



**PROPOSED STARBUCKS
FACILITY AT MAIN ROAD
SERVICE STATION,
WISBECH ROAD, LONG
SUTTON, LINCOLNSHIRE**

FLOOD RISK ASSESSMENT

MARCH 2019

REPORT REF: 2272/RE/03-19/01

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CONTRACT

Evans Rivers and Coastal Ltd has been commissioned by Wyeth Projects Services for Motor Fuel Limited to carry out a flood risk assessment for a proposed Starbucks facility at Main Road Service Station, Wisbech Road, Long Sutton, Lincolnshire.

QUALITY ASSURANCE, ENVIRONMENT AND HEALTH AND SAFETY

Evans Rivers and Coastal Ltd operates a Quality Assurance, Environmental, and Health and Safety Policy.

This project comprises various stages including data collection; depth analysis; and reporting. Quality will be maintained throughout the project by producing specific methodologies for each work stage. Quality will also be maintained by providing specifications to third parties such as surveyors; initiating internal quality procedures including the validation of third party deliverables; creation of an audit trail to record any changes made; and document control using a database and correspondence log file system.

To adhere to the Environmental Policy, data will be obtained and issued in electronic format and alternatively by post. Paper use will also be minimised by communicating via email or telephone where possible. Documents and drawings will be transferred in electronic format where possible and all waste paper will be recycled. Meetings away from the office of Evans Rivers and Coastal Ltd will be minimised to prevent unnecessary travel, however for those meetings deemed essential, public transport will be used in preference to car journeys.

The project will follow the commitment and objectives outlined in the Health and Safety Policy operated by Evans Rivers and Coastal Ltd. All employees will be equipped with suitable personal protective equipment prior to any site visits and a risk assessment will be completed and checked before any site visit. Other factors which have been taken into consideration are the wider safety of the public whilst operating on site, and the importance of safety when working close to a water source and highway. Any designs resulting from this project and directly created by Evans Rivers and Coastal Ltd will also take into account safety measures within a "designers risk assessment".

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1. INTRODUCTION

1.1 Project Scope

1.1.1 Evans Rivers and Coastal Ltd has been commissioned by Wyeth Projects Services for Motor Fuel Limited to carry out a flood risk assessment for a proposed Starbucks facility at Main Road Service Station, Wisbech Road, Long Sutton, Lincolnshire.

1.1.2 It is understood that this Flood Risk Assessment will be submitted to the Environment Agency (Agency, hereafter). Specifically, this assessment intends to:

- a) Consider the impacts of the 1 in 20 year, 1 in 200 year and 1 in 1000 year flood events (all inclusive of climate change), in accordance with NPPF;
- b) Review any literature and guidance specific to this area;
- c) Determine the extents and depths of floodwater and hazard;
- d) Assess the risks to people and property and propose mitigation measures accordingly;
- e) Review existing evacuation and warning procedures for the area;
- f) Carry out an appraisal of flood risk from any other sources such as groundwater as required by NPPF;
- g) Report findings and recommendations.

1.1.3 This assessment is carried out in accordance with the requirements of the National Planning Policy Framework (NPPF) dated 2018. Other documents which have been consulted include:

- DEFRA/EA document entitled *Framework and guidance for assessing and managing flood risk for new development Phase 2 (FD2320/TR2)*, 2005;
- Communities and Local Government 2007. *Improving the Flood Performance of New Buildings*. HMSO.
- DEFRA/EA document entitled *The flood risks to people methodology (FD2321/TR1)*, 2006;
- EA *Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose*, 2008;
- National Planning Practice Guidance – Flood Risk and Coastal Change.
- UK Government's climate change allowances guidance dated February 2016.
- Lincolnshire County Council Preliminary Flood Risk Assessment dated 2011.
- South East Lincolnshire Strategic Flood Risk Assessment (SFRA) dated March 2017.

2. DATA COLLECTION

2.1 To assist with this report, the data collected included:

- Ordnance Survey 1:10,000 street view map (Evans Rivers and Coastal Ltd OS licence number 100049458).
- British Geological Survey *Online Geology Viewer*.
- 1:250,000 *Soil Map of Eastern England* (Sheet 4) published by Cranfield University and Soil Survey of England and Wales 1983.
- 1:625,000 *Hydrogeological Map of England and Wales*, published in 1977 by the Institute of Geological Sciences (now the British Geological Survey).
- Flood level/hazard data provided by the Agency in their response received 6th July 2018 (Appendix A) for a nearby project undertaken by Evans Rivers and Coastal Ltd.
- Filtered LIDAR data at 2m resolution.

3. SITE CHARACTERISTICS

3.1 Existing Site Characteristics and Location

- 3.1.1 The site is located across land at the Main Road Service Station, Wisbech Road, Long Sutton, Lincolnshire. The approximate Ordnance Survey (OS) grid reference for the site is 544040 321810 and the location of the site is shown on Figure 1.

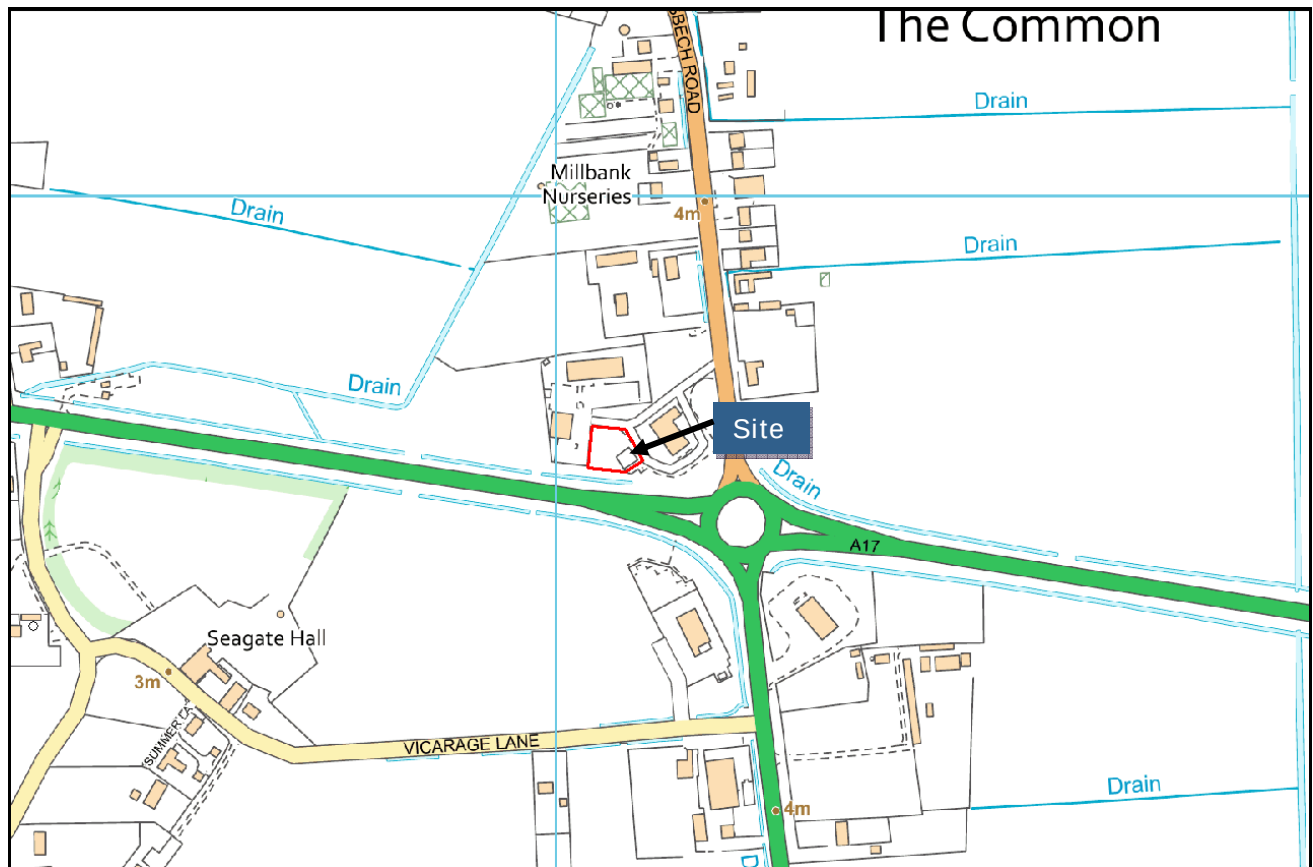


Figure 1: Site location plan (Source: Ordnance Survey)

- 3.1.2 The site is approximately square in shape and currently comprises a grassed area which forms part of the Main Road Service Station. Access is provided via internal access roads which extend out onto Wisbech Road. The existing site layout can be seen on Drawing Number WPS-MFG-130-PL02/A.
- 3.1.3 Filtered LIDAR data at 2m resolution (higher resolutions not available) has been obtained in order to determine and illustrate the topography across the site and surrounding area (Figure 2). It can be seen that ground levels across the site are typically set at 4.20m AOD. Ground levels rise along Wisbech Road to the north.

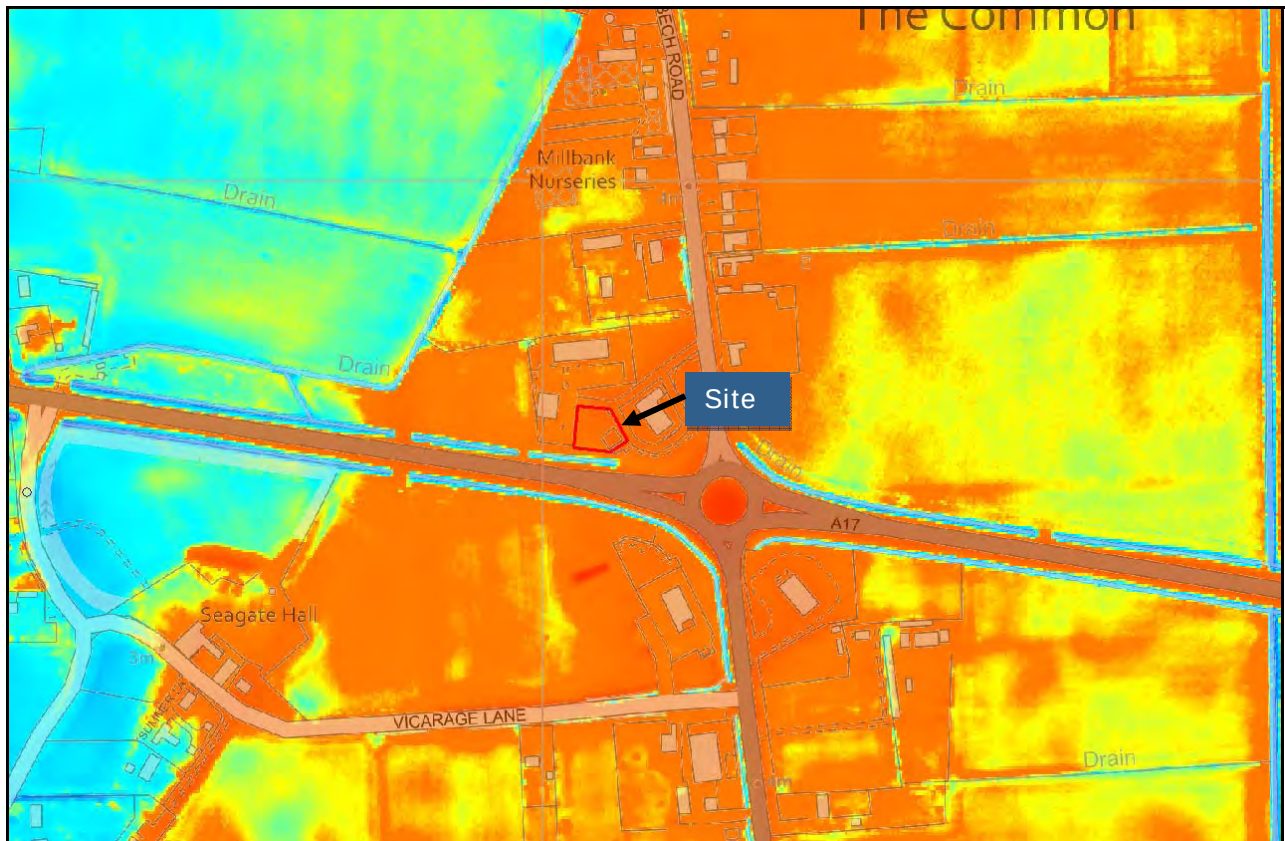


Figure 2: LIDAR survey data where higher ground is denoted as orange and yellow colours and lower areas denoted by blue and green colours

3.2 Site Proposals

- 3.2.1 It is the Client's intention to erect a Starbucks facility together with parking areas. The site proposals can be seen on Drawing Number WPS-MFG-130-PL03/B.
- 3.2.2 The proposals are classified as a "less-vulnerable" use according to Table 2 of the NPPF Planning Practice Guidance.

