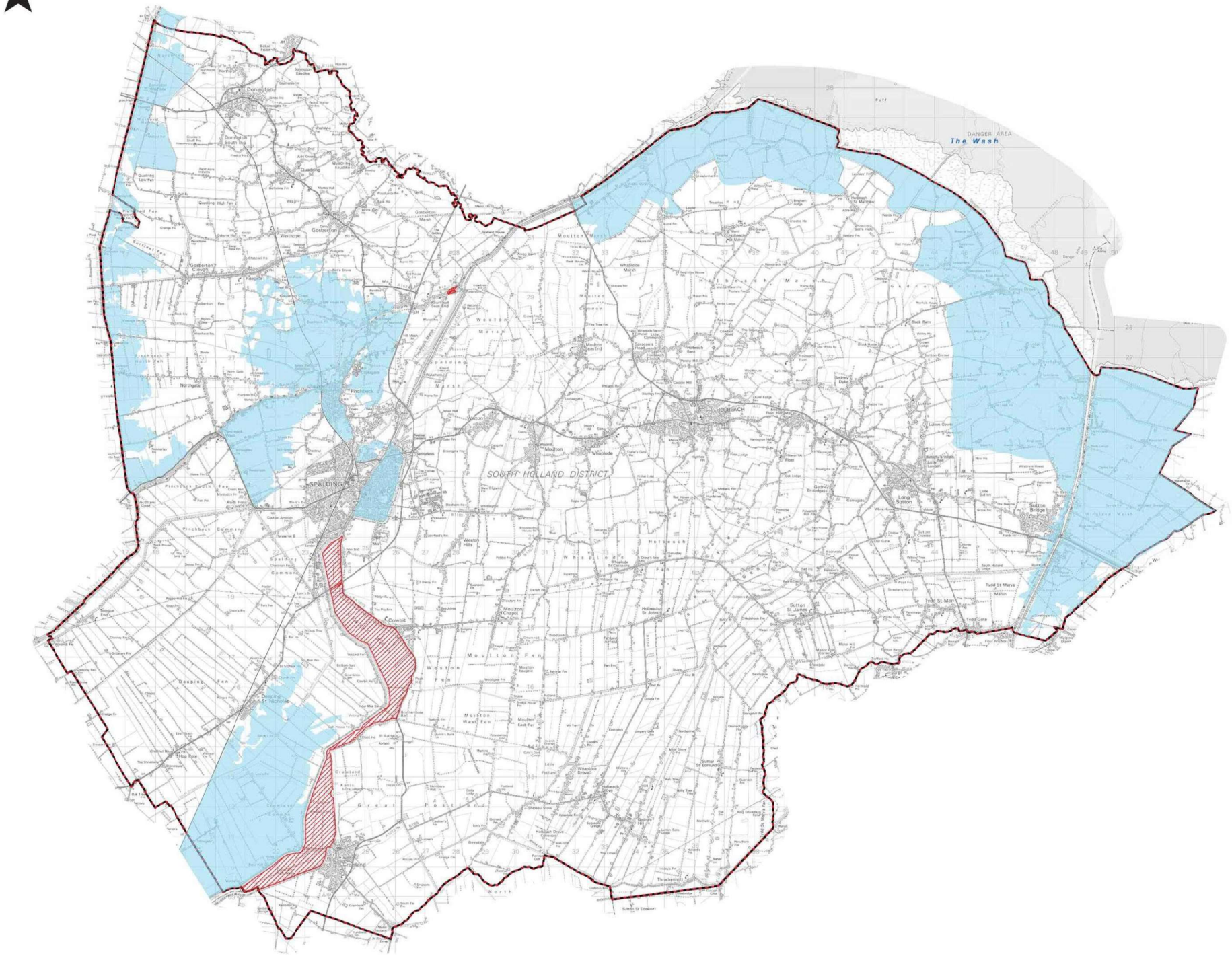
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FILE NAME

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APPENDIX 4

SFRA FLOOD MAP



NOTES

1. The potential flooding consequences shown on this map reate to flooding from the sea, main rivers and Internal Dainage Board systems taking into account the presence of current flood risk management measures such as flood defences.

2. In addition to the potential flood extens shown on this map there may be shallow flooding in low-lying rural areas

3. The consequences designated as being an Actual Risk arise from direct overtopping of defences, where this would occur, together with assumed breach failure of some defences. Breach failure has been assumed to occur in places where the freeboard between peak sea or river water level and the defence crest level is less than the minimum desirable for structural security of the defence.

4. The consequences designated as being a Residual Risk arse from direct overtopping of deiences, where this would occur, together with breach failure which is assumed could occur at any point along the defences.

5. The potential flooding consequences relate to flood probablity bandings as follows:

Probability Band	Annual probability of Flooding	
	from a river (fluvial)	from the sea (tidal)
Low	<0.1%	<0.1%
Medium	1%-0.1%	0.5%-0.1%
High	>1%	>0.5%

6. Functional Floodplain encompasses areas where water is intended to flow or be stored in times of flood.

7. Land outside South Holland District is not considered.

8. This map shows the extents only of the flooding probability bands relevent to the map Title

Map Legend

Flooding Probability bands :

- High
- Low or medium, but reliant on protection by flood defences for this standard
- Functional Floodplain
- South Holland District Boundary

REV	DATE	REMARKS

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FAX +44 (0)1733 262243

SOUTH HOLLAND DISTRICT COUNCIL
COUNCIL OFFICES
PRIORY ROAD
SPALDING
LINCOLNSHIRE
PE11 2XE

UPDATE OF STRATEGIC FLOOD RISK ASSESSMENT

Actual Risk Extent
District - 2055
1% Fluvial / 0.5% Tidal Event Probability

DATE OF ISSUE: January 2010 **REV NO:**

SCALE: 1 : 60,000 @ A1

MAP NO:

APPENDIX 5

ENVIRONMENT AGENCY TIDAL BREACH AND OVERTOPPING DATA

Environment Agency

Emily Fell
emilyfell@mtcengineering.co.uk

Our ref: CCN-2016-7783
Your ref:

Date: 4 May 2016

Dear Emily

Flood Hazard Mapping – Site at Fleet Road, Spalding, PE12 8LD (NGR TF 37408 25004)

Thank you for your request for copies of our flood hazard mapping for the above location.

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 breaching for the 0.5% (1 in 200) and 0.1% (1 in 1000) chance events in 2006.

Hazard Mapping – Overtopping
Your site is not affected by overtopping for the 0.5% (1 in 200) and 0.1% (1 in 1000) chance events in 2006 or 2115.

Please note that the modelling completed to date does not include overtopping along the following tidal river; Welland (upstream of Fosdyke Bridge).

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

I hope that we have correctly interpreted your request. Please see the Standard Notice or licence for details of permitted use. The Standard Notice can be found at the link below.

http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/

If you have any queries about the hazard mapping please contact Jessica Pain using the telephone/email details below. Please quote our CCN reference number in all correspondence where data is referenced.

FLOODS DESTROY BE PREPARED

Yours sincerely

FOR Ian Cappitt
Partnerships and Strategic Overview Team Leader Lincolnshire

Direct dial 01522 785925
Direct fax 01522 785018
Direct e-mail PSOLINCS@environment-agency.gov.uk

Awarded to Lincolnshire & Northamptonshire Area

Enc.
FRA/FCA Advisory Text
Breach Location Plan
Breach Hazard Maps x 2

Use of Environment Agency Information for Flood Risk / Flood Consequence Assessments

Important
If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:-

http://www.environment-agency.gov.uk/research/planning/33580.aspx

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice, the technical guidance to the National Planning Policy Framework and the existing PPS25 Practice Guide for information about what flood risk assessment is needed for new development in the different Flood Zones. These documents can be accessed via:

http://www.environment-agency.gov.uk/research/planning/82587.aspx

http://www.communities.gov.uk/publications/planningandbuilding/nppftechnicalguidance

http://www.communities.gov.uk/publications/planningandbuilding/pps25guideupdate

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

In **Wales,** you should refer to TAN15 for information about what flood consequence assessment is needed for new development in the different flood zones
http://new.wales.gov.uk/splash;jsessionid=8ylGTfGZthmB0t2vhp6hS1GcB1LXvZzB3Ylczf20Xn7LK3zK0nMk!981825250?orig=/topics/planning/policy/tans/tan15/

You should also consult the Strategic Flood Consequence Assessment if one has been produced by your local planning authority.

