FLOOD RISK ASSESSMENT

PROPOSED RESIDENTIAL DEVELOPMENT
FLEET ROAD
FLEET
HOLBEACH,
PE12 8LD



RM ASSOCIATES

10 Main Street
Thorpe on the Hill
Lincoln
LN6 9BG
Tel 01522 681728
Mobile 07967 304737
email ray.rmassociates@gmail.com

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INTRODUCTION

The Government has placed increasing priority on the need to take full account of the risk associated with flooding at all stages of the planning and development process. This seeks to reduce the future damage to property and the risk to life from incidents of flooding. Their expectations relating to flooding are contained in the National Planning Policy Framework (NPPF) July 2018, which identifies how the issue of flooding is dealt with in the drafting of planning policy and the consideration of planning applications by avoiding inappropriate development in areas at risk from flooding and to direct development away from areas at highest risk.

The NPPF provides that development in areas at risk of flooding should be avoided and seeks to direct development away from areas at highest risk. There is a sequential, risk-based approach to the location of development avoiding where possible, flood risk to people and property managing any residual risk and taking account of the impacts of climate change.

The Environment Agency's flood maps show areas that are at risk, from fluvial and tidal flooding. These maps show the limits of the flood plain of the area which could be affected by flood events, over topping or breaching of flood defences. They are based on the approximate extent of floods with a 1% annual probability of exceedance (1 in 100-year flood) for rivers and 0.5% annual probability of exceedance (1 in 200-year flood) for coastal areas under present expectations or the highest known flood. However, they do not consider of the presence of defences or the likelihood that flood return intervals will be reduced by climate change.

This Flood Risk Assessment and Drainage Statement has been prepared in support of a planning application and considers the risk of flooding from fluvial and tidal sources in accordance with National Planning Policy Framework (NPPF). It also considers the risks of localised flooding due to inadequate Foul and Surface Water Sewers, Failure of Reservoirs, Water Main pipe bursts, Sewer Blockages, Pump Failures or High Ground Water Table etc.

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APPLICATION SITE

The site is located at Fleet Road, Fleet, Holbeach. PE12 8LD within the administrative area of South Holland District Council. The National Grid Reference is TF 38009 24889, the site area is 0.45Ha or thereabouts. **Plan 1**

This flood risk assessment has been prepared for a full planning application for the redevelopment of a former horticultural site with 8No 2 storey residential dwellings (Class C3) and private access road. **Plans 2**

The Site would be classed as Non-Major Development applying the National Planning Policy Guidance (NPPG) as the site is to be developed for less than 10 dwellings.

The National Planning Policy Framework Technical Guidance NPPF defines three levels of flood risk depending upon the annual probability of fluvial flooding occurring.
Zone 1 – Low Probability (<0.1%)
Zone 2 – Medium Probability (0.1 – 1.0%
Zone 3 – High Probability (>1.0%)

The proposed development site is shown to be within Flood Zone 3a 'High Probability' as detailed on the Environment Agency's Flood Zone Maps without defences, and as defined in Table 1 of NPPF**.**

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

Flood Zone 3 – High Probability
Definition This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. **Appropriate uses** The water-compatible and less vulnerable uses of land (Table 2) are appropriate in this zone. The highly vulnerable uses should not be permitted in this zone. The more vulnerable uses and essential infrastructure should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. **Flood Risk Assessment requirements** All development proposals in this zone should be accompanied by a Flood Risk Assessment. **Policy aims** In this zone, developers and Local Authorities should seek opportunities to: • Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage systems; • Relocate existing development to land in zones with a lower probability of flooding; and • Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

Applying the Flood Risk Vulnerability Classification in Table 2 of NPPF the proposed residential use is classified as More Vulnerable", with Table 1 of NPPF stating that such uses are appropriate in this zone subject to the Exception Test.

Table 2: Flood Risk Vulnerability Classification

More Vulnerable
• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and Evacuation Plan.

From the topographical survey, the site is a reasonable level rectangular shape, land levels vary from 3.00m to 3.35mODN and Fleet Road level is 3.35mODN, **Plan 3**

The development will be designed to consider the potential flood depth at the site following a breach/ overtopping to the tidal flood defences for the 1 in 200-year event.

DRAINAGE AUTHORITIES

Environment Agency

The Environment Agency has permissive powers for reducing the risk of flooding from designated main rivers and from the sea.

The following potential sources of flooding affecting the development site have been identified as:

- The Wash / River Nene

The flood zone maps indicate that the area would be flooded without flood defences. The Flood Map indicates the area at risk of flooding, **assuming no flood defences exist**, for a flood event with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring for fluvial (river) flooding. It also shows the extent of the Extreme Flood Outline which represents the extent of a flood event with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater.