4. BASELINE INFORMATION

4.1 Environment Agency Flood Zone Map

- 4.1.1 The Environment Agency's Flood Zone Map (Figure 3) shows that the site is located within the NPPF defined Flood Zone 3 associated with the River Nene located 4.3 km east of the site.
- 4.1.2 The Flood Zone 3 is divided into two sub-categories, the Flood Zone 3a and Flood Zone 3b. The extent of the Flood Zone 3a 'High Probability' is defined as the 1 in 100 year return period fluvial event, or 1 in 200 year tidal event (or a combination of the two). As the River Nene is predominantly tidal at this location, the 1 in 200 year event will be most relevant.
- 4.1.3 The maps do not show the extent of the functional floodplain (Flood Zone 3b). Flood Zone 3b functional floodplain is defined in Table 1 of the NPPG as the area where water flows or is stored during flood events. The functional floodplain is generally defined by the limit of the 1 in 20 year flood envelope.
- 4.1.4 The extent of the flood zones do not take into account the presence of any formal flood defences, or other features which also act as informal flood defences.

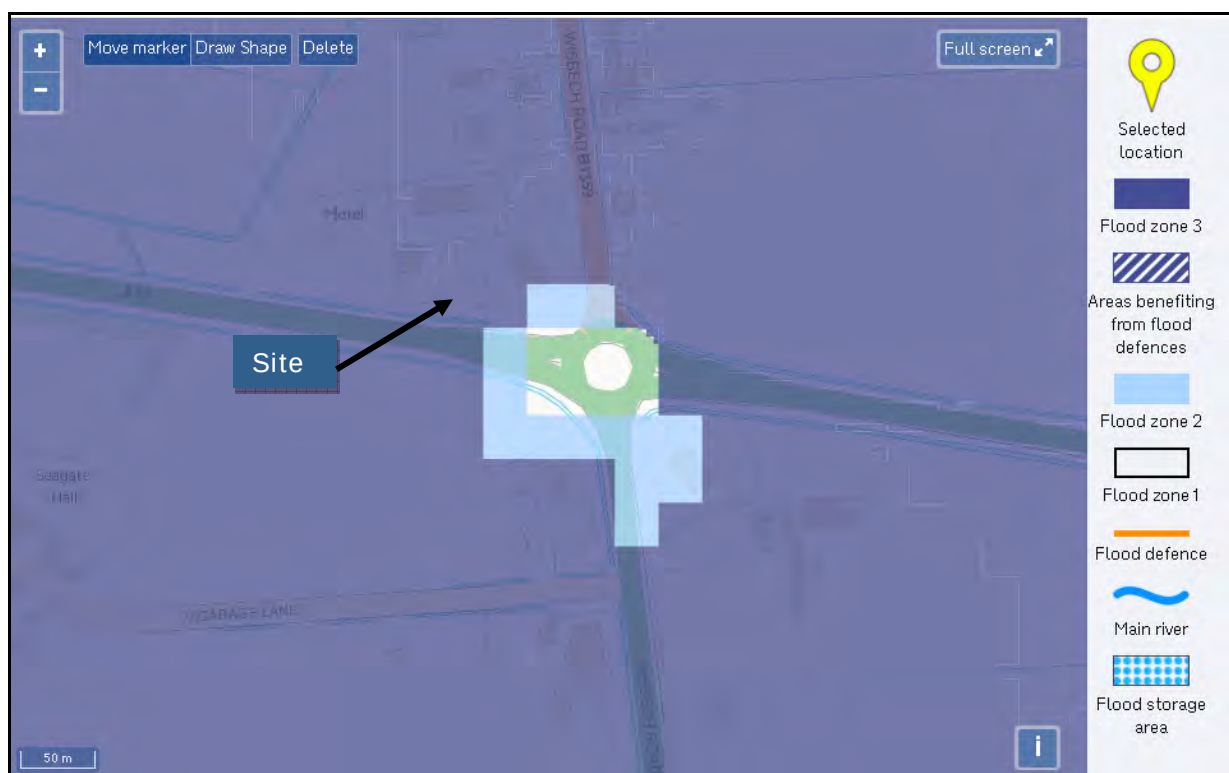


Figure 3: Environment Agency Flood Zone Map (Source: Environment Agency)

4.2 Flood Defences and Environment Agency Flood Levels

- 4.2.1 It is understood from the Agency's response received 6th July 2018 (Appendix A) for a nearby project undertaken by Evans Rivers and Coastal Ltd, that the River Nene is defended by tidal earth embankments which offers a standard of protection of 1 in 150 years, and which are routinely inspected by the Agency to ensure potential defects are identified.

- 4.2.2 The Agency has modelled overtopping and breaching of the River Nene defences and has provided the latest depth and hazard mapping which is discussed further in this report.

4.3 Internal Drainage Board

- 4.3.1 The site is located within the South Holland Internal Drainage Board (IDB) area (Lutton Lean – Free Discharge C). The closest IDB controlled drainage ditch is located 131m to the north west of the site and is classified as an IDB Ordinary Watercourse.
- 4.3.2 Information from the IDB's *Policy Statement on Flood Protection and Water Level Management* indicates that the IDB maintains the drainage network and more specifically water levels through the operation and maintenance of its pumping stations. The IDB's infrastructure, including its watercourses and pumping stations, is monitored by the IDB to ensure that their condition meet the standards of protection sought and improvement works are carried out where appropriate and necessary.

4.4 Flood Warning and Emergency Planning

- 4.4.1 The site is located within an Environment Agency Flood Warning area 055FWTNE3A (Long Sutton to Newborough, including Sutton St James, Leverington, Wisbech St Mary, and Thorney).
- 4.4.2 The Environment Agency can issue each level of warning when necessary at least 12 hours prior to the next high tide or critical estimated peak surge tide (based on a model run which is reviewed every 6 hours).
- 4.4.3 Flood Alerts, Flood Warnings and Severe Flood Warnings are issued to residents and businesses within flood risk areas by the Agency's *Floodline Warnings Direct* (FWD) service. This system is managed by the Environment Agency and dials out a message to the recipient when a particular category of flood warning is being advised. The message is conveyed by a constant ringing of the telephone or can alternatively be communicated to mobile phones and computers. The system functions at all times, issuing flood warnings and alerts in conjunction with announcements on radio and other media. Owners and occupiers of dwellings or businesses thought to be at risk can sign up to the scheme. **The owners are encouraged to confirm details with the Agency and to sign up for these warnings.** The various flood warning codes can be seen on Figure 4.

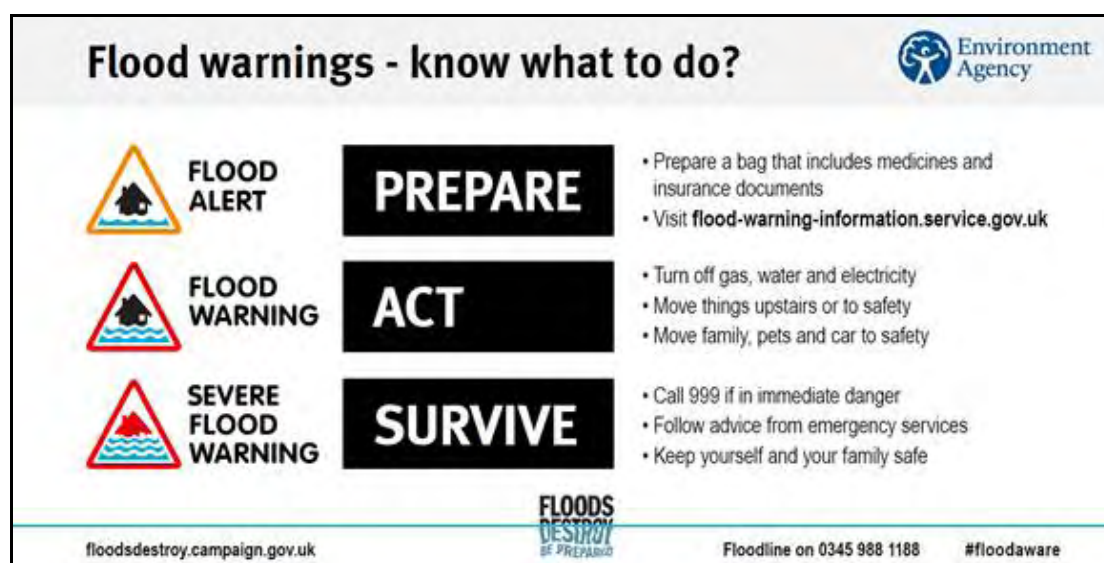


Figure 4: Flood warning codes (Source: Environment Agency)

- 4.4.4 It is understood that in the event of flooding, evacuation is managed by a multi-agency team in conjunction with the Police. The multi-agency team provides suitable premises for shelter, first aid, refreshments and possible transportation with consideration given to the elderly and vulnerable groups. It is essential that occupants produce robust Emergency Flood Plans to avoid putting themselves or emergency services at risk and that they do not rely solely on emergency services during the event.

5. TIDAL FLOOD RISK

- 5.1 The Agency has investigated the impacts of breaching of the River Nene defences and provided flood extents, depths and hazard (Appendix A) as part of their response received 6th July 2018 for a nearby project undertaken by Evans Rivers and Coastal Ltd.
- 5.2 However, as the site is located slightly outside of the Agency's mapped area, the SFRA maps entitled *Residual_Flood_Depth_District_2115_1_Fluvial_05_Tidal_20170224-1* and *Residual_Flood_Depth_District_Present_Day_1_Fluvial_05_Tidal_20170224-1*, have also been consulted (i.e. the SFRA maps compare well to the Agency's mapping in Appendix A).
- 5.3 The data indicates that the site and Wisbech Road would not be affected by floodwater during the present day 1 in 200 year event.
- 5.4 If the defences overtopped and breached, the SFRA maps show that during the climate change 1 in 200 year event, the site would not be affected by floodwater.
- 5.5 However, the SFRA maps do not show the flood depth during the climate change 1 in 1000 year event, and it is suggested from the Agency's mapping in Appendix A that the depth of floodwater across the site could range between 1m and 1.6m. The hazard would be *Dangerous for Most*.
- 5.6 The "residual risk" to the site is therefore high during the extreme event. The flood level could therefore be 5.80m AOD.
- 5.7 It is expected that inflow through a breach of the defences would occur during periods when the surge tide is above the breach sill. As floodwater flows through the breach opening it will need to travel 4.3 km before it reaches the site and the wave front will spread out in all directions away from the breach opening. The maximum flood depth across the site is therefore expected to be reached gradually.

Internal Drainage Board

- 5.8 It is understood from the IDB's *Policy Statement on Flood Protection and Water Level Management* that through the operation, maintenance and improvement of watercourses within the District, the Board seeks to achieve a general standard of water level management that enables the drainage and irrigation of agricultural land, reduces flood risk to developed areas and sustains environmental features throughout the District.
- 5.9 Therefore, it is considered that there is a low risk of flooding to the site from the IDB drainage network and that the main flood risk is from the River Nene.

6. FLOOD RISK MITIGATION AND EVACUATION

6.1 Reducing Exposure to the Hazard

- 6.1.1 In order to assess and reduce the exposure to the hazard and the vulnerability to the hazard after the site has been developed, the guidance outlined in the DCLG/DEFRA/EA document entitled *Flood Risk Assessment Guidance for New Development Phase 2; Flood Risks to People, Phase 2; Improving the Flood Performance of New Buildings* has been consulted.
- 6.1.2 During overtopping and breaching of the defences, the SFRA maps show that during the climate change 1 in 200 year event, the site would not be affected by floodwater. The flood depth across the site could be between 1m and 1.6m during the “extreme” climate change 1 in 1000 year event. The flood level could therefore be 5.80m AOD.
- 6.1.3 Paragraph 060 (ID 7-060-20140306) of the NPPF Planning Practice Guidance states that the first preference is to avoid flood risk by raising floor levels above the design flood level.
- 6.1.4 Paragraph 060 of the NPPF Planning Practice Guidance continues to state that “Resistance and resilience measures are unlikely to be suitable as the only mitigation measure to manage flood risk, but they may be suitable in some circumstances, such as:
- water-compatible and less vulnerable uses where temporary disruption is acceptable and an appropriate flood warning is provided;
 - in some instances where the use of an existing building is to be changed and it can be demonstrated that no other measure is practicable;
 - as a measure to manage residual flood risk”.
- 6.1.5 The site has been identified to have a low “actual risk” and “residual risk” of flooding during the design event. Therefore, the proposals comply with the third criterion above. The proposals do not comply with the second criterion above. The site comprises a less-vulnerable use and therefore the proposals comply with the first criterion above
- 6.1.6 When considering the proposed building it is important that people can easily access the ground floor and therefore raising the proposed ground floor level above the extreme flood level (i.e. by up to 1.6m) is not practical. However, other mitigation measures such as resistance and resilience measures will be appropriate in this case.
- 6.1.7 Research provided in paragraph 6.13 of the superseded 2009 DCLG document entitled *PPS 25 Development and Flood Risk Practice Guide* states that car parking areas should not be flooded to depths of more than 300mm. The expected flood depths across parking areas will exceed this threshold during the extreme event and appropriate signage should be placed across the car parking area to warn of the flood risk. Vehicles should be moved to higher ground prior to the flood event in order to ensure that they do not become a hazard.