In both **England and Wales** you should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk / Consequence Assessment (FRA / FCA) where one is required, but does not constitute such an assessment on its own.

2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.

3. Where a planning application requires a FRA / FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.

4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.



^ **Modelled Breach Locations**

0 3.5 7 14 Kilometres

This map indicates the location of where we have modelled the consequence of breaches in the defences along the coastline and tidal rivers. We have mapped the the maximum values of Hazard Rating (Danger to People), Depth and Velocity.

We have not assumed that all breaches occur at the same time, but have modelled each breach individually and overlaid the results to find the maximum values.

Our modelling only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. Our defences generally provide a good standard of flood defence but a risk of breaching remains.

Please contact the Environment Agency for information on how these maps are used in the management of flood risk.

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

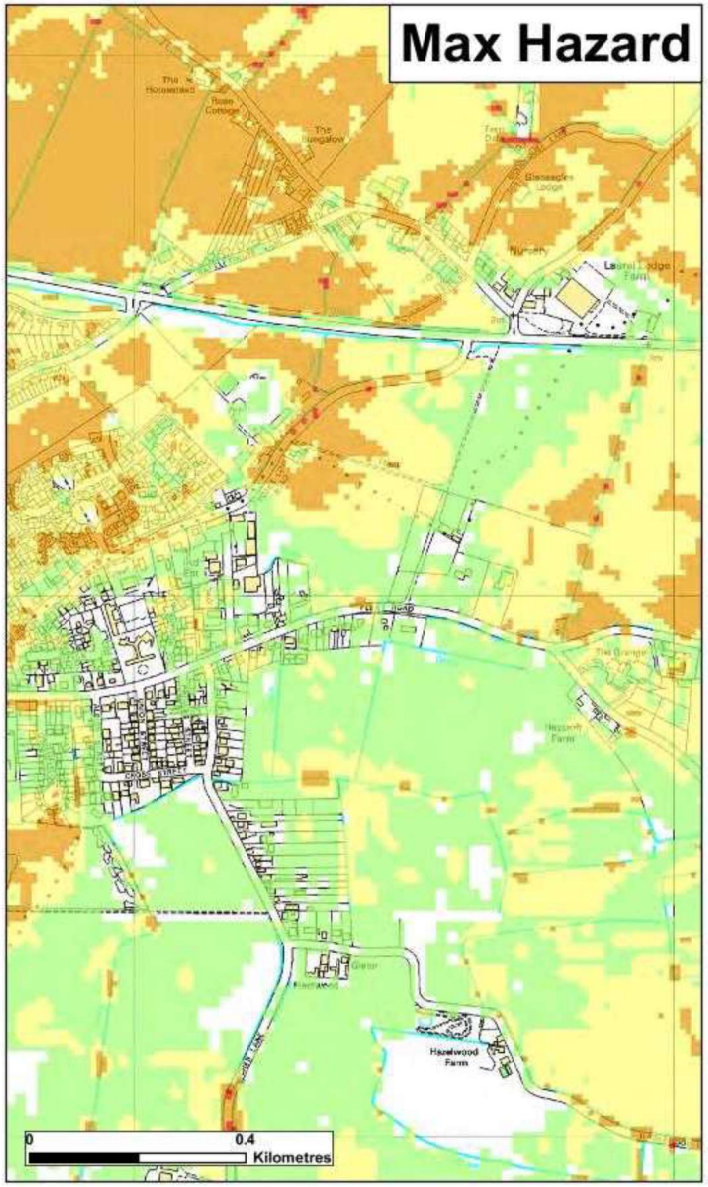
Environment Agency

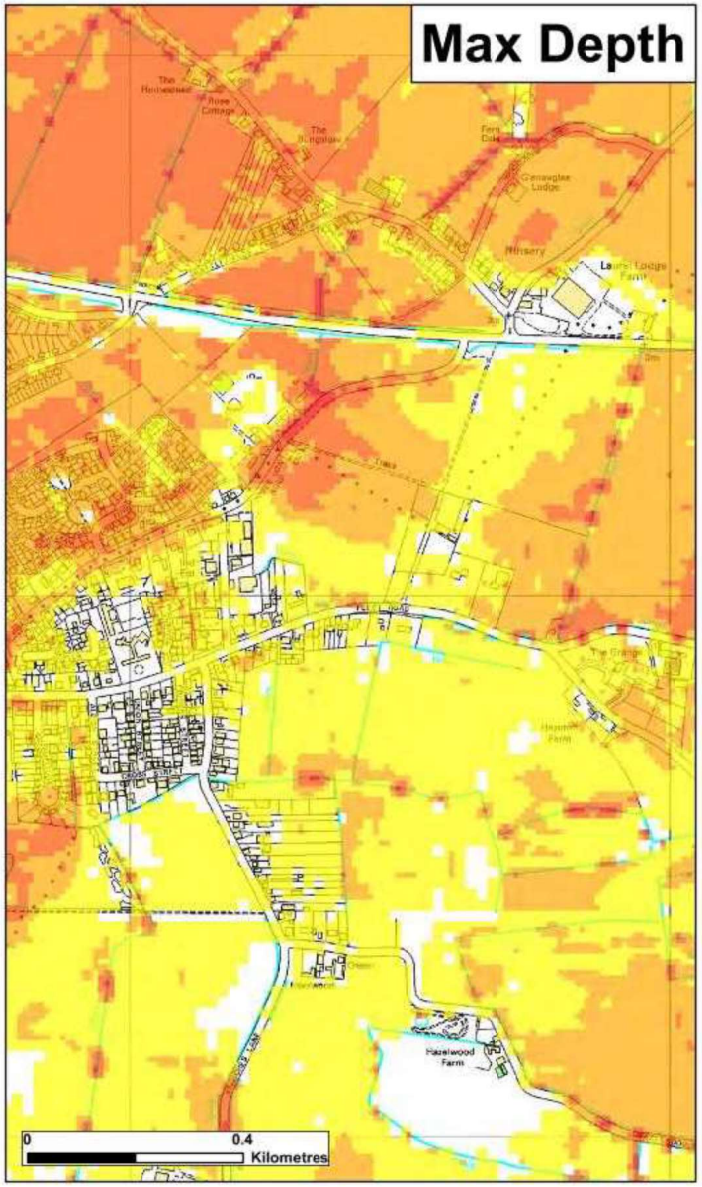
Produced by the Partnership and Strategic Overview Team, Lincoln
General Enquiries No: 03708 506 506