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

These maps show that the site of the proposed development is within the extreme flood outline. The maps indicate that the area would be flooded without flood defences, which are in place along the river/ coastal edge (with an annual probability of more than 0.5% i.e. return frequency of less than 1 in 200 years for tidal flooding or more than 1.33% return frequency of less than 1 in 100 years for fluvial flooding). **Map 1**

The risk of flooding from Rivers and Sea shows that the site is at a Low risk of flooding. Low means that each

year this area has a chance of flooding less than 1 in 1000 (0.1%). This considers the effect of any flood defences that may be in this area. Flood defences reduce, but do not completely stop the chance of flooding as they can be overtopped or fail. **Map 2**

The flood banks for the Wash and River Nene, which both lie approximately 11km from the site, constitute the first line of defence against any tidal flooding. In this area, these consist of earth banks, within in a relatively sheltered environment, which is less of a hazard from wave action than the North Sea coastline.

Breach Analysis to the Tidal Defences

From Lincolnshire & Northamptonshire Area, Tidal Modal Analysis (June 2006) **Map 3**)

Peak tide levels Present Day (2006) at West Lighthouse. 0.5% (1 in 200) = 6.01mODN

Peak tide levels (2115) at West Lighthouse, 0.5% (1 in 200) = 6.01mODN plus climate change of 1143mm = 7.15mODN

Taking the precautionary approach, the Hazard Rating following a breach which in Flood Risk Assessment (FD 2320) Guidance for New Development Phase 2 R& D Technical Report these are classified as low <0.75, moderate 0.75-1.25, significant 1.25-2.50 and extreme >2.50 based upon an empirical measure of velocity and depth.

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

HR = d x (v + 0.5) +DF

Where V = Flood flow velocity (m/sec)

D = Flood depth (m)

DF = A debris factor included to represent the greater damage, or risk of injury to people, that can occur if debris is swept along with the water. = 0.5 for depths <0.25 or 1.0 for depths

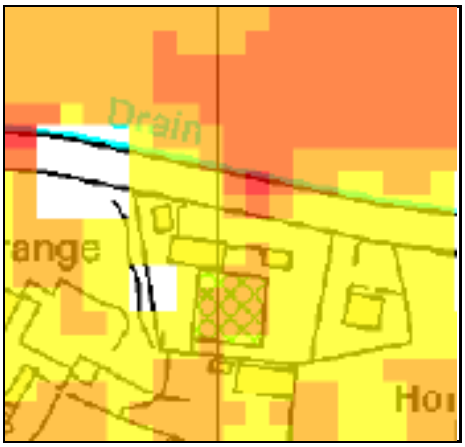
Flood depth (m)	All areas (rural and urban)
≤ 0.25	0.5
> 0.25	1

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

The Environment Agency has recently carried out a Tidal Hazard Mapping for the Wash following a breach to the defences. The Lincolnshire & Northamptonshire Area Tidal Hazard Maps for Scenario year 2006 for the 1 in 200-year event show that the site for the development is not within a Hazard Rating area.

With climate change, the tidal Hazard Maps for Scenario year 2115 for the 1 in 200 event shows that the area of

the site for the development is within two Hazard Rating areas of less than 0.75 Low Hazard, between 0.75 – 1.25 (Danger for Some) and between 1.25 – 2.0 (Danger for Most) with a velocity of 0 - 0.3m/sec and depth of flow for the majority of the site is within the range 0 – 0.25m **Map 4**



1 in 200-year depth breach map 2115

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

The site is not affected by overtopping of the defences for the present day (2006), or with climate change, up to year 2115 scenarios.

The Environment Agency recommends for any proposal that single storey developments that include ground floor sleeping accommodation should be informed by the flood depths arising from the 2115.0.1% breach scenario. Any proposals that do not include ground floor sleeping can be informed by the flood depths arising from the 0.5% breach scenario.

For areas where the flood depths are 0 – 0.25 the finished floor level should be 300mm above the existing ground level.

From the 1 in 200-year 2115 breach depth map the majority of the site is within the depth range 0 – 0.25m and ground levels average 3.30mODN, in accordance with the Environment Agency's recommendations the ground floor for the properties will be raised 300mm, set at a minimum of 3. 60mODN.**Map 6**

South Holland District Council

In order to inform the process of risk assessment and site selection the District Council commissioned Consultants in 2010 to prepare a Strategic Flood Risk Assessment which has recently been replaced by the South-East Lincolnshire SFRA.