6.2 Differential Depth

- 6.2.1 During the “extreme” event the maximum depth of floodwater above the ground floor area could be between 1m and 1.6m. Assuming that floodwater is restricted from entering the building somewhat by external doors etc, the differential depth (i.e. the depth difference between the inside of the building and outside of the building) could therefore be between 1m and 1.6m.

- 6.2.2 The DEFRA/EA document entitled *Improving the Flood Performance of New Buildings*, dated 2007, suggests that where the depth of floodwater is higher than 0.5m above the floor level within a building, there will be damage to internal finishes.
- 6.2.3 It is also stated in the aforementioned DEFRA/EA document that there is some damage to buildings if the depth differential between the outside and inside water levels exceeds 0.6m. Severe damage can occur if this reaches 1m even if the buildings are flood proofed.
- 6.2.4 Therefore, in order to reduce this differential depth to safe limits, it is proposed that floodwater is allowed across the ground floor area as part of a *Water Entry Strategy*.

6.3 Water Entry Strategy

- 6.3.1 In accordance with the ODPM guidance document *Preparing for Floods* and Figure 4.1 of the aforementioned DCLG/DEFRA/EA document, a *Water Entry Strategy* essentially permits the passage of floodwater through the building and prevents any displacement of floodwater during the event. A *Water Entry Strategy* in this case aims to allow floodwater to enter the building and flood resilience techniques are incorporated to reduce the consequences of flooding. It is proposed that the following mitigation measures are established up to the flood level of 5.80m AOD (i.e. 1.6m higher than ground floor level).

Floors

- 6.3.2 If ground supported floors are present at the site they should be approximately 150mm thick, however, if suspended floors are preferred then they should consist of reinforced concrete (as timber floors can deform if exposed to floodwater). Suspended floors are however less preferable as the void beneath the floor will need cleaning especially after heavy rainfall events and access may be difficult.
- 6.3.3 A damp-proof membrane should also be included within the floor construction and suitable floor finished such as ceramic or concrete based floor tiles are recommended. Figures 5 and 6 are from the aforementioned DCLG guidance document and illustrate the options when considering resilient floor design.

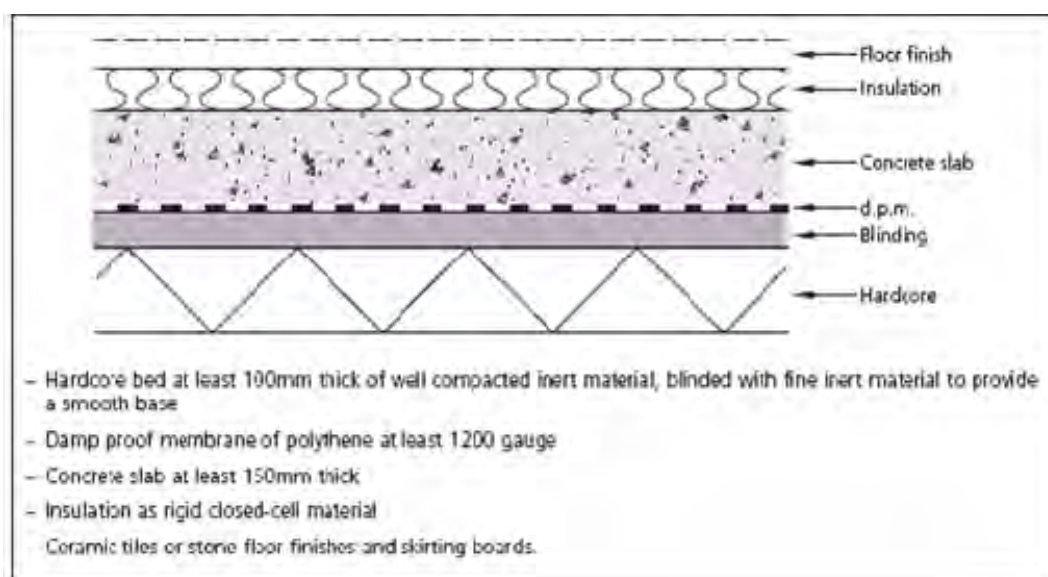


Figure 5: Ground-supported floor (Source: DCLG, 2007)

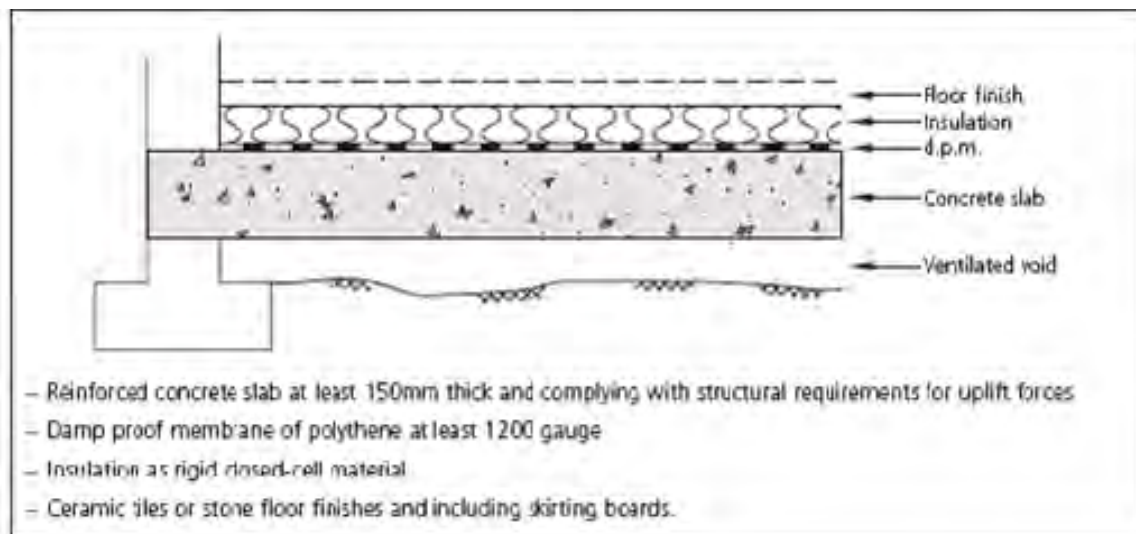


Figure 6: Suspended Concrete Floor (Source: DCLG, 2007)

Walls

- 6.3.4 Suitable flood proofing measures will need to be incorporated within the walls up to the flood level. Concrete block walls dry quicker than other types such as Aircrete blocks.
- 6.3.5 Clear cavity walls (with no insulation) should be used as they also allow for quicker drying. Insulation can be fitted externally as it is easily replaced. If cavity insulation is preferred then rigid closed cell materials should be used as they have a low moisture take-up (Figure 7).
- 6.3.6 Internal cement renders should be avoided as they prevent effective drying. Standard gypsum plasterboard could be used as a sacrificial material and can be removed after the flood. Lime-based plaster and ceramic tiles are also known to offer some resilience.

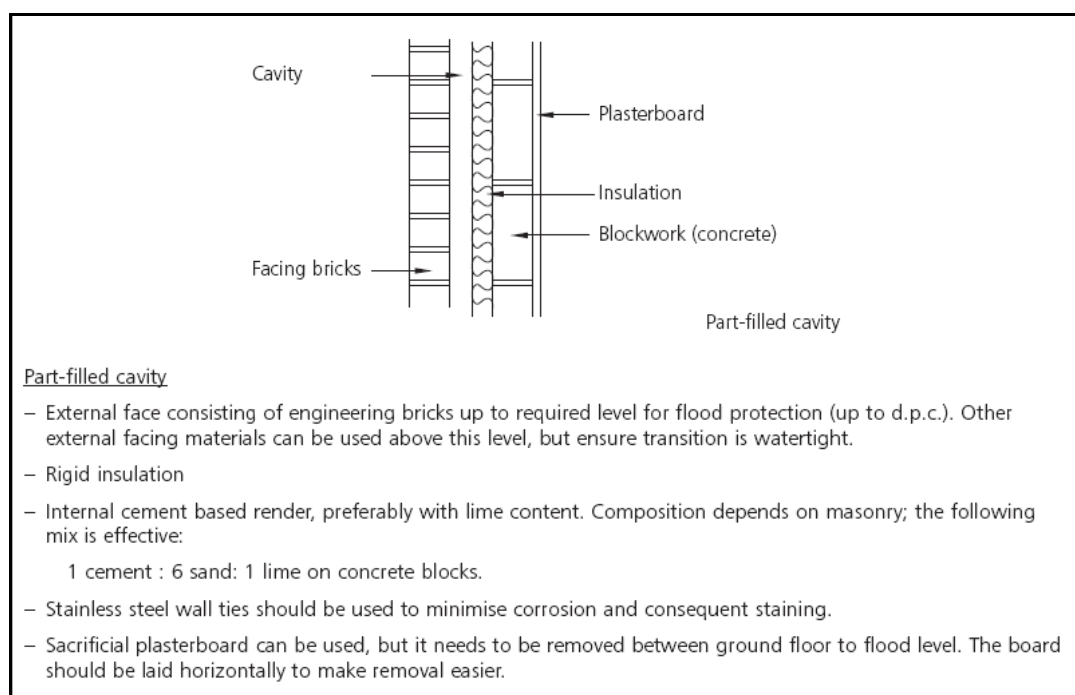


Figure 7: Cavity External Walls (DCLG, 2007)

Fittings

- 6.3.7 Durable fittings which are not affected by floodwater could be used internally (e.g. plastic or stainless steel units). Wood fittings should be avoided; however sacrificial fittings can be installed which can then be replaced easily after the flood. There should be gaps behind the fittings to promote drainage and drying.

Services

- 6.3.8 It will not be practical to raise the ground floor electrical sockets above the flood level, however, the electricity should be turned off during the event. Boiler units should be placed as high as possible. Wiring for communications should also be insulated to prevent damage. Non-return valves are recommended to prevent back-flow of foul water.
- 6.3.9 It is recommended that after the event, a structural survey is carried out in order to assess any damage due to prolonged periods of flood water exposure. The CIRIA guidance document (C623) entitled *Standards for the repair of buildings following flooding* outlines the various approaches.

6.4 Reducing Vulnerability to the Hazard

- 6.4.1 Although employees will only be occupying the site during normal working hours, people at the site are unlikely to have detailed knowledge of the dynamics of the flood event and the storminess of the event could result in people panicking or becoming anxious, particularly if they observe flooding across site.
- 6.4.2 The Agency aims to provide up to 12 hours warning for tidal events. It is understood that the police and other emergency services will assist in the evacuation to rest centres operated by the Council. The Fire Service will assist in any rescuing of people from the flooded area once this has occurred.
- 6.4.3 It is recommended that the site owners liaise with the Agency in order to register with the Agency's Flood Warnings Direct service and ensure that they are aware of the flood risk so that employees have the option to escape/evacuate upon receipt of a *Flood Warning* or upon the instruction of the emergency services.
- 6.4.4 Signs and information plaques should be located regularly across the site to inform people of the flood risk. A member of staff should regularly review the flood warnings in place prior to commencing work on-site. Furthermore, staff should not proceed with the site operations if it is considered that there is a flood risk.
- 6.4.5 It is recommended that a *Business Flood Plan* is developed. Formal training would also be required and the plan would include information on what to do when receiving a flood warning, together with evacuation procedures and routes. Flood wardens (possibly site managers) would be responsible for co-ordinating the closing of the site. Staff checklists would also be useful to prioritise procedures. It may be prudent to act during the early warning stages in order to provide sufficient time to evacuate people and to implement the flood action plan.
- 6.4.6 Any Flood Plan should be practiced regularly in order to minimise the risk to people at the site (i.e. similar to a fire drill). A *Flood Kit* is a useful precautionary measure especially if evacuation from the site is prolonged and many hours after the flood event. The *Flood Kit* includes items such as:

1. Important documents
2. Torch and batteries
3. Mobile phone (fully charged)
4. First-aid kit
5. Wind-up radio
6. Important telephone numbers
7. Bottled water
8. Non-perishable food provisions
9. Rubber Gloves and wellington boots
10. Medication
11. Blankets, warm clothes
12. Camera to record any damage

6.4.7 It may be prudent to evacuate the site at the early warning stages in order to provide sufficient time to evacuate people and remove stock and vehicles from the site which could cause a hazard if mobilised by the floodwater.