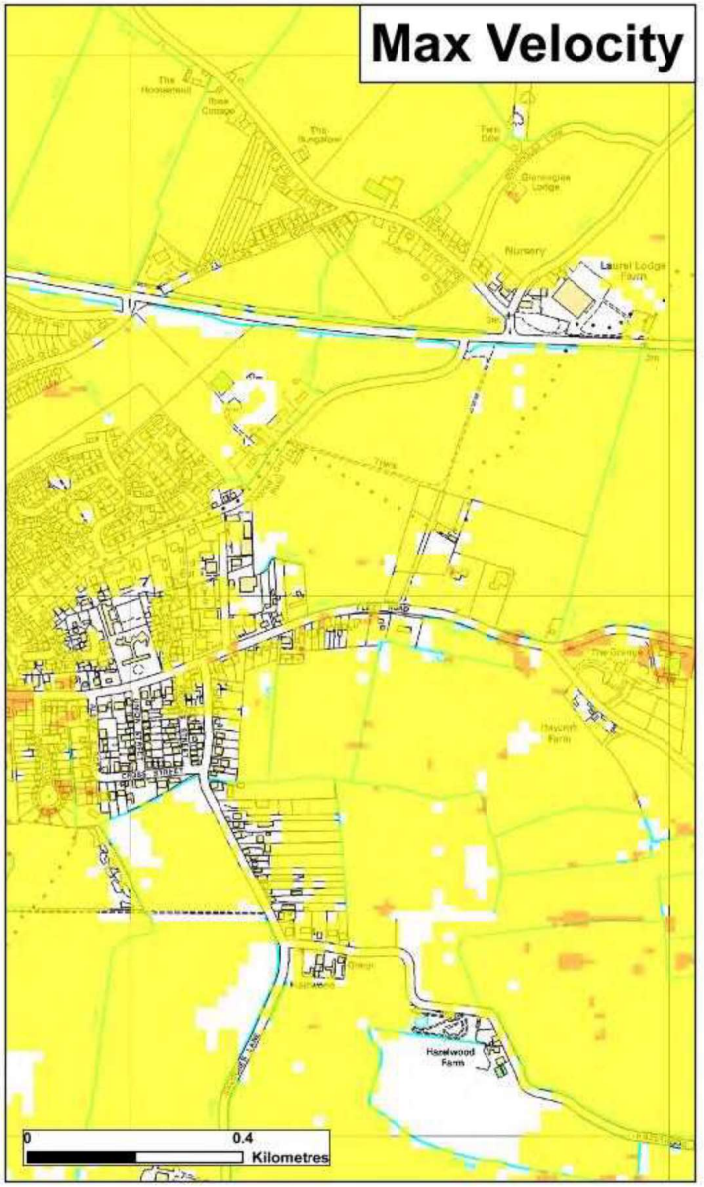
Northern Area Tidal Hazard Mapping

Location of Modelled Breaches

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★ **Modelled Breach Locations** - see also the accompanying plan "Location of Modelled Breaches"

Max Hazard
(Flood Risk to People : FD2320)

- Less than 0.75 (Low Hazard)
- Between 0.75 and 1.25 (Danger for Some)
- Between 1.25 and 2.0 (Danger for Most)
- Greater than 2.0 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- 2.0 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	May 2016	Scenario year	2115	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2016-7783

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.

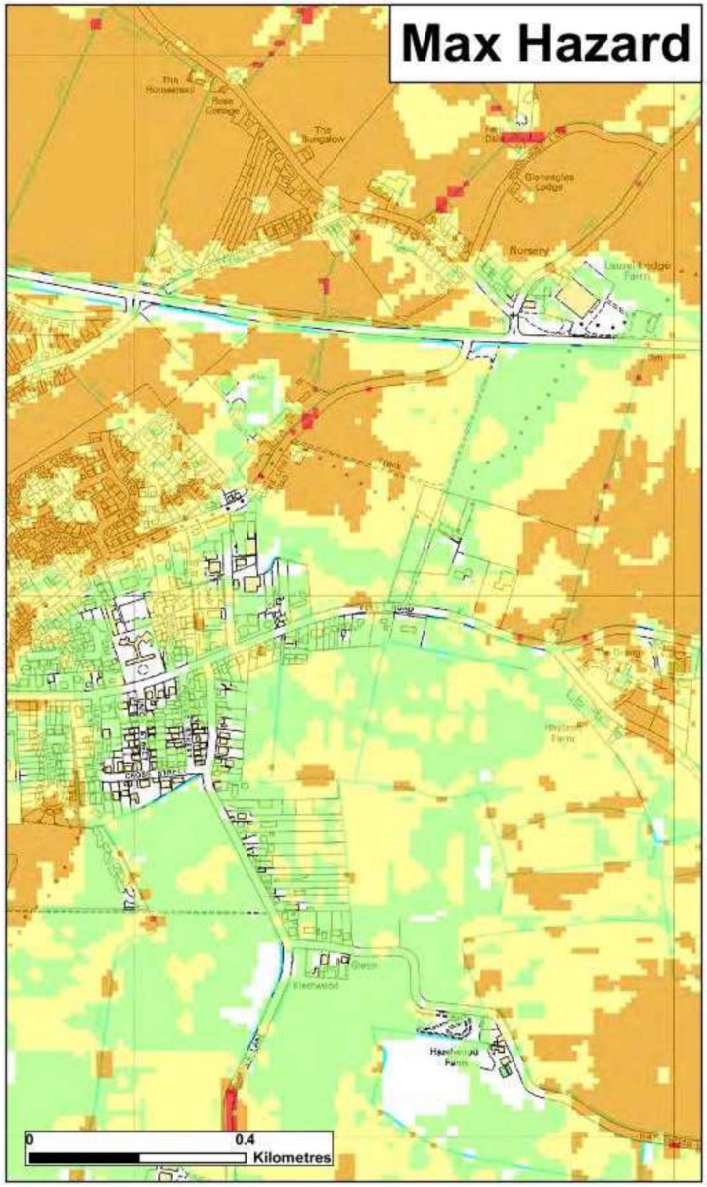
General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary

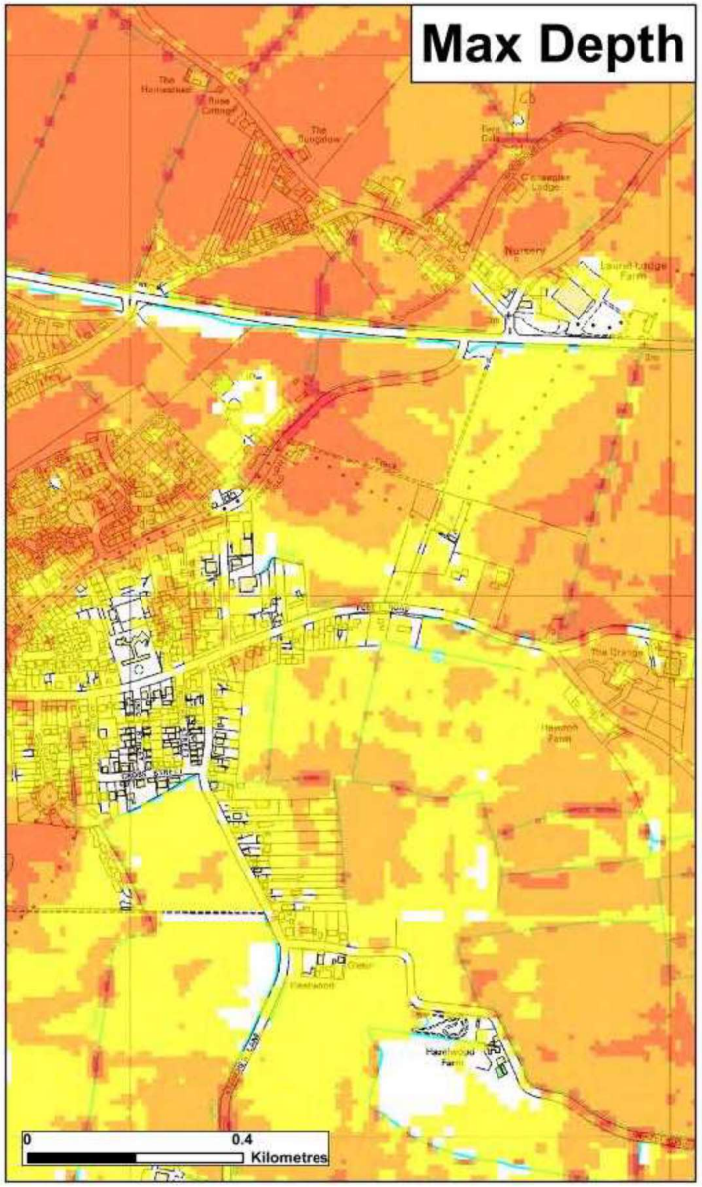
Environment Agency

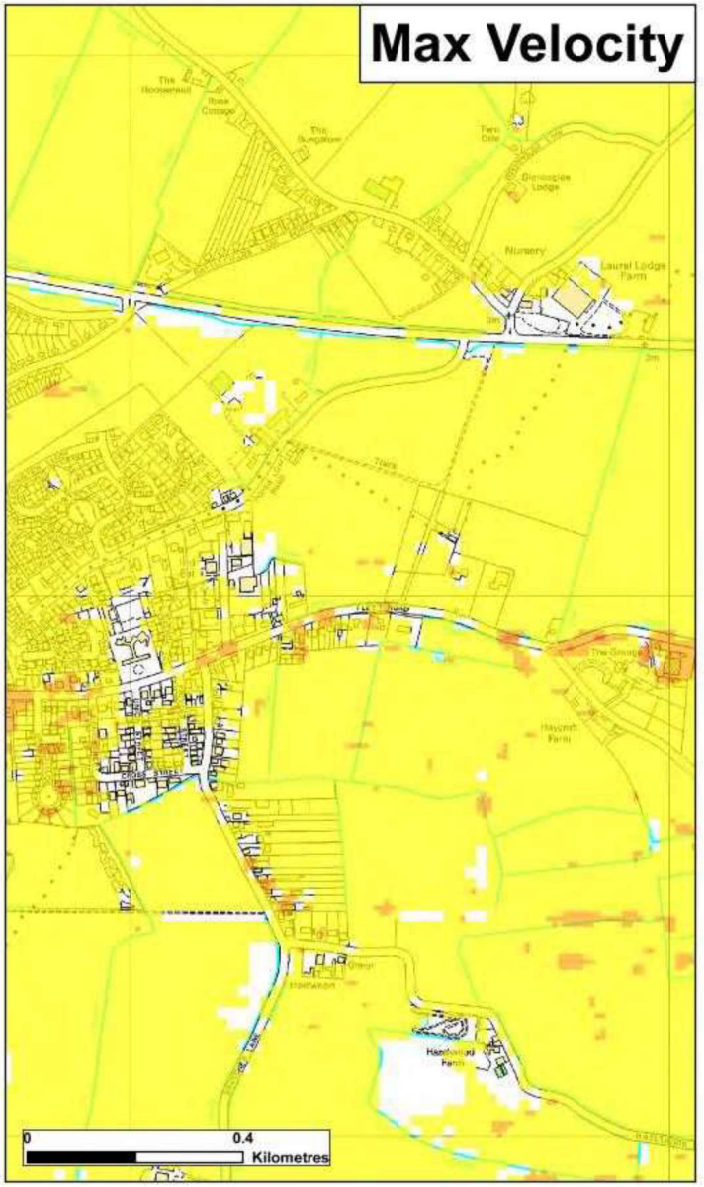
Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping

Map Centred on TF 37408 25004

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- Greater than 2.0 (Danger for All)

Max Depth (m)

- 0 - 0.25
- 0.25 - 0.50
- 0.50 - 1.0
- 1.0 - 2.0
- 2.0 +

Max Velocity (m/s)

- 0 - 0.3
- 0.3 - 1.0
- 1.0 - 1.5
- 1.5 - 2.5
- 2.5 +

Date Printed	May 2016	Scenario year	2115	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2016-7783

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.

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Environment Agency

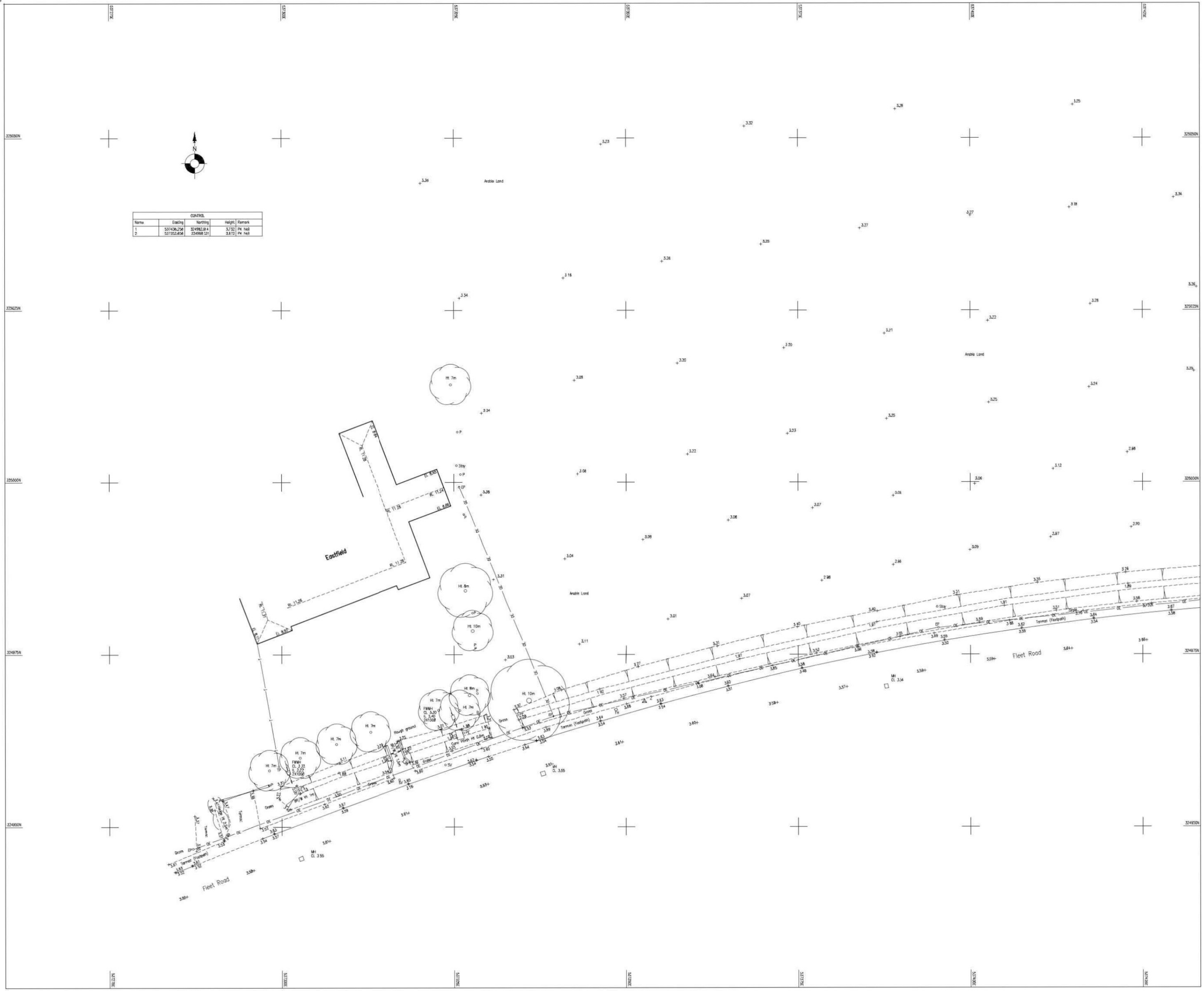
Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping

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APPENDIX 6

TOPOGRAPHIC SURVEY



CONTROL				
Name	Easting	Northing	Height	Remark
1	537436.256	324982.914	3.732	PK Nail
2	537352.656	324968.131	3.672	PK Nail

Legend:

Abbreviated Features:

AV	Air Valve
Av.	Average
B	Bollard
BB	Belisha Beacon
BH	Borehole
BL	Bed Level
BS	Bus Stop
BT	British Telecom Cover
B/RW	Brick Retaining Wall
Br/W	Brick Wall
CATV	Cable TV Cover
CCTV	Close Circuit TV
CL	Cover Level
Col.	Column
C/RW	Concrete Retaining Wall
C/Pit	Catch Pit
DPC	Damp Proof Course
DK	Drop Kerb
Dr	Drain
EL	Eaves Level
ER	Earth Rod
EP	Electricity Pole
FH	Fire Hydrant
FL	Floor Level
F/Light	Flood Light
FW	Foul Water
FP	Foot Path
G	Gully
GV	Gas Valve
GP	Gate Post
Ht.	Height
IC	Inspection Chamber
IL	Invert Level
KO	Kerb Outlet
LB	Letter Box
LP	Lamp Post
MH	Manhole
Mkr	Marker Post
MS	Mile Stone
OSBM	Ordnance Survey Bench Mark
OH	Overhead
P	Post
OH	Overhead
P	Post
PB	Post Box
PE	Pipe
PM	Parking Meter
RE	Rodding Eye
RL	Ridge Level
RP	Reflector Post
RS	Road Sign
RW	Retaining Wall
RWP	Rain Water Pipe
S	Stump
SL	Soffit Level
SN	Sign
SNP	Street Name Plate
SV	Stop Valve
SVP	Soil & Vent Pipe
SW	Surface Water
S/RW	Stone Retaining Wall
St/W	Stone Wall
TCB	Telephone Call Box
TL	Traffic Light
TP	Telegraph Pole
UG	Underground
US	Underside
UTL	Unable To Lift
DUTL	Damaged UTL
OUTL	Obstructed UTL
SUTL	Sealed UTL
VP	Vent Pipe
WL	Water Level
WM	Water Meter
WO	Wash Out
WT	Water Tap
Ø	Diameter

Fence Abbreviations.