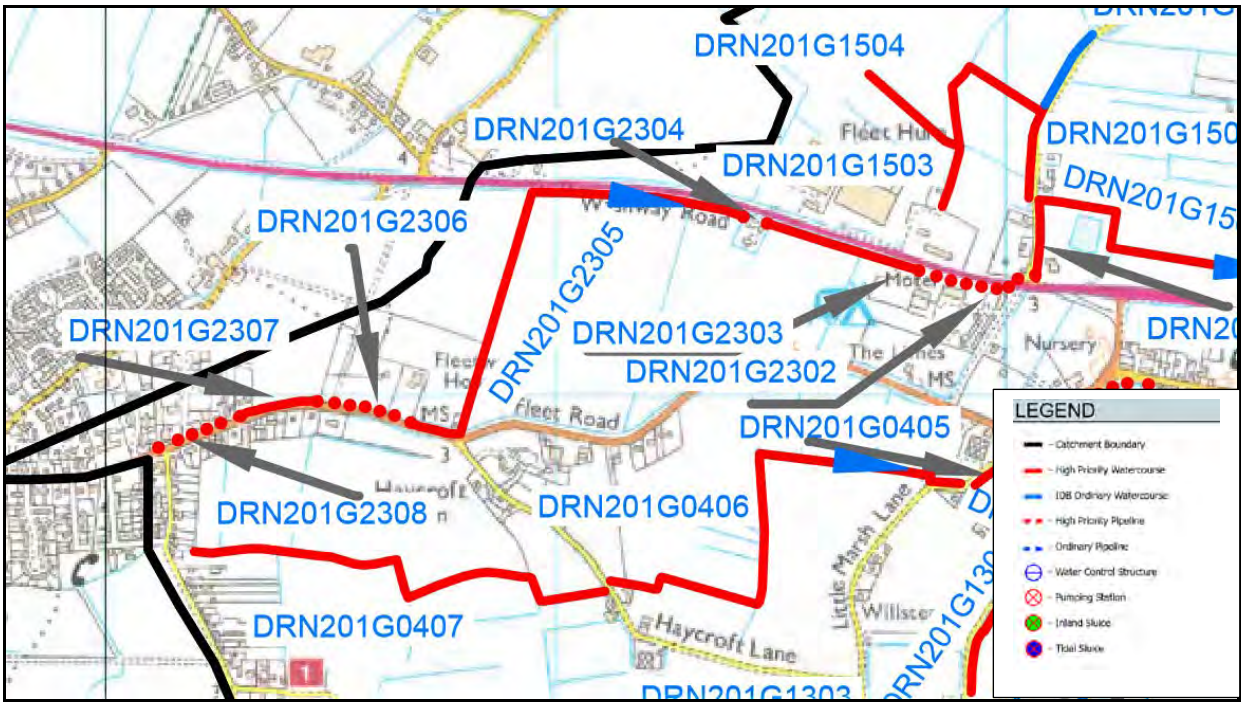
The whole of the tidal flooding information has been replaced by the mapping from the latest Environment Agency Tidal Hazard mapping. Where the mapping for an area contains both fluvial and tidal components, the more severe of the two has been presented.

South Holland Internal Drainage Board

The proposed development site is located within the catchment area of South Holland Internal Drainage Board. The Board is responsible to operate and maintain the arterial fluvial system.

The site lies within the Boards catchment area K Lutton Leam. The Board's nearest maintained drain, DRN201G2305 (K23 Washway Road), is located to the west of the site.

The Board do not have any record of any flooding in this area associated with the Board's system.



SURFACE WATER FLOODING

The site is not shown on the Surface Water flood maps to be affected by surface water flooding. Very low risk means that each year this area has a chance of flooding of less than 1 in 1000 (0.1%). Flooding from surface water is difficult to predict as rainfall location and volume are difficult to forecast. **Map 6**

FLOODING FROM OTHER SOURCES

Flooding is a natural process and can happen at any time from sources other than watercourses and the sea.

- Flooding from land can occur from intense rainfall, often over short duration of time that is unable to soak into the ground or enter the drainage system. However, with the natural topographic nature of the ground being flat, with no high ground around the site this will not cause any rapid inundation of

the site and is likely only lead to local ponding of shallow depth and low velocity following the natural land contours which fall away from the site. With the ground floor levels of the dwellings being raised 300mm above the existing ground level, flooding from this source is limited to minor isolated cases and is not of strategic significance with regards to flood risk.

- The area is not known to suffer from any groundwater problems and therefore is taken as having no strategic significance with regards to flood risk.

- Flooding from sewers can occur from over loading from heavy rainfall caused by blockages or having inadequate capacity. There are no sewers in the vicinity of the site.

- Non-natural or artificial sources of flooding such as reservoirs, lakes or canals where water is stored above natural ground level could cause flooding if the structure fails or is over topped. There are no known sources within the vicinity of the site.

RESIDUAL RISKS

There is always a possibility of a flood more than that allowed for which might conceivably cause some flooding to the properties. However, such an event would have a very low probability and the risk of flooding to the property would be extremely small. It is therefore considered that the residual risks associated with flooding are not significant.

SEQUENTIAL APPROACH

When applying the sequential approach for flood risk in accordance NPPF the site of the barn would fall into Flood Zone 3 (High Probability) as the site is shown to be within the fluvial flood plain as shown on the Environment Agency's Flood Map without defences in place.

The Environment Agency categorise land into one of three Flood Zones.