Table 1: Flood Event Action Plan

Environment Agency Flood Warning Code	What to do!	Evacuate?
Flood Alert (Flooding Possible. Be aware/prepared! Watch Out). 	- Monitor flood risk through media and Floodline Warnings Direct. - Locate employees and inform them of risk. If away from the site make assessment on risk if considering returning to site (i.e. how long it will take to return etc).	Not necessary. Occupants can evacuate themselves if they feel unsafe providing that they make a judgement in relation to any external flood hazard.
Flood Warning (Flooding of homes, businesses and main roads is expected. Act now!). 	- Maintain communication through Floodline Warnings Direct and the media. - Begin to implement Flood Plan. - Consider advice given from emergency services/Environment Agency. - Check insurance, Check flood kit. - Check alternative accommodation arrangements. - Close business. - Remove vehicles and other equipment.	Occupants can evacuate themselves if they feel unsafe providing that they make a judgement in relation to any external flood hazard. No formal evacuation or rest centre set-up will be undertaken at this warning level, however, if flooding is experienced across the area emergency services will rescue people.

Severe Flood Warning (Severe flooding is expected. Imminent danger to life and property. Act now!). 	• Leave site immediately if not already done so. • Take flood kit with you. • Follow advice given by Emergency Services and Council.	Leave site according to advice given by Emergency Services and Council.
Warnings no longer in force (No further flooding is expected in the area. Be careful).	• Return to site upon instruction from emergency services and assess any damage. • Contact insurance company depending on damage caused. • Beware of flood debris. • Do not touch sources of electricity. • Arrange for utilities to reconnect services.	Not applicable, however site may be uninhabitable. Return to site upon instruction from emergency services as floodwater may not have receded.

6.5 Vulnerable Groups

- 6.5.1 The employees and customers at the site may include vulnerable groups such as elderly people, those with sensory or physical disabilities, minority ethnic groups, or the infirm. Priority will need to be given to these people during the flood event.
- 6.5.2 Vulnerable groups should be identified by the site management and priority should be given to these groups.

6.6 Safe Access/Egress

- 6.6.1 Safe access and egress can be achieved during the present day 1 in 200 year event. However, safe access/egress cannot be achieved during the peak of the design event and extreme event.
- 6.6.2 By consulting the Agency's data and the SFRA maps, it can be seen that during the peak of the climate change 1 in 200 year event, people would need to travel either in a north westerly direction along the A17, or north along Wisbech Road in order to reach low hazard areas and vital amenities. However, people should take the advice of the emergency services in these circumstances.
- 6.6.3 A flood response plan will be compiled to ensure that the occupants are aware of the flood risk and procedures to take before, during and after a flood.
- 6.6.4 Research provided in paragraph 6.13 of the superseded 2009 DCLG document entitled *PPS 25 Development and Flood Risk Practice Guide* states that cars can be unstable in depths greater than 300mm. The DEFRA/EA document FD2321/TR1 and FD2321/TR2 suggests that fire engines become unstable in 0.9m of still water and this value reduces as the velocity increases.

- 6.6.5 The expected flood depths across car parking areas will exceed this threshold during the extreme event. Vehicles should be moved to higher ground prior to the flood event in order to ensure that they do not become a hazard. People are unlikely to be able to access (or leave) the site by vehicle during the peak of the design event and extreme event and it may be difficult for emergency services to access the site in these circumstances.

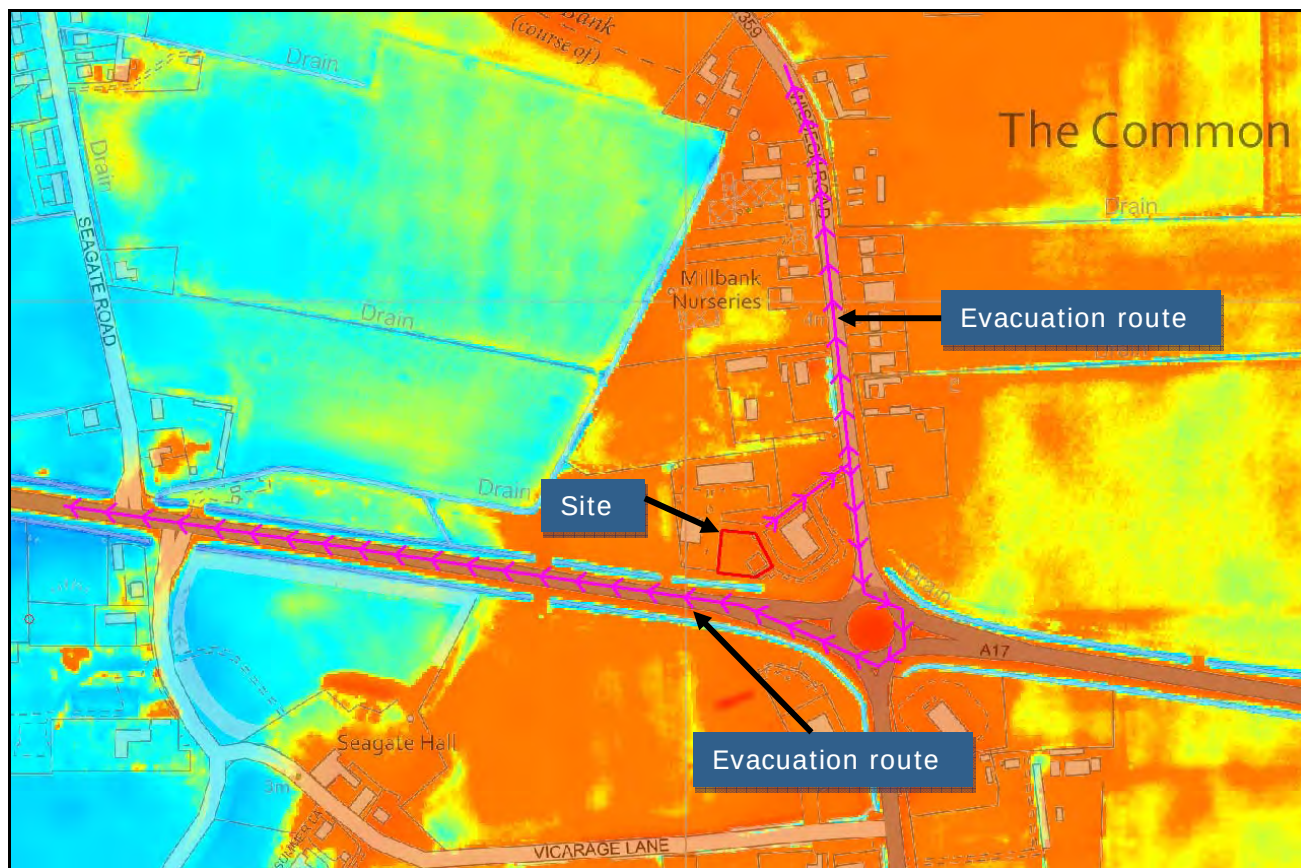


Figure 8: Preferred evacuation Route

6.7 Insurance

- 6.7.1 The Association of British Insurers (ABI) published a guidance document in 2012 entitled *Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England*.
- 6.7.2 The ABI guidance sets out the requirements of the insurance industry when considering flood risk and insurability of the property. The guidance suggests that properties should be protected for flood events up to the 1 in 100 year event in order to access insurance at a competitive price.
- 6.7.3 The guidance also states that insurers would of course prefer to cover properties which are not at risk of flooding, however, for those properties which are at risk of flooding insurers would prefer that the properties are raised above the flood level, over resistance measures which prevent floodwater from entering the building, or resilience measures which allows floodwater to enter the building.
- 6.7.4 The ground floor level will be set above the climate change 1 in 200 year flood level, and flood resilience measures have been proposed up to the climate change 1 in 1000 year

event. Therefore, the ABI's requirement of protection during the climate change 1 in 100 year event will be exceeded and there will be a good chance of the property being insured at a competitive rate.

7. OTHER SOURCES OF FLOODING

7.1 Groundwater Flooding

- 7.1.1 In order to assess the potential for groundwater flooding during higher return period rainfall events, the Jacobs/DEFRA report entitled *Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study*, published in May 2004, was consulted, together with the guidance offered within the document entitled *Groundwater flooding records collation, monitoring and risk assessment (ref HA5)*, commissioned by DEFRA and carried out by Jacobs in 2006.

Soil and Geology at the Site

- 7.1.2 It can be seen from the various soil and hydrogeological data, listed in Section 2, that the soil types and geology across the site comprise clay and silt.

Groundwater Flooding Potential at the Site

- 7.1.3 There have been no recorded groundwater flood events across the area between 2000 and 2003, as indicated by the Jacobs study. The PFRA shows that the site is located across an area with a negligible groundwater flooding risk.
- 7.1.4 It is unlikely that during periods of prolonged or heavy rainfall the water table will have the capacity to rise and breach the ground surface, particularly due to the cohesive content of the soil.
- 7.1.5 As surface water is also managed over a large scale and the soil types have a low infiltration capacity, the site is at low risk from groundwater flooding.

7.2 Surface Water Flooding and Sewer Flooding

- 7.2.1 Surface water and sewer flooding across urban areas is often a result of high intensity storm events which exceed the capacity of the sewers thus causing them to surcharge and flood. Poorly maintained sewer networks and blockages can also exacerbate the potential for sewer flooding.
- 7.2.2 The Environment Agency's Surface Water Flooding Map (Figure 9) indicates that across the site and Wisbech Road there is a very low surface water flooding risk (i.e. less than 1 in 1000 year chance).



Figure 9: Environment Agency Surface Water Flooding Map (Source: Environment Agency, 2019)

7.3 Reservoirs, Canals And Other Artificial Sources

- 7.3.1 The failure of man-made infrastructure such as flood defences and other structures can result in unexpected flooding. Flooding from artificial sources such as reservoirs, canals and lakes can occur suddenly and without warning, leading to high depths and velocities of flood water which pose a safety risk to people and property.
- 7.3.2 The Environment Agency's "Risk of flooding from reservoirs" map suggests that the site is not at risk from reservoirs or other artificial sources.

8. CONCLUSIONS

- The site is located within Flood Zone 3.
- There is a low fluvial risk of flooding from the IDB drainage network.
- There is an 'actual' risk and 'residual' risk of flooding to the site if the River Nene defences overtopped and breached. During the climate change 1 in 200 year event the site would not be affected by floodwater.
- During the 'extreme' climate change 1 in 1000 year event the data suggests that the flood depth across the site would be between 1m and 1.6m.
- A *Water Entry Strategy* should be adopted across the ground floor area of the building to reduce the differential depth to safe limits during the extreme event and to protect property.
- A warning and evacuation strategy has been developed within this assessment. It is proposed that the occupants register with the Agency's *Flood Warnings Direct* and prepare a *Business Flood Plan*.
- Safe access/egress cannot be achieved during the peak of the event, however, it is recommended that the occupants evacuate the site during the early warning stages.
- It is considered that there is a low risk of groundwater flooding at the site from underlying deposits and a very low surface water flooding risk at the site.

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APPENDIX A – CORRESPONDENCE

Lincolnshire & Northamptonshire Area



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

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

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

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



^ Modelled Breach Locations



This map indicates the location of where we have modelled the consequence of breaches 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.