B/W	Barbed Wire
C/B	Close Boarded
C/I	Corrugated Iron
C/L	Chain Link
C/P	Chestnut Paling
I/R	Iron Railing
P/R	Post & Rail
P/W	Post & Wire

Symbols:

Control Station .
Manhole/Inspection Chamber .
Inlet Pipe
Inlet Pipe
Out Flow Pipe
Bush :
Tree : Spread & Girth Shown to Scale
Gate :
Spot Level : 52.36
Bore Hole :
Trial Hole :

Lines:

Wall :
Verge :
Fence :
Boundary :
Edge of Spread :
Hedge :
Embankment : Top of Bank / Bottom of Bank
OH Telecom :
OH Electric :
Drainage Flow :
Contours :

Hatching:

Building :
Open Sided Building :

General Notes.

1. Man entry to sewers has not been undertaken. Depths, pipe sizes and quantity of pipes are measured from the surface. We therefore cannot guarantee the completeness or accuracy of the sewer data which should be checked with the local authority or and/on site.
2. All tree heights and spreads are approximate. The plan position of trunks are taken at ground level. Girth measurements are taken at a 1.5m height. We have attempted to identify tree species, however if tree species are critical specialist advice should be sought
3 Survey information is as result of measurement to existing features and does not imply legal ownership of boundaries or land divisions Where boundary alignment lines are added to the survey drawing and are taken from legal documents or other information supplied they are done so within the constraints of drawing quality and scale. They are provided on the basis of opinion and do not imply legal contract.

Plan Coordinate Control:-
Plan Coordinates relate to National Grid OSGB36(02) using GPS
LSF 1.000 at Stn 1

Level Datum:-
All Levels relate to OSGB36(02) using GPS

Sheet Location Diagram:

1 2

Notes:

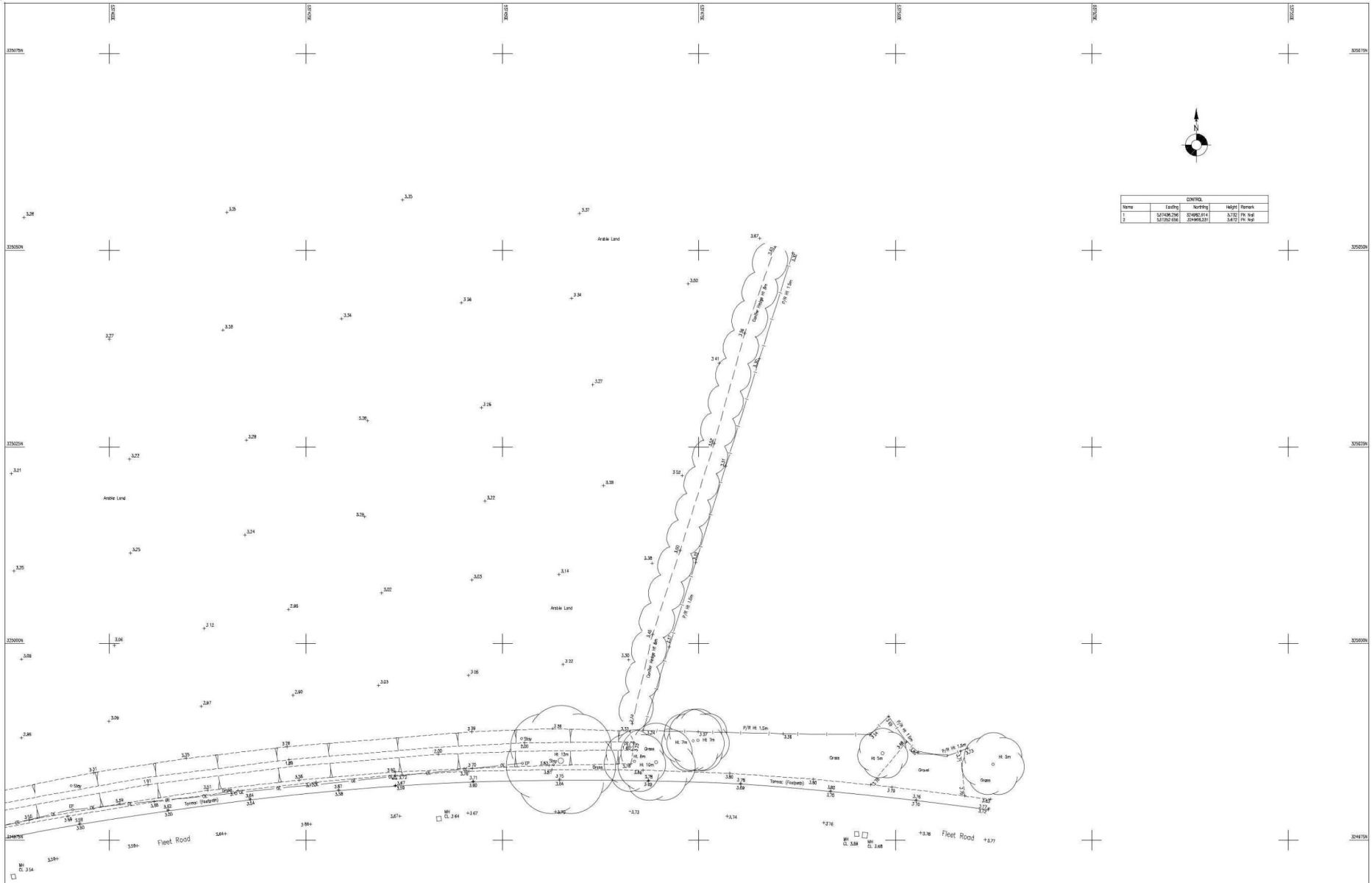
REV NO	REV NOTE	DATE	SIGNED

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CHAS
THE SURVEY ASSOCIATION
smas

GLOBAL SURVEYS
6 Franklin's Close, Ecton, Northants, NN6 0QG
Tel: 01604 491543 Fax: 01604 790361
Email: info@globalsurveys.co.uk

Site:	Land At Fleet Road Holbeach PE12 8LA
Client:	Mr P & Mrs J McCarthy
Survey Description:	Topographical Survey

Date	March 2016	Scale	1/250 @ A1
Dwg No	15797-Topo	Surveyor	SPH
Sheet	1 of 2	Checked	MSW



Legend:

Abbreviated Features:

AV	Air Valve	OH	Overhead
Av.	Average	P	Post
B	Bollard	PB	Post Box
BB	Belisha Beacon	PE	Pipe
BH	Borehole	PM	Parking Meter
BL	Bed Level	RE	Reading Eye
BS	Bus Stop	RL	Ridge Level
BT	British Telecom Cover	RP	Reflector Post
B/RW	Brick Retaining Wall	RS	Road Sign
Br/W	Brick Wall	RW	Retaining Wall
CATV	Cable TV Cover	RWP	Rain Water Pipe
CCTV	Close Circuit TV	S	Stump
CL	Cover Level	SL	Soffit Level
Col.	Column	SN	Sign
C/RW	Concrete Retaining Wall	SNP	Street Name Plate
C/PR	Catch PR	SV	Stop Valve
DPC	Damp Proof Course	SVP	Soil & Vent Pipe
DK	Drop Kerb	SW	Surface Water
Dr	Drain	S/RW	Stone Retaining Wall
EL	Eaves Level	S/W	Stone Wall
ER	Earth Rod	TCB	Telephone Call Box
EP	Electricity Pole	TL	Traffic Light
FH	Fire Hydrant	TP	Telegraph Pole
FL	Fiber Level	UG	Underground
F/Light	Flood Light	US	Underside
FW	Foul Water	UTL	Unable To Lift
FP	Foot Path	DUTL	Damaged UTL
G	Gully	OUTL	Obstructed UTL
GV	Gas Valve	SUTL	Sealed UTL
GP	Gate Post	VP	Vent Pipe
Ht.	Height	WL	Water Level
IC	Inspection Chamber	WM	Water Meter
IL	Invert Level	WO	Wash Out
KO	Kerb Outlet	WT	Water Tap
LB	Letter Box	Ø	Diameter
LP	Lamp Post		
MH	Manhole		
MkP	Marker Post		
MS	Milk Stone		
OSBM	Ordnance Survey Bench Mark		
OH	Overhead		
P	Post		

Fence Abbreviations.

B/W	Barbed Wire
C/B	Close Boarded
C/I	Corrugated Iron
C/L	Chain Link
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Symbols:

Control Station .

Manhole/Inspection Chamber .

Inlet Pipe / Out Flow Pipe

Bush .

Tree : Spread & Girth Shown to Scale

Gate :

Spot Level : 52.16

Bore Hole :

Trial Hole :

Lines:

Wall :

Verge :

Fence :

Boundary :

Edge of Spread :

Hedge :

Embankment : Top of Bank / Bottom of Bank

OH Telecom :

OH Electric :

Drainage Flow :

Contours :

Hatching:

Building :

Open Sided Building :

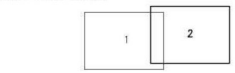
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3. Survey information is as result of measurement to existing features and does not imply legal ownership of boundaries or land divisions. Where boundary alignment lines are added to the survey drawing and are taken from legal documents or other information supplied they are done so within the constraints of drawing quality and scale. They are provided on the basis of opinion and do not imply legal contract.

Plan Coordinate Control:-
Plan Coordinates relate to National Grid OSGB36(02) using GPS
LSF 1.000 at Stn 1

Level Datum:-
All Levels relate to OSGB36(02) using GPS

Sheet Location Diagram:



Notes:

REV NO	REV NOTE	DATE	SIGNED

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CHAS
THE SURVEY ASSOCIATION
smas

GLOBAL SURVEYS
6 Franklin's Close, Ecton, Northants, NN6 0QG
Tel: 01604 491543 Fax: 01604 790361
Email: info@globalsurveys.co.uk

Site: Land At Fleet Road, Holbeach, PE12 8LA

Client: Mr P & Mrs J McCarthy

Survey Description: Topographical Survey

Date	March 2016	Scale	1/250 @ A1
Dwg No	15797-Topo	Surveyor	SPH
Sheet	2 of 2	Checked	MSW

APPENDIX 7

ENVIRONMENT AGENCY PREVIOUS APPROVAL

South Holland District Council
Planning & Development
Council Offices Priory Road
Spalding
Lincolnshire
PE11 2XE

Our ref: AN/2016/123705/01-L01
Your ref: H05-0469-16

Date: 27 May 2016

Dear Sir/Madam

Residential development
Land North of Fleet Road, Holbeach, Spalding

Thank you for consulting us on the application above, on 17 May 2016.

Environment Agency position
The proposed development will only meet the requirements of the National Planning Policy Framework if the following mitigation measures are secured and implemented by way of a planning condition on any planning permission.

Condition
The development permitted by this planning permission shall be carried out in accordance with both the approved Flood Risk Assessment (dated May 2016) and approved Design and Access Statement (dated May 2016) and in particular the following mitigation measures:

- Finished floor levels shall be set no lower than 3.65mAOD;
- The dwellings shall be a minimum of two storeys.

The mitigation measures shall be fully implemented prior to occupation and subsequently in accordance with the timing / phasing arrangements embodied within the scheme, or within any other period as may subsequently be agreed, in writing, by the local planning authority.

Reason
To reduce the risk of flooding to the proposed development and future occupants.

As you are aware the discharge of planning conditions rests with your Authority. It is, therefore, essential that you are satisfied that the proposed draft condition meets the requirements of paragraph 4 of the National Planning Practice Guidance (Use of Planning Conditions, section 2). Please notify us immediately if you are unable to apply our suggested condition, as we may need to tailor our advice accordingly.

Informative to the applicant
We strongly recommend that future occupants register with the Environment Agency's free Floodline Warnings Direct Service in accordance with the recommendation of the Flood Risk Assessment.

Informative to the LPA
The National Planning Policy Framework places responsibilities on local authorities to consult their Emergency Planners and the Emergency Services with regard to specific emergency planning issues relating to new development. It is not our role to comment on or approve the adequacy of these plans and we would expect local planning authorities, through their Emergency Planners, to formally consider the implication of this in making their decision.

Please note that the Local Planning Authority must be satisfied with regard to the safety of people (including those with restricted mobility), the ability of such people to reach places of safety (including safe refuges within buildings) and the ability of the emergency services to access such buildings to rescue and evacuate those people.

Should you require any additional information, or wish to discuss these matters further, please do not hesitate to contact me on the number below.

Yours faithfully

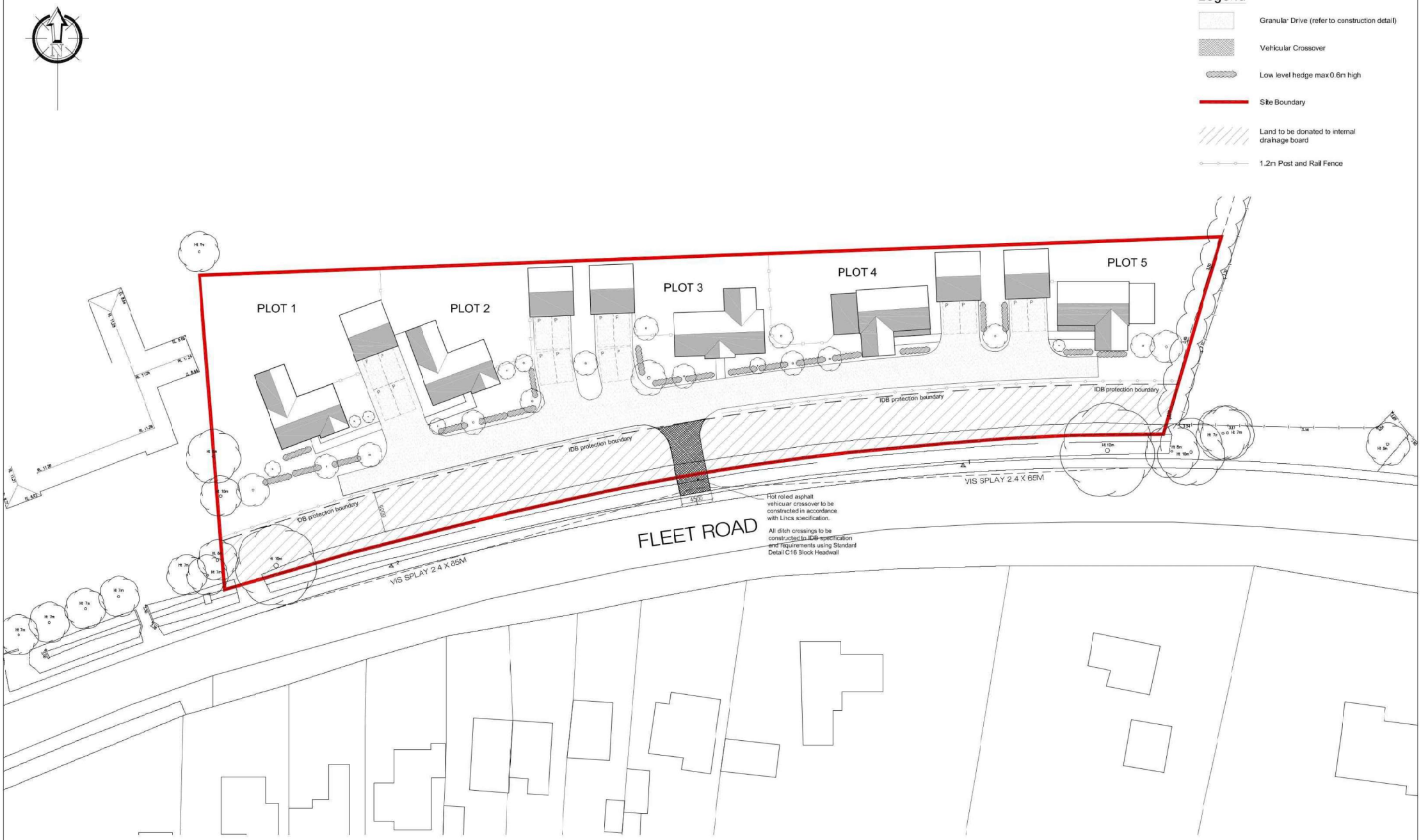
Mr Rob Millbank
Sustainable Places - Planning Adviser