• Flood Zone 1 is land outside the 0.1% floodplain (with a chance of flooding of less than 0.1% chance in any given year);

• Flood Zone 2 is land that falls between the 1 in 100-year extent and the 1 in 1000-year extent (a chance of flooding between 1% and 0.1% in any given year);

• Flood Zone 3a is land which falls within the 1 in 100-year flood extent (has a 1% chance of a flood occurring in any given year).

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

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

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone	Flood Zone 1	✓	✓	✓	✓	✓
	Flood Zone 2	✓	✓	Exception Test required	✓	✓
	Flood Zone 3a	Exception Test required	✓	✗	Exception Test required	✓
	Flood Zone 3b Functional Floodplain	Exception Test required	✓	✗	✗	✗

NPPF Guidance Paragraphs 100 - 104 requires development within high areas of flood risk be determined using a sequential risk-based approach to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account the impacts of climate change.

Sequential Test

A Sequential & Exception Test has been prepared by others and for the purpose of this report it is deemed to be compliant.

CLIMATE CHANGE

Global warming is now recognised that it is likely to affect the frequency and severity of extreme events as both tidal and fluvial flooding. The Climate change allowances in the NPPF Guidance was updated on the 19th February 2016.

The site is located within the Anglian River Basin, for sites within Flood Zone 3 and for "More vulnerable" land uses the Higher Central and Central river flow allowances figures in Table 1 should be used.

Table 1 Peak river flow allowances by river basin district (1961 to 1990 baseline)				
River basin District	Allowance category	Total potential change anticipated for '2020s' (2015 to2039)	Total potential change anticipated for '2050s' (2040 to2069)	Total potential change anticipated for '2080s' (2070 to2115)
Anglian	Upper End	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

The effect of global warming on peak rainfall allowances is given in Table 2

Table 2 Peak rainfall intensity allowance in small and urban catchments (1961 to 1990 baseline)			
Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper End	10%	20%	40%
Central	5%	10%	20%

The annual sea rise due to climate change is given in NPPF and the recommended contingency allowances are stated in Table 3.

Table 3 Peak sea level allowance for each epoch in (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)					
Area of England) (Use River Basin maps	1990 to 2025	2026 to 2050	2051 to 2080	2081 to 2115	Cumulative Rise 1990 to 2115 (m)
East, Midlands, London, South East	4 (140mm)	8.5 (212.5mm)	12 (360mm)	15 (525mm)	1.24m

From Lincolnshire & Northamptonshire Area, Tidal Modal Analysis (June 2006) **Map 3**)

Peak tide levels Present Day (2006) at West Lighthouse. 0.5% (1 in 200) = 6.01mODN

Peak tide levels (2115) at West Lighthouse, 0.5% (1 in 200) = 6.01mODN plus climate change allowances in Table 3 of 1143mm = 7.15mODN

MANAGEMENT OF SURFACE WATER RUN-OFF

At present the impervious area of the garden centre site which consists of glasshouse and building roofs, tarmac or concrete and hardcore hardstandings. The existing surface water for the site either discharges by infiltration to soakaways or direct to ground, or to a gulley which discharges ultimately to the ditch on the opposite side of the road. This system of drainage has worked satisfactory for many years.

It is therefore proposed that this principle be adopted to serve the new development. Roof water from the new dwellings will discharge to pvc crate soakaways, driveways and the private access road will be constructed with permeable paving with a restricted outfall connected to the existing pipe discharging to the dyke opposite.

In accordance with recognised guidance, within the Building Regulations, there is a hierarchy of where surface water should discharge. This hierarchy should be followed where practicable, and is as follows:

1) Infiltration
2) Watercourse
3) Public sewer

Infiltration

It is therefore proposed that the roof water from the new dwellings will discharge to pvc crate soakaways design in accordance with BRE 365.

Watercourse

Surface water runoff and storage calculations have been undertaken using a software tool developed by Brett Paving Perm Calc., a summary is included below with the full results. **Document 1**

The total site area is approximately 4521m^2 and the area that will be served, edge purple, by the development drainage system is assumed to be 1192m^2. **Plan 4**

Access Road= 254.6m^2
Access Road footpath= 271.9m^2
Individual drives= 666m^2

The surface water captured by System C is stored within the sub-base and released slowly into the next stage of the management train or drainage system via outlet pipes at suitable locations. The attenuation of this out flow is controlled with a restricted discharge orifice within the outfall manhole to achieve the desired "run off flow rate". The Construction Industry Research and Information Association (CIRIA) defines Greenfield run-off as the surface water run-off from a site before development or the existing site conditions for Brownfield redevelopment sites. Greenfield run-off rate is considered to be 7.0 litres/second / Ha.

The depth of storage required for the hydraulic design is 280mm.

The existing pipe discharging to the watercourse will be used as the method of disposal of surface water from the impermeable area.

The CIRIA SUDs Manual (Section 3.2.4) indicates that temporary storage should empty from full within 24 to 48 hours so that it can receive runoff from subsequent storms. The calculation shows that the half empty time is 14.77hours.