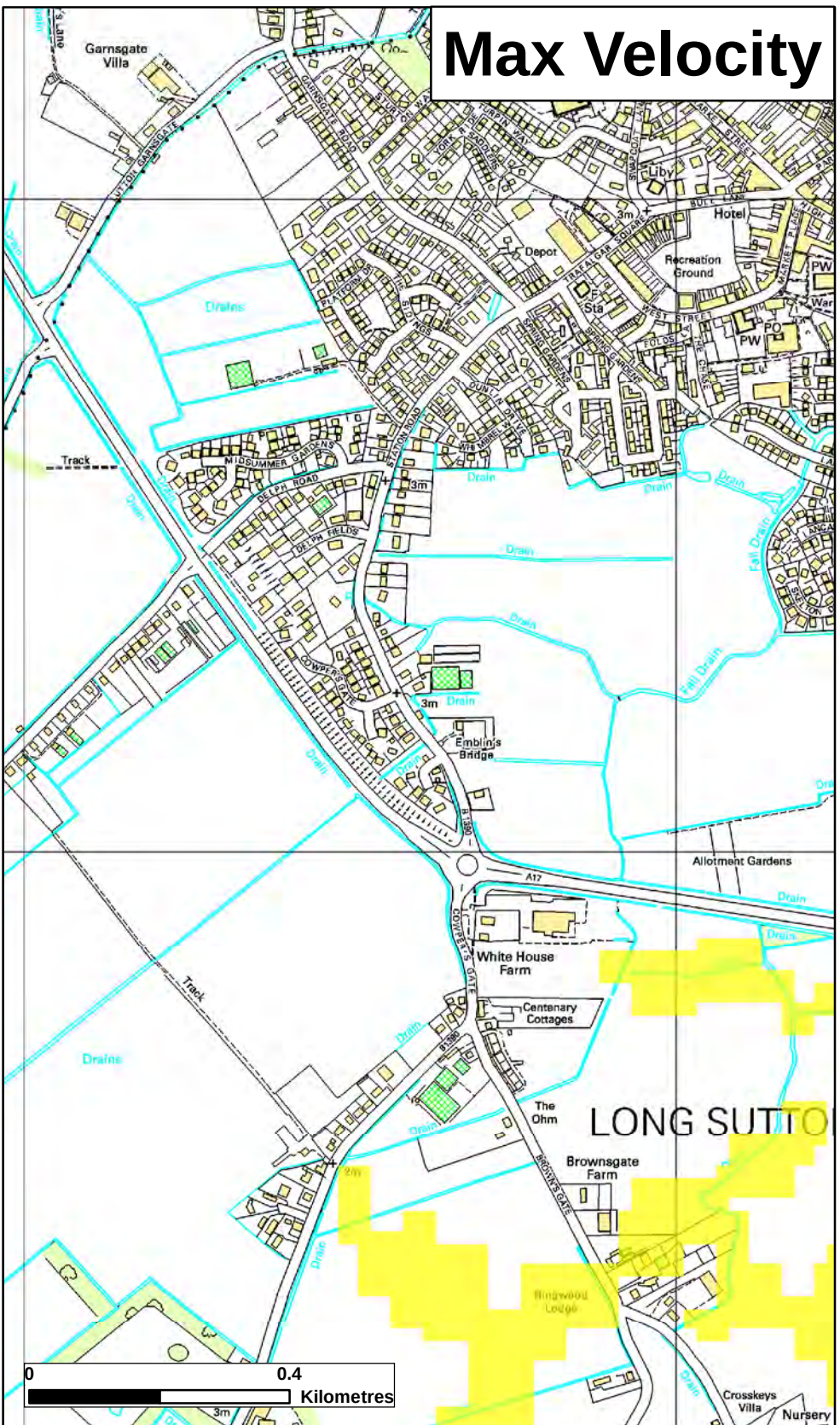
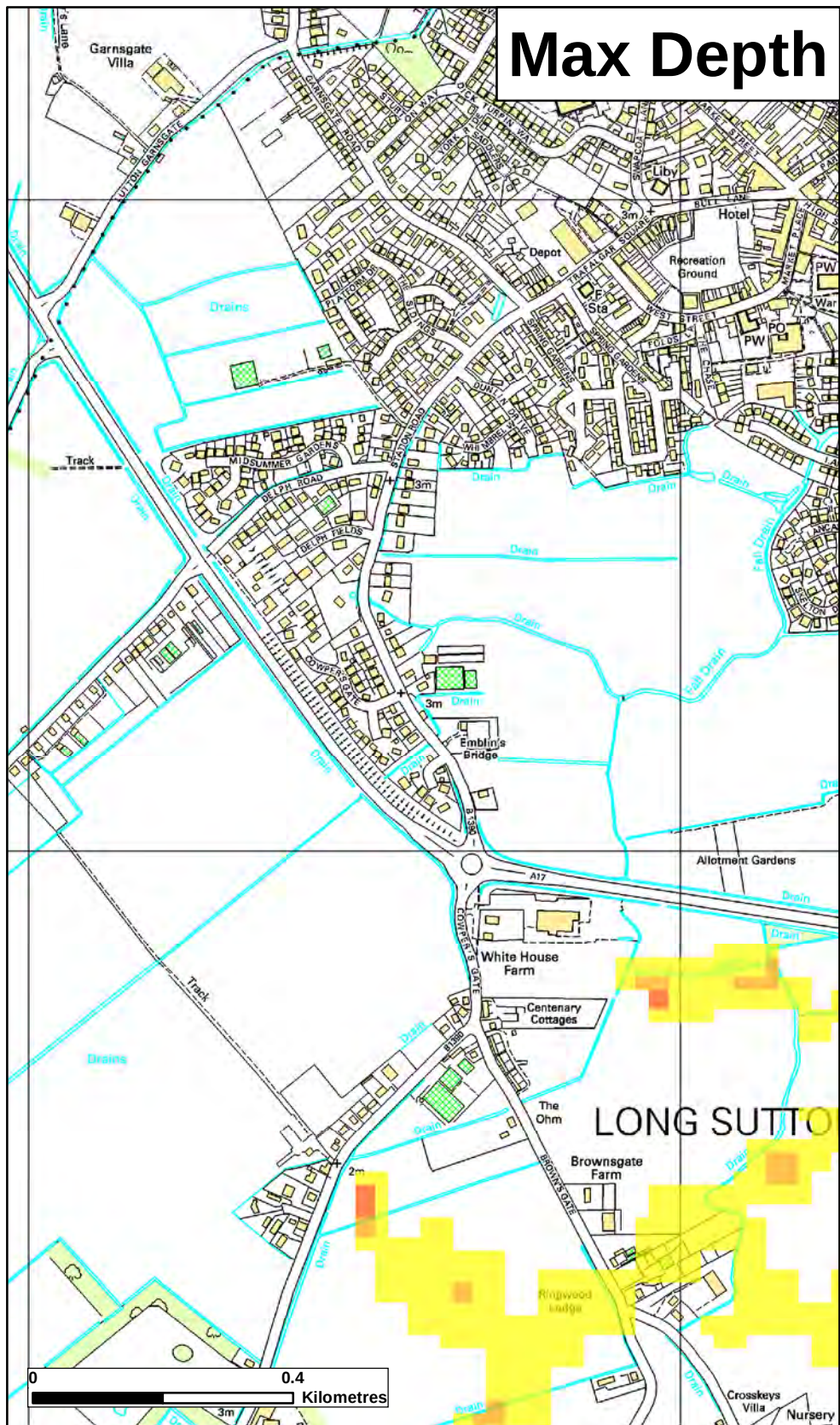
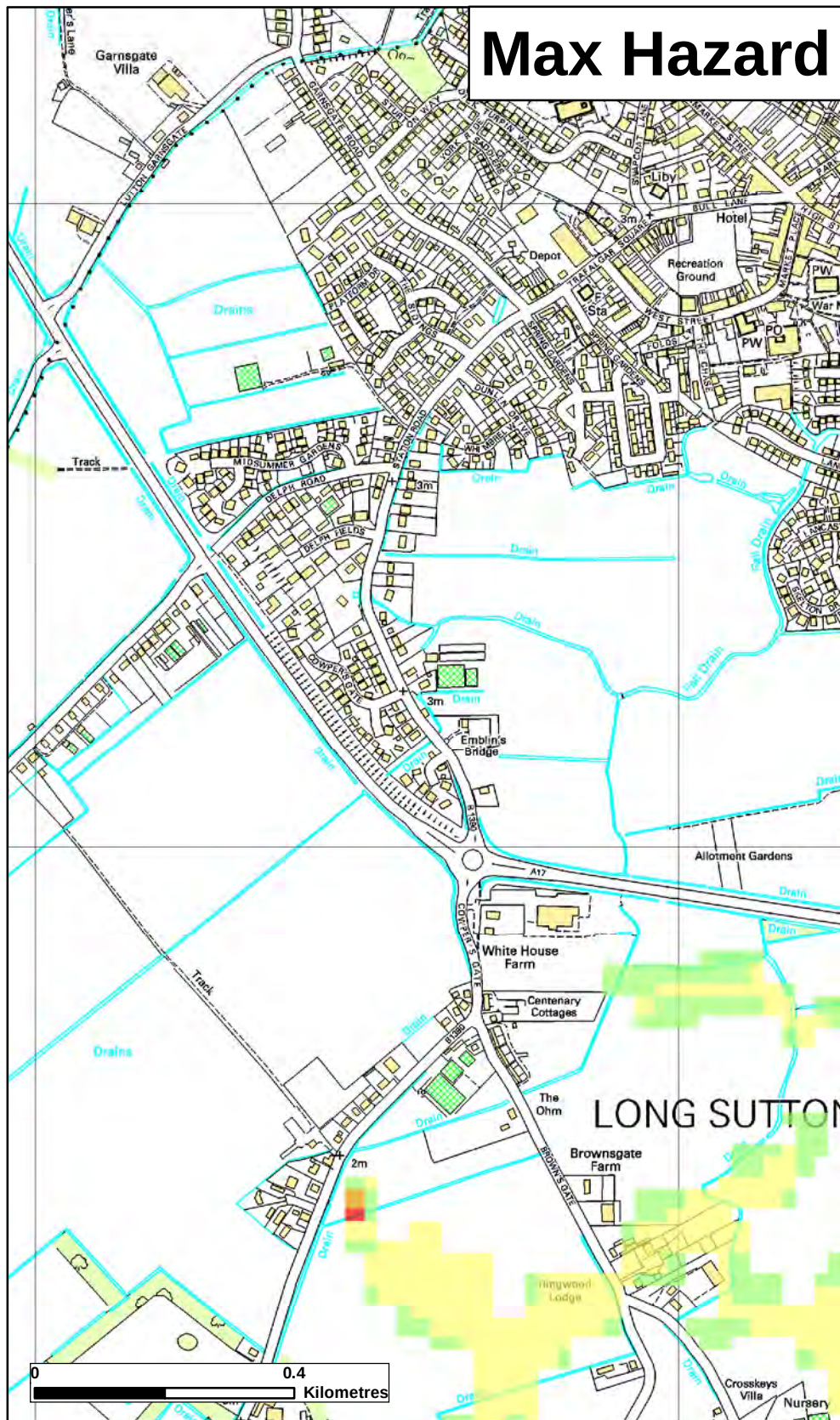


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General Enquiries No: 03708 506 506