Direct dial 02030 255036
Direct e-mail rob.millbank@environment-agency.gov.uk

End

APPENDIX 8

PROPOSED SITE LAYOUT



Illustrative Site Layout 1:250@A1

This drawing remains the property of Welland Design and Build Ltd and may not be reproduced or amended except by written permission. No liability will be excepted for am amendments made by others. The Contractor is responsible for checking all site dimensions, ida levels, sewer inverts at connection points before commencing any works. All work by the contractor must comply with all current relevant legislation, regulation standards guidance and lawwether or not specified in this drawing. The contractor is responsible for checking this drawing against all other relevant architect and engineers details and drawings prior to commencement of site works.

Project Title
Proposed Development at Fleet Road, Holbeach

Client:
P & J McCarthy

24.05.2017 | Revision : J

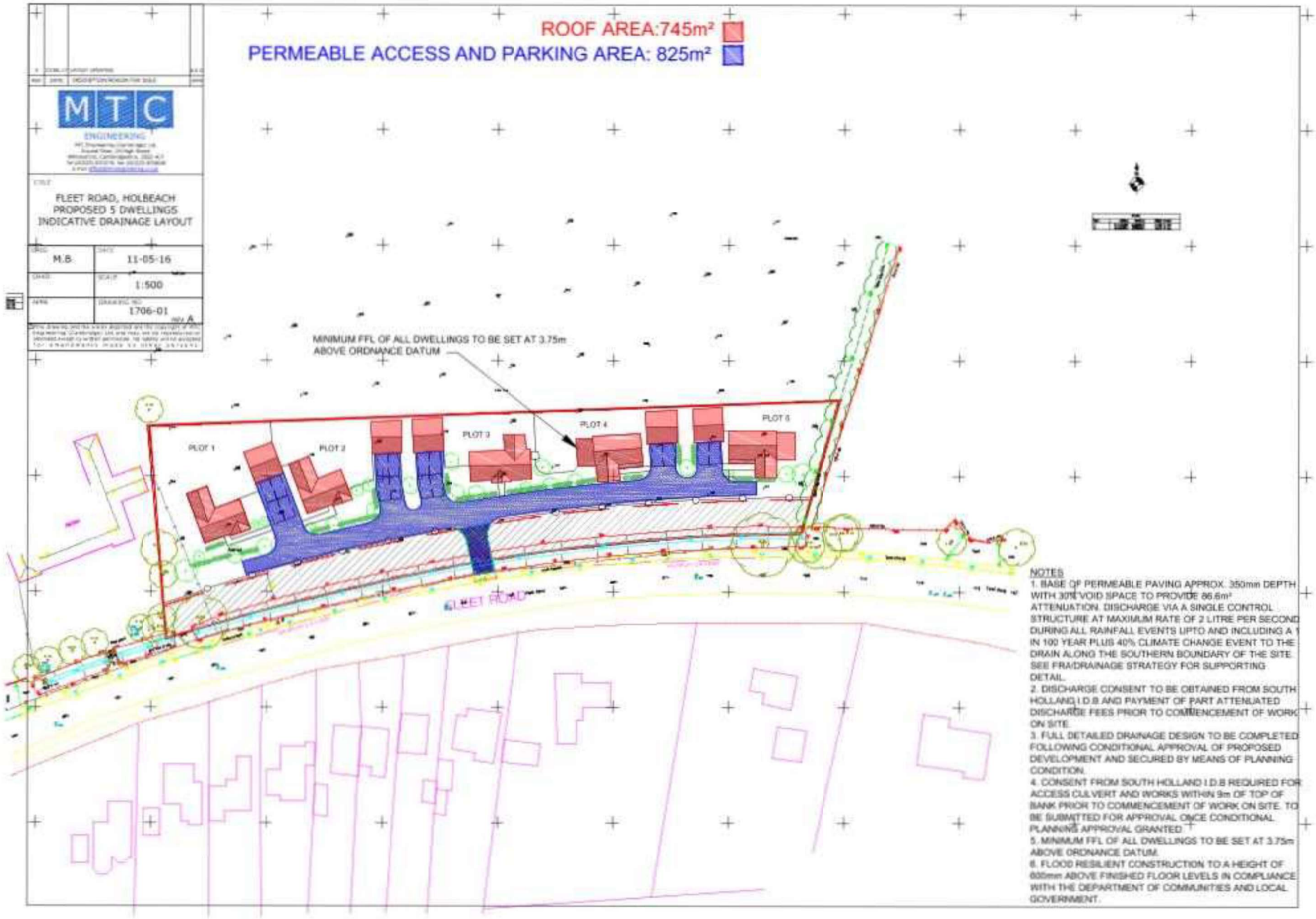
Drawing:
Illustrative Site Layout

Drawing Number: 15037/SK01 | Scale: 1 : 250 AI

WELLAND
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APPENDIX 9

INDICATIVE DRAINAGE PLAN


ROOF AREA:745m²
PERMEABLE ACCESS AND PARKING AREA: 825m²
MTC
ENGINEERING
FLEET ROAD, HOLBEACH
PROPOSED 5 DWELLINGS
INDICATIVE DRAINAGE LAYOUT
M.B
11-05-16
1:500
1706-01
rev A
MINIMUM FFL OF ALL DWELLINGS TO BE SET AT 3.75m
ABOVE ORDNANCE DATUM
PLOT 1
PLOT 2
PLOT 3
PLOT 4
PLOT 5
FLEET ROAD
NOTES
1. BASE OF PERMEABLE PAVING APPROX. 350mm DEPTH WITH 30% VOID SPACE TO PROVIDE 86.6m³ ATTENUATION. DISCHARGE VIA A SINGLE CONTROL STRUCTURE AT MAXIMUM RATE OF 2 LITRE PER SECOND DURING ALL RAINFALL EVENTS UPTO AND INCLUDING A 1 IN 100 YEAR PLUS 40% CLIMATE CHANGE EVENT TO THE DRAIN ALONG THE SOUTHERN BOUNDARY OF THE SITE. SEE FRA/DRAINAGE STRATEGY FOR SUPPORTING DETAIL.
2. DISCHARGE CONSENT TO BE OBTAINED FROM SOUTH HOLLAND I.D.B AND PAYMENT OF PART ATTENUATED DISCHARGE FEES PRIOR TO COMMENCEMENT OF WORK ON SITE.
3. FULL DETAILED DRAINAGE DESIGN TO BE COMPLETED FOLLOWING CONDITIONAL APPROVAL OF PROPOSED DEVELOPMENT AND SECURED BY MEANS OF PLANNING CONDITION.
4. CONSENT FROM SOUTH HOLLAND I.D.B REQUIRED FOR ACCESS CULVERT AND WORKS WITHIN 9m OF TOP OF BANK PRIOR TO COMMENCEMENT OF WORK ON SITE. TO BE SUBMITTED FOR APPROVAL ONCE CONDITIONAL PLANNING APPROVAL GRANTED.
5. MINIMUM FFL OF ALL DWELLINGS TO BE SET AT 3.75m ABOVE ORDNANCE DATUM.
6. FLOOD RESILIENT CONSTRUCTION TO A HEIGHT OF 600mm ABOVE FINISHED FLOOR LEVELS IN COMPLIANCE WITH THE DEPARTMENT OF COMMUNITIES AND LOCAL GOVERNMENT.