This statement contains schematic concept drainage proposals. The detailed foul and surface water sewer design for the development would proceed, following receipt of planning approval and drawings and submitted under reserved matters.

Foul Water

Due to the remoteness of the site and no public sewers close by, the foul drainage will be collected in underground pipes within the domestic curtilages of the proposed development and will be discharged into an individual package treatment unit.

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

FLOOD PROTECTION

Any impact of damage to the properties can be foreseen and mitigated against by relatively simple design and construction techniques. There are two forms of flood protection works: -

- **Flood-resistance or proofing works**: - these try to reduce the amount of water entering a building.
- **Flood-resilient works: -** these reduce the amount of damage caused by water entering the building.

The proposed property will have the following resilient measures incorporated in the construction in accordance with "Improving the flood performance of new buildings" CLG (2007).

- The ground floor living accommodation for the dwellings is to be raised to 3.60mODN, in accordance with the Environment Agency's recommendations.

- The ground floor to be constructed with a solid concrete floor with no voids beneath and no low-level wall vents. However, if a beam type floor is to be used, provision should be incorporated for draining the under-floor voids. The wall vents are to be fitted with 'Flood Angel' air bricks which allow air to free pass through as a usual, (complying with BS493:1995) but under flood conditions it shuts down when in contact with water. A removable mesh prevents the passage of debris which may otherwise impinge on the moving part.

- Use Close Cell cavity insulation to the ground floor level.

- External doors to be of construction not susceptible to moisture.

- Arrange for all service circuits to be routed at first floor level where practical socket outlets, boilers etc. to be a minimum of 0.5m above the ground floor level.

- As this site is in an area that can receive flood alerts from the Environment Agency Floodline Warning Direct system. It is recommended that the property Owner contact the Environment Agency's Floodline on **0845 988 1188** to register the property to receive warnings of flooding by telephone, mobile, fax, SMS text, email or pager. The Environment Agency aim to issue a 'severe flood warning' approximately 2 hours before existing defences are overtopped.

CONCLUSION

- The site for the proposed change of use is shown to lie within the Flood Zone 3a (High Probability), which is land assessed as having a less than 1 in 100 annual probability of river or sea flooding in any year (1%), without defences on the Agency's flood maps.

- The ground floor living accommodation for the dwellings is to be raised to 3.60mODN, this is in accordance

with the Environment Agency's recommendations.

- Applying the Flood Risk Vulnerability Classification in Table 2 of NPPF. The proposed use of the land and buildings for residential use falls within the 'More Vulnerable' uses of land shown in Table 2 Flood Risk Vulnerability Classification and buildings used for all purposes are appropriate in Flood Zone 3a subject to the Exception Test.

- No obvious constraints have been identified that may impact the proposed development and the type of mitigation measures that can be used to reduce the flood risk.

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APPENDIX

Map 1	Environment Agency Flood Map.
Map 2	Flooding from Rivers and Sea Map
Map 3	Lincolnshire & Northamptonshire Area Tidal Model Analysis Map & Table
Map 4	Lincolnshire & Northamptonshire Area Tidal Breach Hazard Mapping 2115 1 in 200-year event
Map 5	Breach Depth Overlay Map
Map 6	Surface Water Flood Map
Plan 1	Location Plan
Plan 2	Proposed Layout
Plan 3	Topographical Survey
Plan 4	Drainage Areas
Document 1	Suggested Permeable Pavement Design

Flood map for planning

Your reference	Location (easting/northing)	Created
Fleet	**538007/324869**	**2 Aug 2018 5:10**

Your selected location is in flood zone 3, an area with a high probability of flooding.

This means:

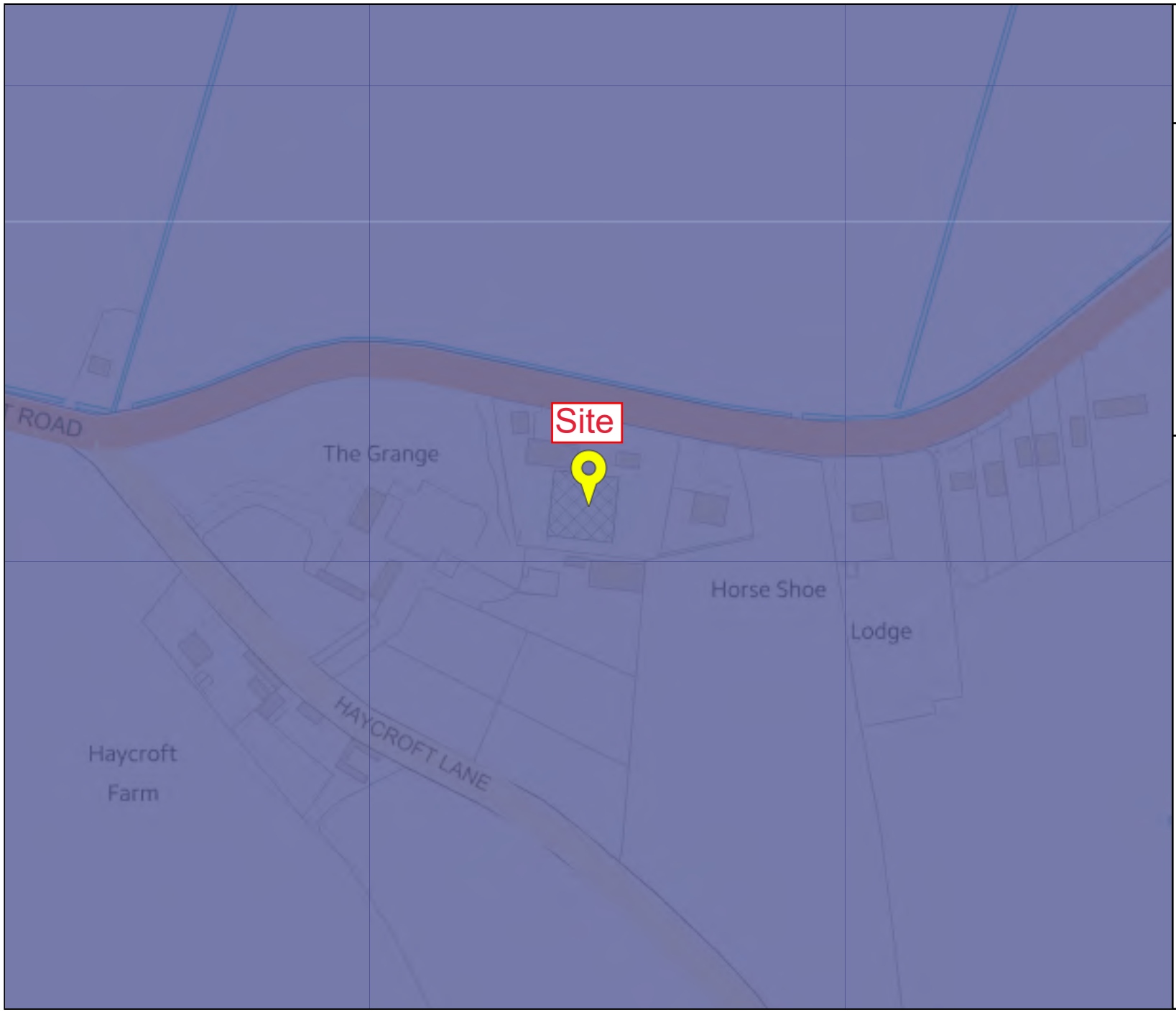
- you must complete a flood risk assessment for development in this area
- you should follow the Environment Agency's standing advice for carrying out a flood risk assessment (see www.gov.uk/guidance/flood-risk-assessment-standing-advice)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

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Environment Agency