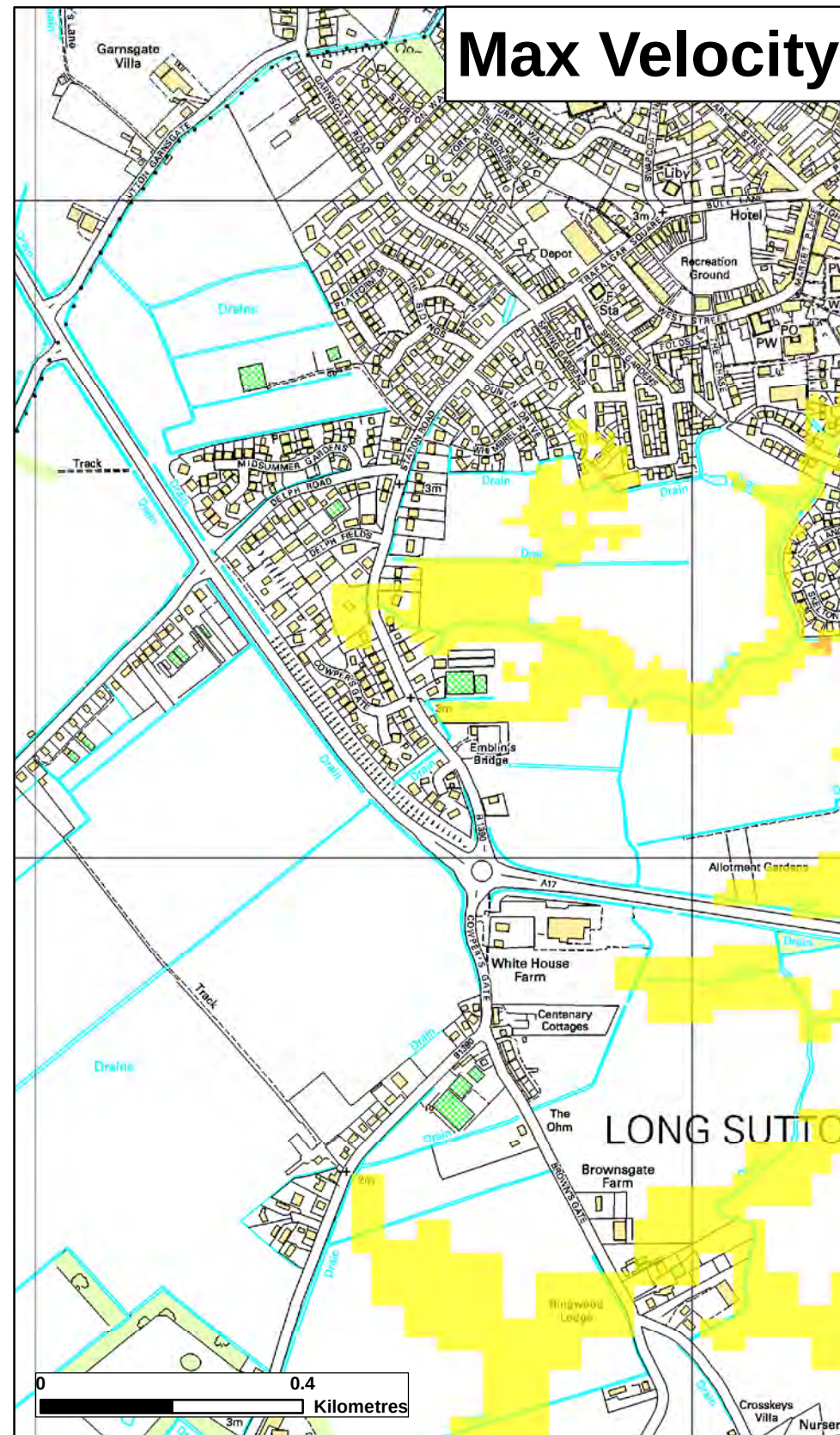
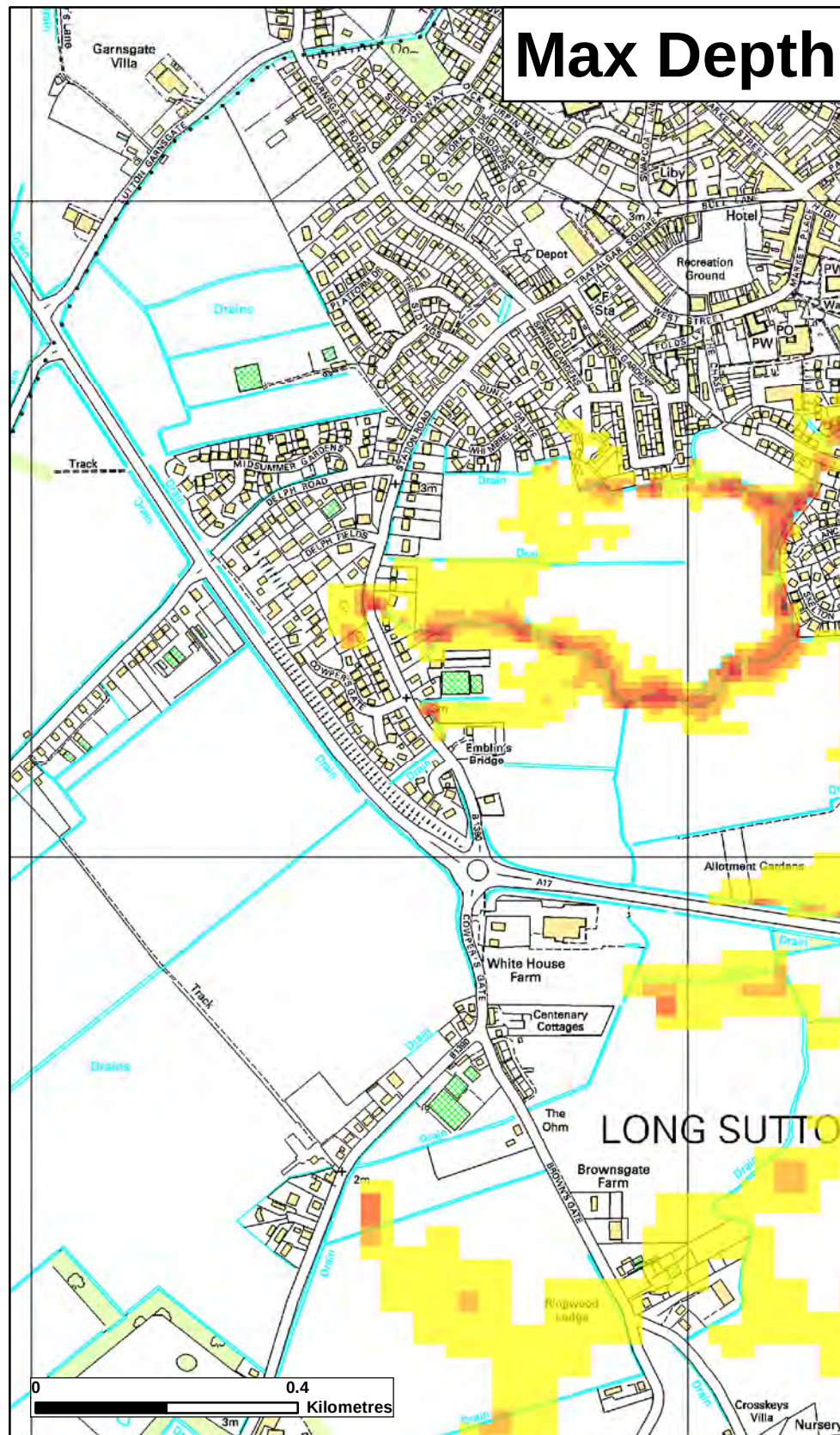
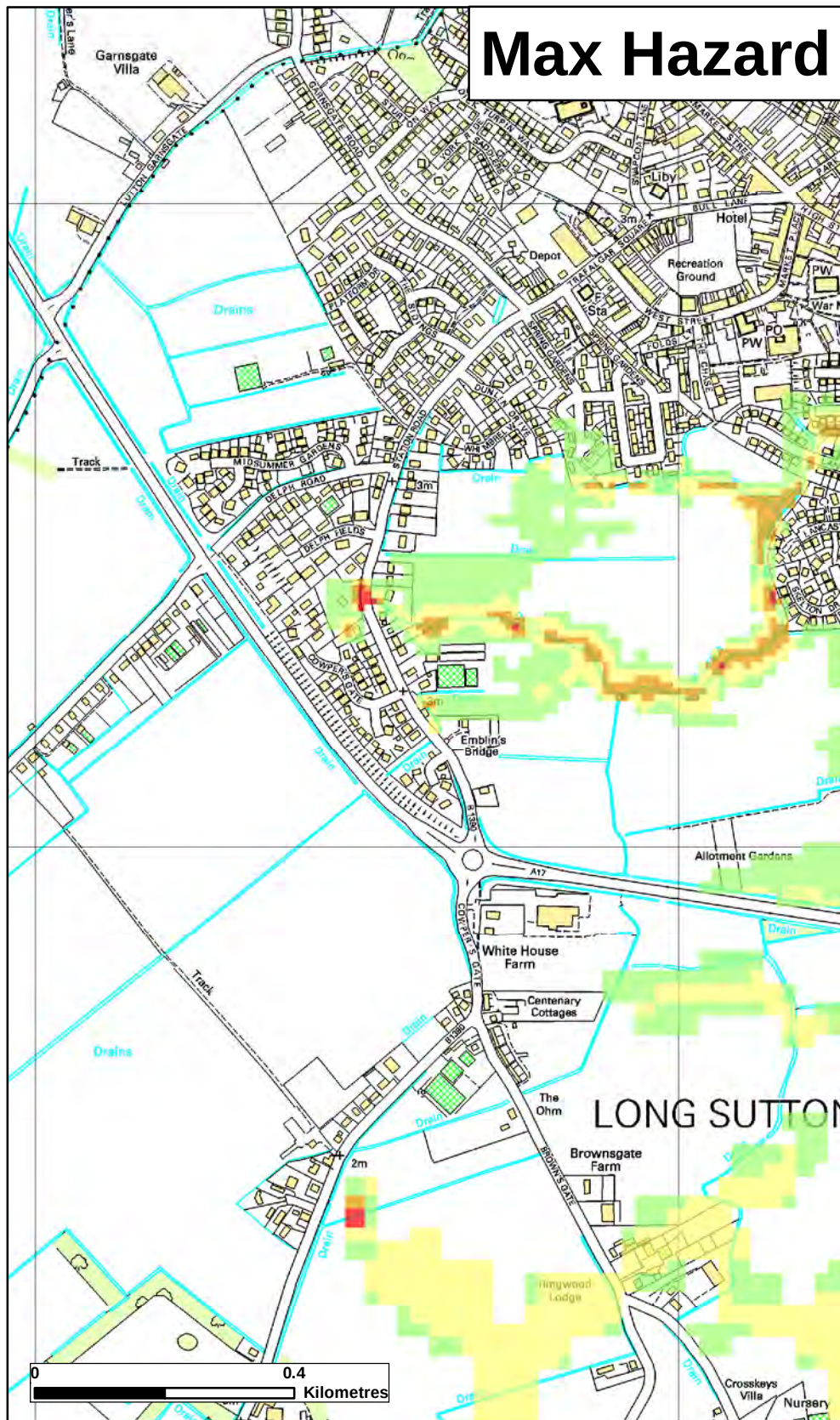
Northern Area Tidal Hazard Mapping