APPENDIX 10

MICRO DRAINAGE STORAGE GREENFIELD RUN OFF CALCULATIONS

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	0.162	Urban	0.000
SAAR (mm)	572	Region Number	Region 5

Results l/s

QBAR Rural	0.2
QBAR Urban	0.2
Q100 years	0.8
Q1 year	0.2
Q30 years	0.6
Q100 years	0.8

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APPENDIX 11

MICRO DRAINAGE ATTENUATION CALCULATIONS

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 359 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	2.839	0.139	0.0	2.0	2.0	34.3	Flood Risk
30 min Summer	2.885	0.185	0.0	2.0	2.0	45.8	Flood Risk
60 min Summer	2.930	0.230	0.0	2.0	2.0	56.8	Flood Risk
120 min Summer	2.968	0.268	0.0	2.0	2.0	66.4	Flood Risk
180 min Summer	2.985	0.285	0.0	2.0	2.0	70.4	Flood Risk
240 min Summer	2.991	0.291	0.0	2.0	2.0	72.0	Flood Risk
360 min Summer	2.990	0.290	0.0	2.0	2.0	71.8	Flood Risk
480 min Summer	2.987	0.287	0.0	2.0	2.0	70.9	Flood Risk
600 min Summer	2.981	0.281	0.0	2.0	2.0	69.6	Flood Risk
720 min Summer	2.975	0.275	0.0	2.0	2.0	68.0	Flood Risk
960 min Summer	2.960	0.260	0.0	2.0	2.0	64.3	Flood Risk
1440 min Summer	2.928	0.228	0.0	2.0	2.0	56.4	Flood Risk
2160 min Summer	2.883	0.183	0.0	2.0	2.0	45.3	Flood Risk
2880 min Summer	2.846	0.146	0.0	2.0	2.0	36.2	Flood Risk
4320 min Summer	2.800	0.100	0.0	2.0	2.0	24.7	O K
5760 min Summer	2.781	0.081	0.0	1.7	1.7	20.1	O K
7200 min Summer	2.770	0.070	0.0	1.5	1.5	17.4	O K
8640 min Summer	2.763	0.063	0.0	1.3	1.3	15.7	O K
10080 min Summer	2.758	0.058	0.0	1.2	1.2	14.4	O K
15 min Winter	2.858	0.158	0.0	2.0	2.0	39.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.597	0.0	33.9	18
30 min Summer	85.825	0.0	46.2	33
60 min Summer	53.779	0.0	60.3	62
120 min Summer	32.595	0.0	74.0	122
180 min Summer	24.012	0.0	82.2	182
240 min Summer	19.224	0.0	87.9	240
360 min Summer	13.954	0.0	96.0	328
480 min Summer	11.125	0.0	102.1	384
600 min Summer	9.325	0.0	107.0	444
720 min Summer	8.069	0.0	111.1	506
960 min Summer	6.417	0.0	117.8	638
1440 min Summer	4.640	0.0	127.3	908
2160 min Summer	3.350	0.0	138.1	1280
2880 min Summer	2.656	0.0	145.1	1644
4320 min Summer	1.912	0.0	154.6	2292
5760 min Summer	1.513	0.0	162.1	3000
7200 min Summer	1.261	0.0	166.9	3680
8640 min Summer	1.086	0.0	170.4	4416
10080 min Summer	0.957	0.0	172.9	5144
15 min Winter	130.597	0.0	38.6	18

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	2.910	0.210	0.0	2.0	2.0	52.0	Flood Risk
60 min Winter	2.961	0.261	0.0	2.0	2.0	64.6	Flood Risk
120 min Winter	3.006	0.306	0.0	2.0	2.0	75.7	Flood Risk
180 min Winter	3.025	0.325	0.0	2.0	2.0	80.4	Flood Risk
240 min Winter	3.033	0.333	0.0	2.0	2.0	82.4	Flood Risk
360 min Winter	3.033	0.333	0.0	2.0	2.0	82.5	Flood Risk
480 min Winter	3.027	0.327	0.0	2.0	2.0	80.9	Flood Risk
600 min Winter	3.020	0.320	0.0	2.0	2.0	79.1	Flood Risk
720 min Winter	3.011	0.311	0.0	2.0	2.0	77.0	Flood Risk
960 min Winter	2.990	0.290	0.0	2.0	2.0	71.9	Flood Risk
1440 min Winter	2.939	0.239	0.0	2.0	2.0	59.2	Flood Risk
2160 min Winter	2.870	0.170	0.0	2.0	2.0	42.2	Flood Risk
2880 min Winter	2.819	0.119	0.0	2.0	2.0	29.5	Flood Risk
4320 min Winter	2.779	0.079	0.0	1.7	1.7	19.7	O K
5760 min Winter	2.765	0.065	0.0	1.4	1.4	16.1	O K
7200 min Winter	2.757	0.057	0.0	1.2	1.2	14.1	O K
8640 min Winter	2.752	0.052	0.0	1.0	1.0	12.8	O K
10080 min Winter	2.748	0.048	0.0	0.9	0.9	11.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	85.825	0.0	52.4	33
60 min Winter	53.779	0.0	68.1	62
120 min Winter	32.595	0.0	83.5	120
180 min Winter	24.012	0.0	92.6	178
240 min Winter	19.224	0.0	99.1	234
360 min Winter	13.954	0.0	108.1	344
480 min Winter	11.125	0.0	115.1	438
600 min Winter	9.325	0.0	120.6	472
720 min Winter	8.069	0.0	125.2	548
960 min Winter	6.417	0.0	132.6	704
1440 min Winter	4.640	0.0	143.4	982
2160 min Winter	3.350	0.0	155.7	1360
2880 min Winter	2.656	0.0	163.7	1676
4320 min Winter	1.912	0.0	174.7	2296
5760 min Winter	1.513	0.0	183.3	3000
7200 min Winter	1.261	0.0	189.1	3744
8640 min Winter	1.086	0.0	193.4	4416
10080 min Winter	0.957	0.0	196.6	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.162

Time (mins) From:	To:	Area (ha)
0	4	0.162

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Model Details

Storage is Online Cover Level (m) 3.100

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	165.0
Max Percolation (l/s)	229.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.700	Cap Volume Depth (m)	0.000

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0075-2000-0400-2000
Design Head (m)	0.400
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	75
Invert Level (m)	2.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.400	2.0
Flush-Flo™	0.124	2.0
Kick-Flo®	0.285	1.7
Mean Flow over Head Range	-	1.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	1.200	3.3	3.000	5.0	7.000	7.5
0.200	1.9	1.400	3.5	3.500	5.4	7.500	7.8
0.300	1.7	1.600	3.7	4.000	5.7	8.000	8.1
0.400	2.0	1.800	3.9	4.500	6.0	8.500	8.3
0.500	2.2	2.000	4.1	5.000	6.4	9.000	8.6
0.600	2.4	2.200	4.3	5.500	6.7	9.500	8.8
0.800	2.7	2.400	4.5	6.000	7.0		
1.000	3.0	2.600	4.7	6.500	7.3		

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