Flood map for planning

Your reference
Fleet

Location (easting/northing)
538007/324869

Scale
1:2500

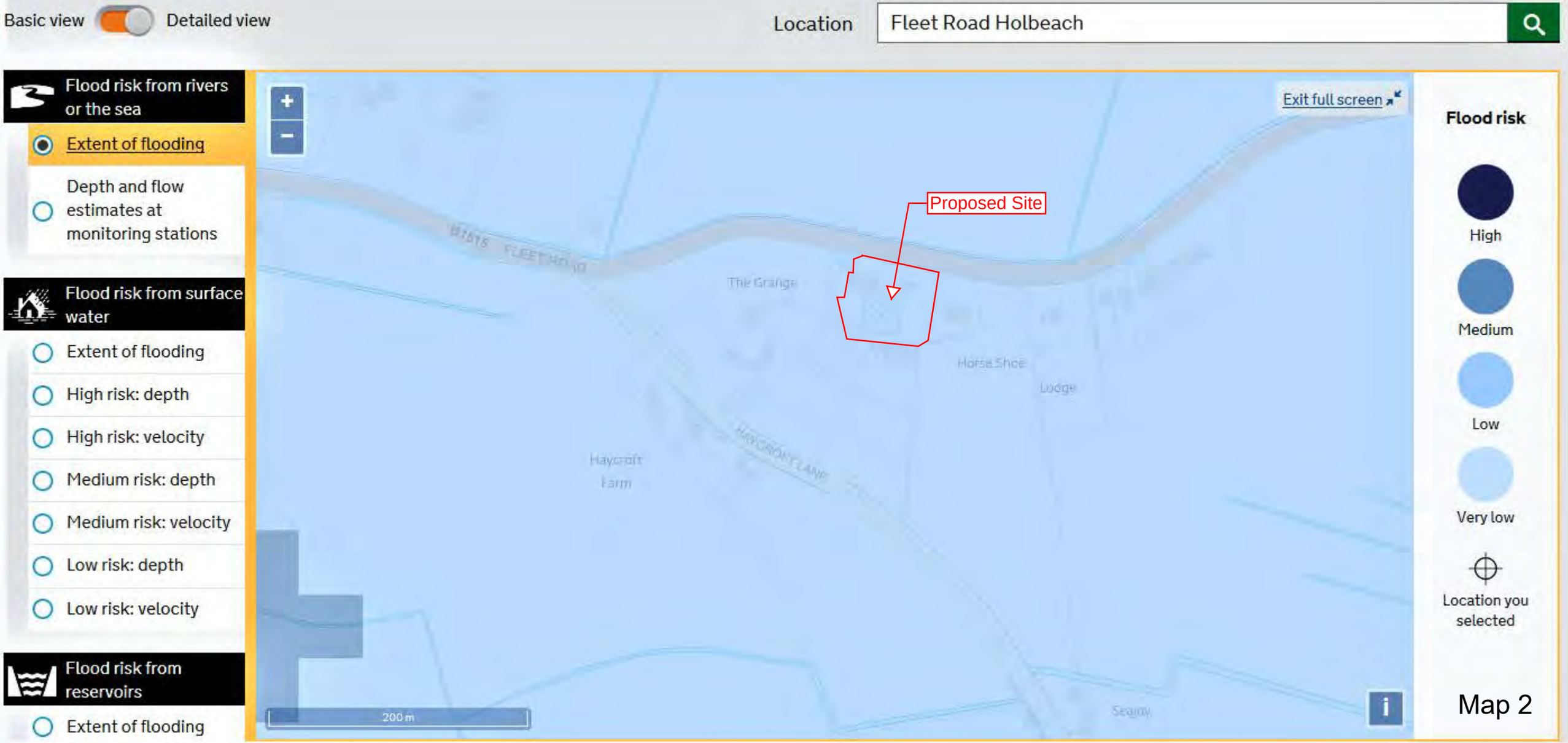
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- Selected point
- Flood zone 3
- Flood zone 3: areas benefitting from flood defences
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Flood storage area