Location of Modelled Breaches

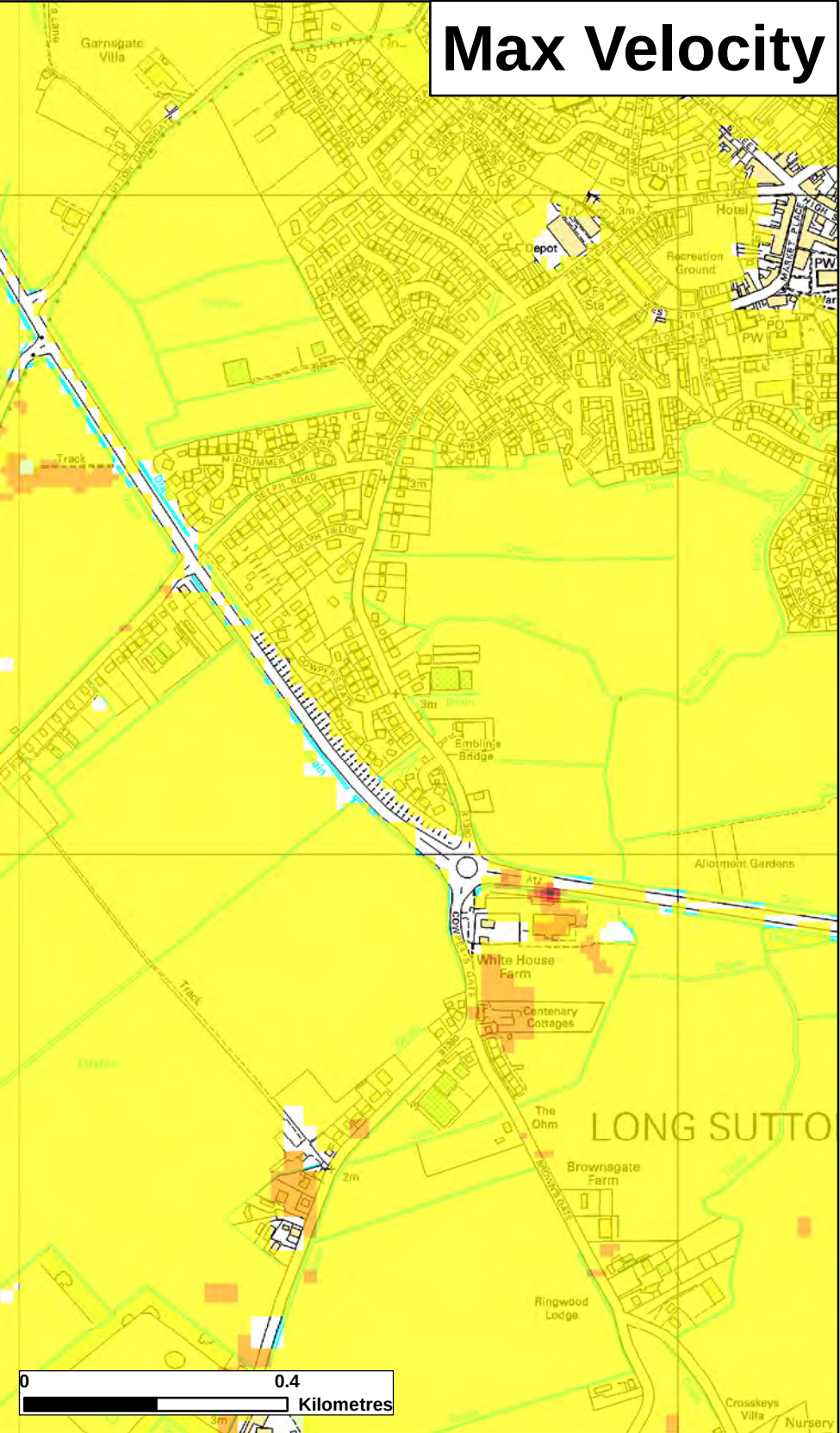
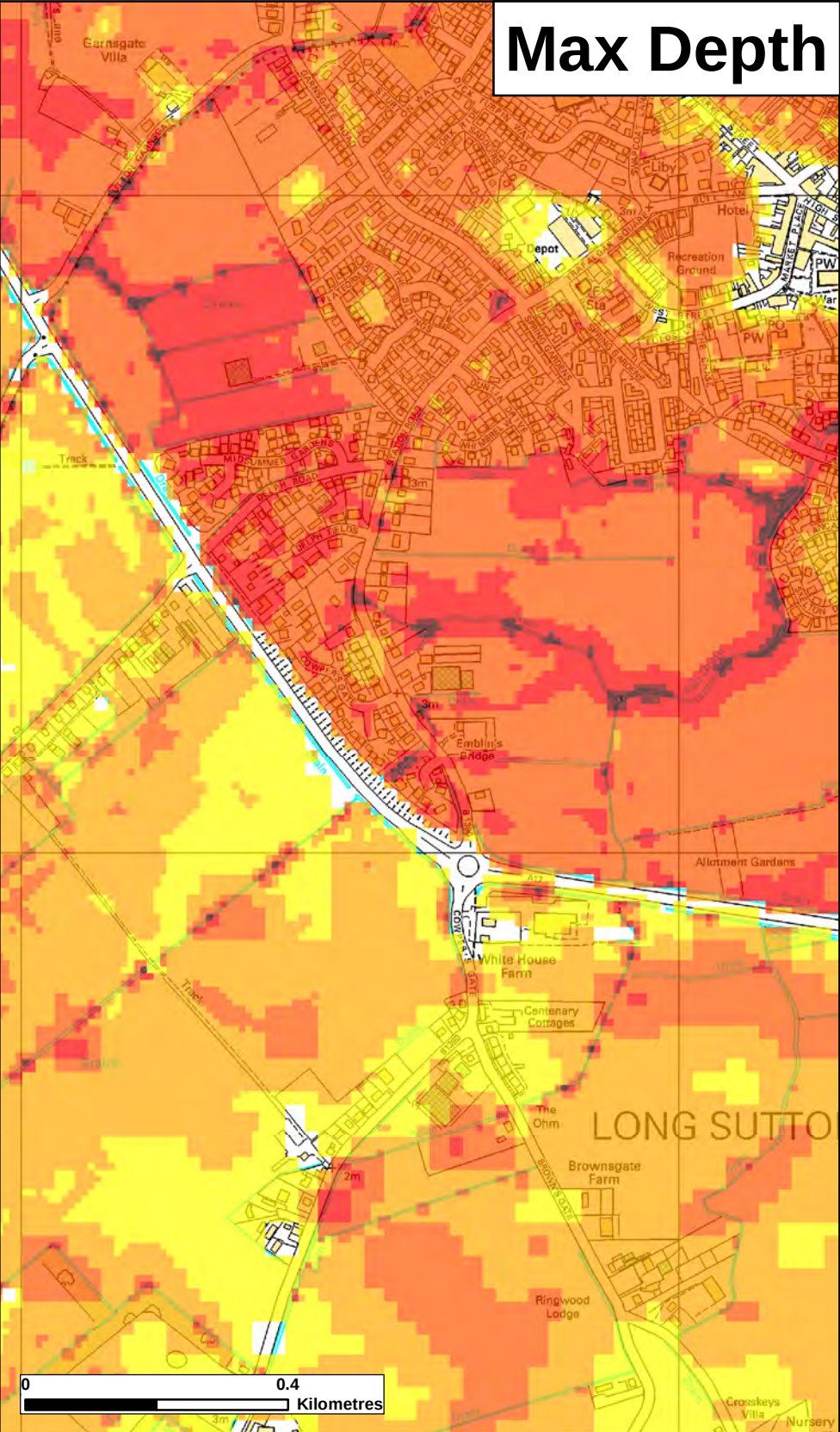
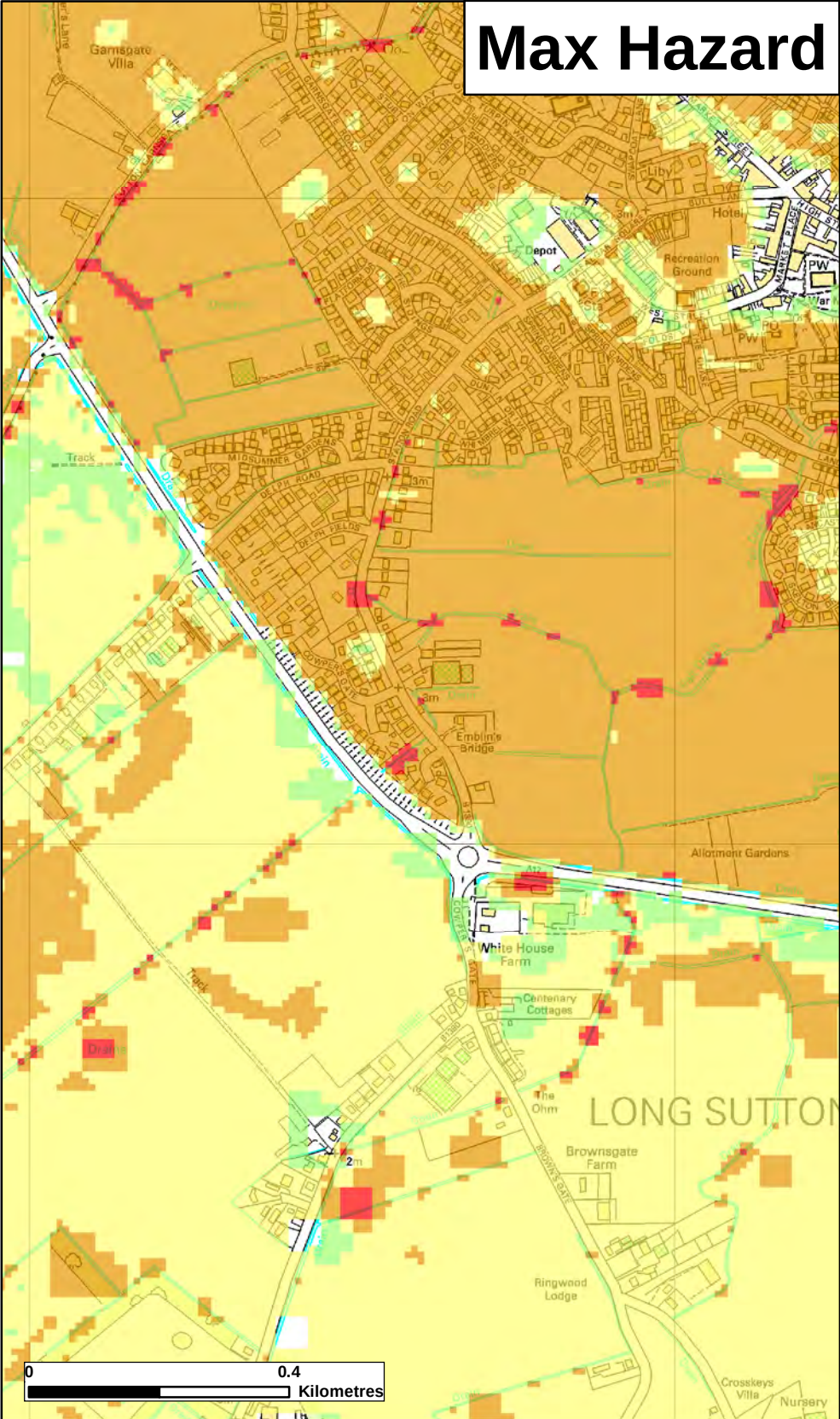
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★ Modelled Breach Locations - see also the accompanying plan "Location of Modelled Breaches"							
Max Hazard (Flood Risk to People : FD2320)		Max Depth (m)		Max Velocity (m/s)		This map shows the level of flood hazard to people (called a hazard rating) 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.	
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)		0 - 0.25 0.25 - 0.50 0.50 - 1.0 1.0 - 1.6 1.6 +		0 - 0.3 0.3 - 1.0 1.0 - 1.5 1.5 - 2.5 2.5 +			
Date Printed	July 2018	Scenario year	2006	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2018-90066
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★ Modelled Breach Locations - see also the accompanying plan "Location of Modelled Breaches"								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
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 - 1.6		 1.5 - 2.5				
Date Printed	July 2018	Scenario year	2006	Scenario Annual Chance	0.1% (1 in 1000)	CCN Number	CCN-2018-90066	
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★ **Modelled Breach Locations** - see also the accompanying plan "Location of Modelled Breaches"

Max Hazard	Max Depth (m)	Max Velocity (m/s)
(Flood Risk to People : FD2320)		
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 - 1.6	1.5 - 2.5
	1.6 +	2.5 +

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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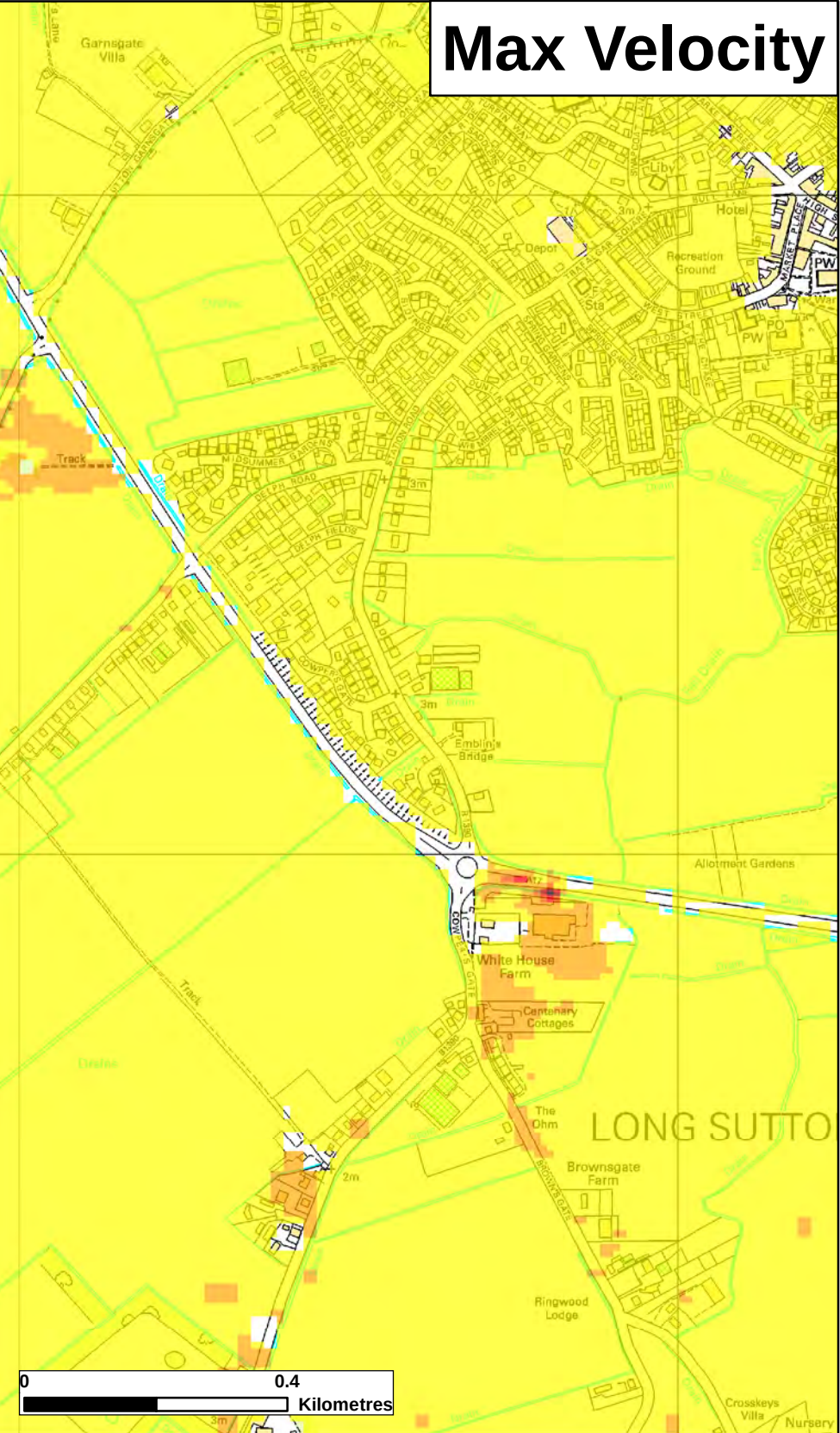
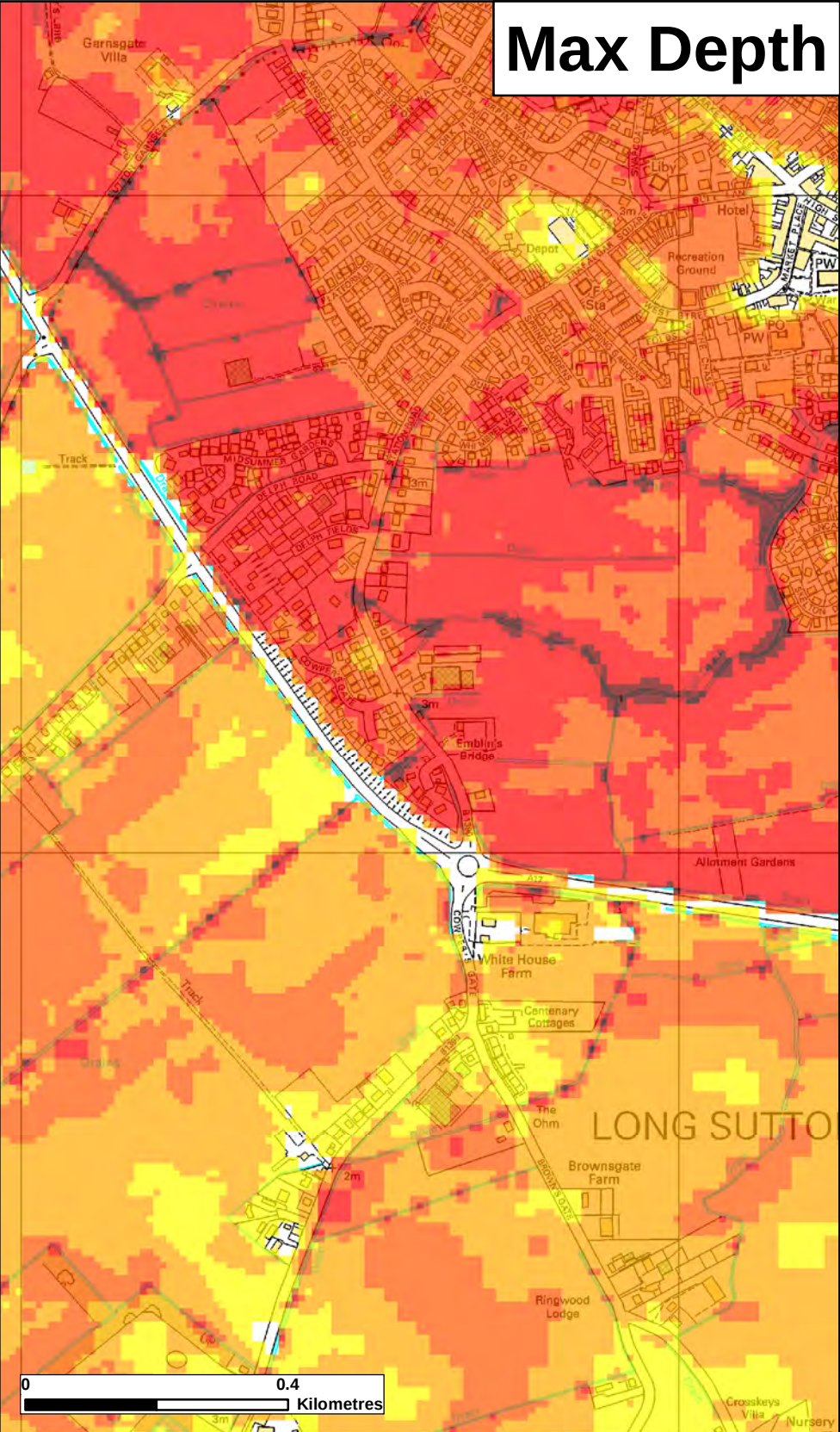
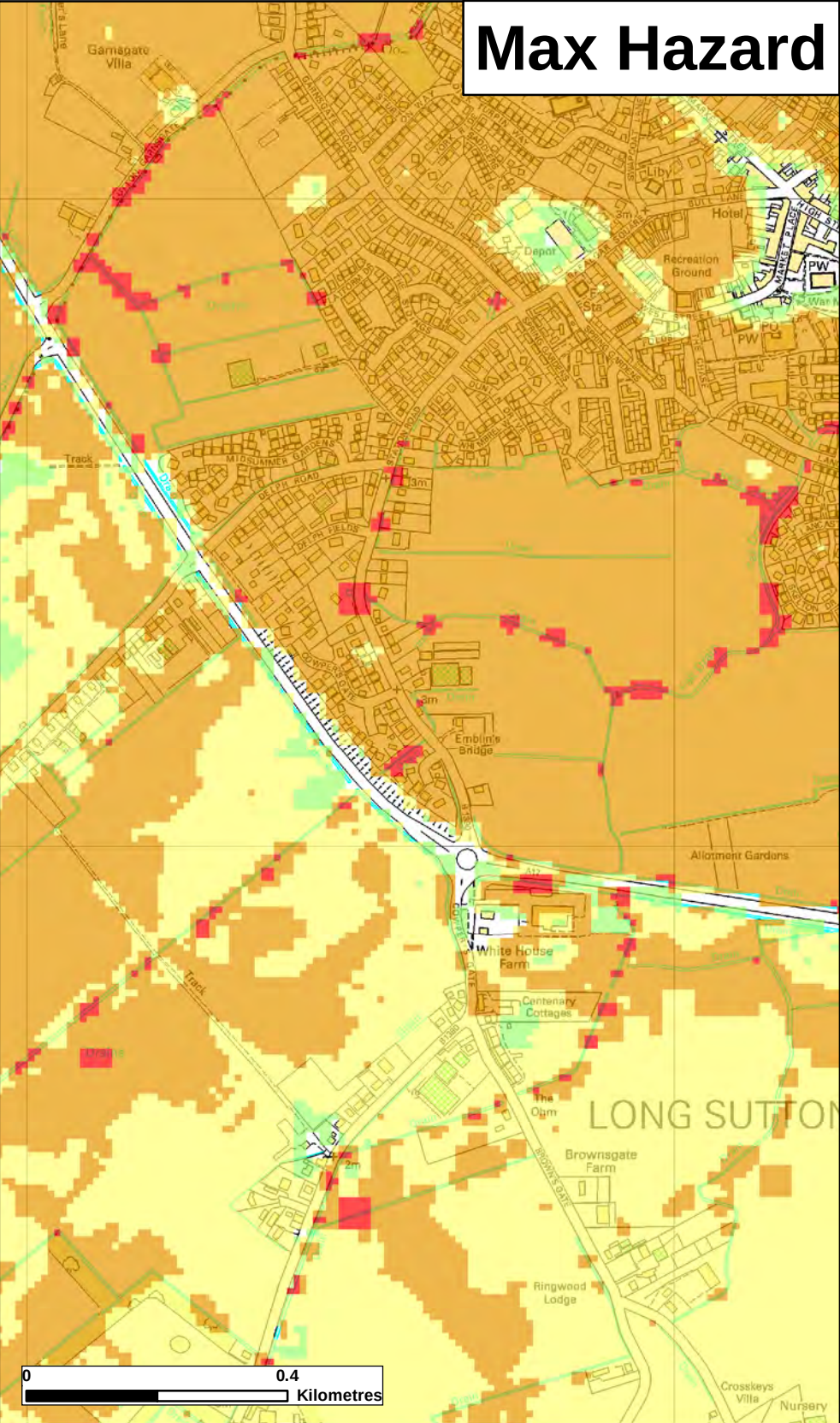
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Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping

Map Centred on TF 42605 22206

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Date Printed	July 2018	Scenario year	2115	Scenario Annual Chance	0.5% (1 in 200)	CCN Number	CCN-2018-90066
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★ **Modelled Breach Locations** - see also the accompanying plan "Location of Modelled Breaches"

Max Hazard	Max Depth (m)	Max Velocity (m/s)
(Flood Risk to People : FD2320)		
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 - 1.6	1.5 - 2.5
	1.6 +	2.5 +

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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Lincolnshire and Northamptonshire Tidal Breaching Hazard Mapping

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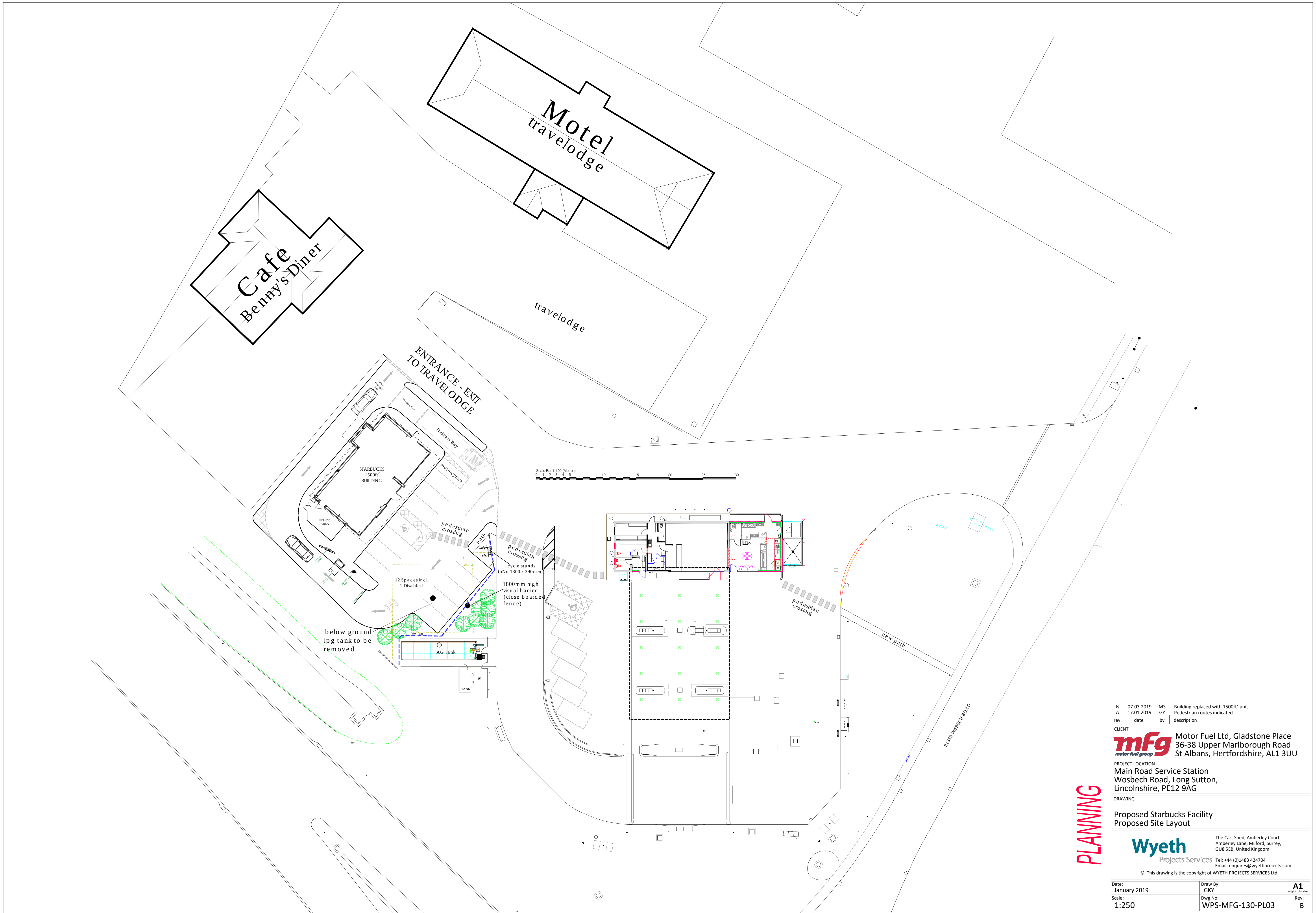
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DRAWINGS



A	17.01.2019	GY	Updated
rev	date	by	description
CLIENT			
mfg Motor Fuel Ltd, Gladstone Place 36-38 Upper Marlborough Road St Albans, Hertfordshire, AL1 3UU			
PROJECT LOCATION			
Main Road Service Station Wosbech Road, Long Sutton, Lincolnshire, PE12 9AG			
DRAWING			
Proposed Starbucks Facility Existing Site Layout			
Wyeth Projects Services The Cart Shed, Amberley Court, Amberley Lane, Milford, Surrey, GU8 5EB, United Kingdom Tel: +44 (0)1483 424704 Email: enquires@wyethprojects.com © This drawing is the copyright of WYETH PROJECTS SERVICES Ltd.			
Date:	January 2019	Draw By:	GKY
Scale:	1:250	Dwg No:	WPS-MFG-130-PL02
			Rev: A

PLANNING



PLANNING

B	07.03.2019	MS	Building replaced with 1500ft² unit
A	17.01.2019	GY	Pedestrian routes indicated
rev	date	by	description
CLIENT			
mfg Motor Fuel Ltd, Gladstone Place 36-38 Upper Marlborough Road St Albans, Hertfordshire, AL1 3UU			
PROJECT LOCATION			
Main Road Service Station Wosbech Road, Long Sutton, Lincolnshire, PE12 9AG			
DRAWING			
Proposed Starbucks Facility Proposed Site Layout			
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Date:	January 2019	Drawn By:	GKY
Scale:	1:250	Dwg No:	WPS-MFG-130-PL03
			Rev: B