0 20 40 60m

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Map 1


Basic view
Detailed view
Location
Fleet Road Holbeach
Flood risk from rivers or the sea
Extent of flooding
Depth and flow estimates at monitoring stations
Flood risk from surface water
Extent of flooding
High risk: depth
High risk: velocity
Medium risk: depth
Medium risk: velocity
Low risk: depth
Low risk: velocity
Flood risk from reservoirs
Extent of flooding
Exit full screen
Proposed Site
The Grange
Horse Shoe Lodge
Haycroft Farm
200 m
Flood risk
High
Medium
Low
Very low
Location you selected
Map 2

Tidal Level Location Map
Lincolnshire & Northamptonshire Area

Environment Agency



Produced May 2017

Produced by Partnerships & Strategic Overview Team

Map 3

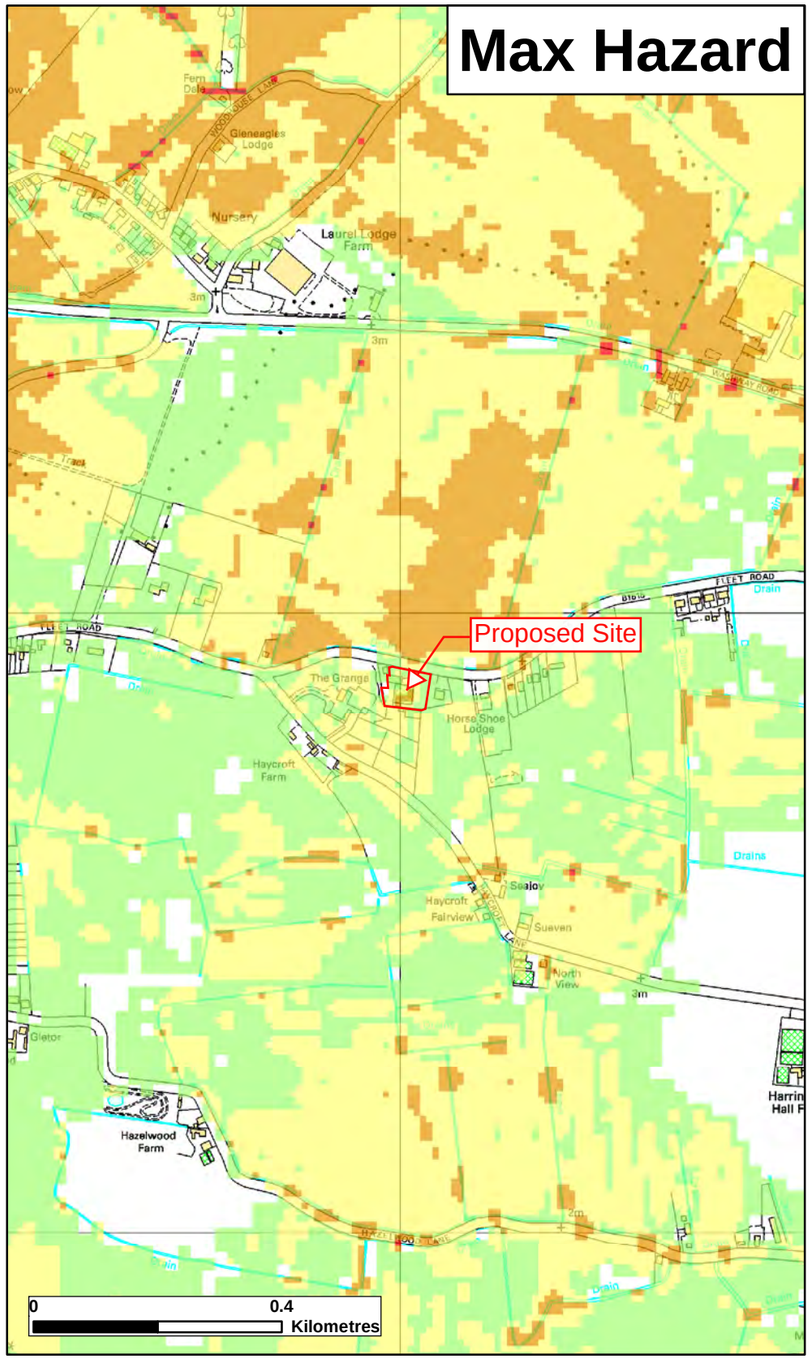
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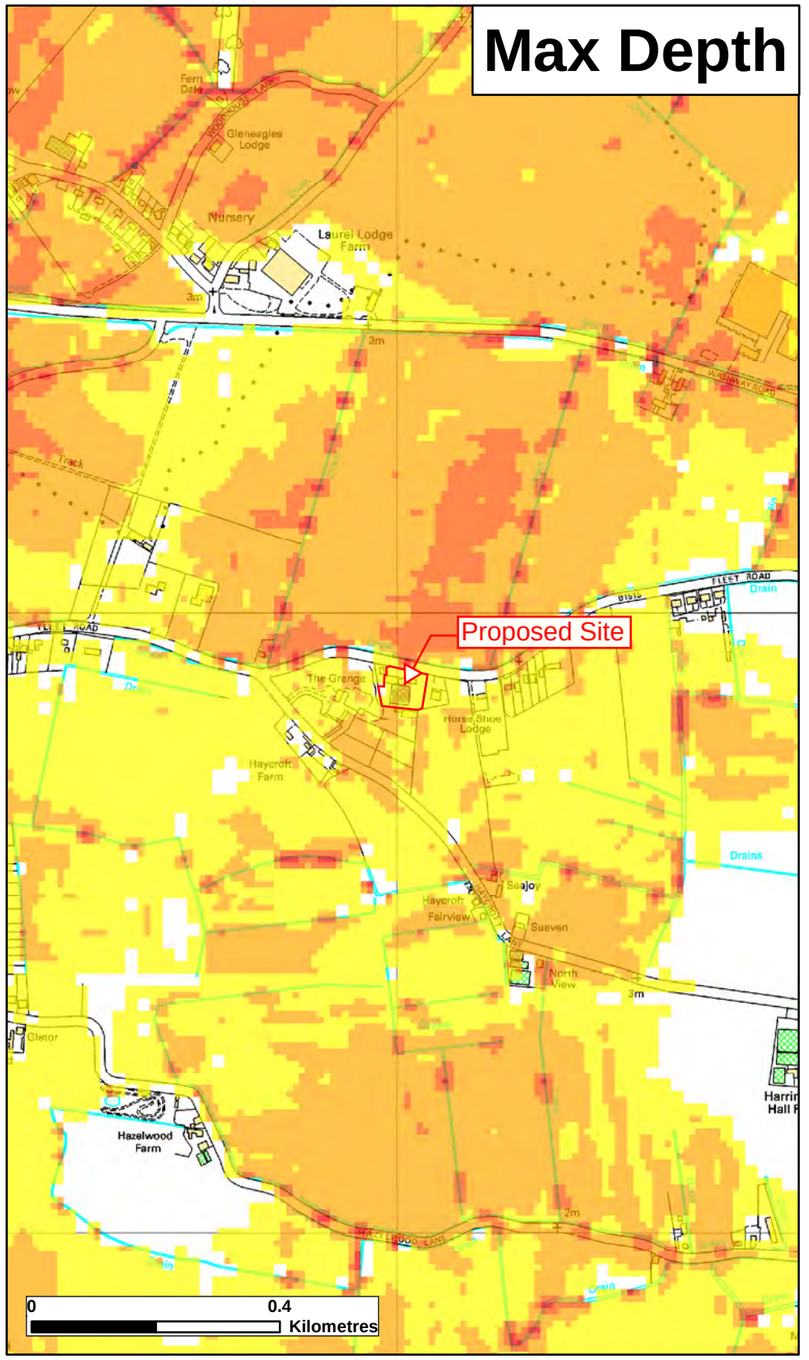
Tidal Water Levels for the South Humber, East Coast and The Wash

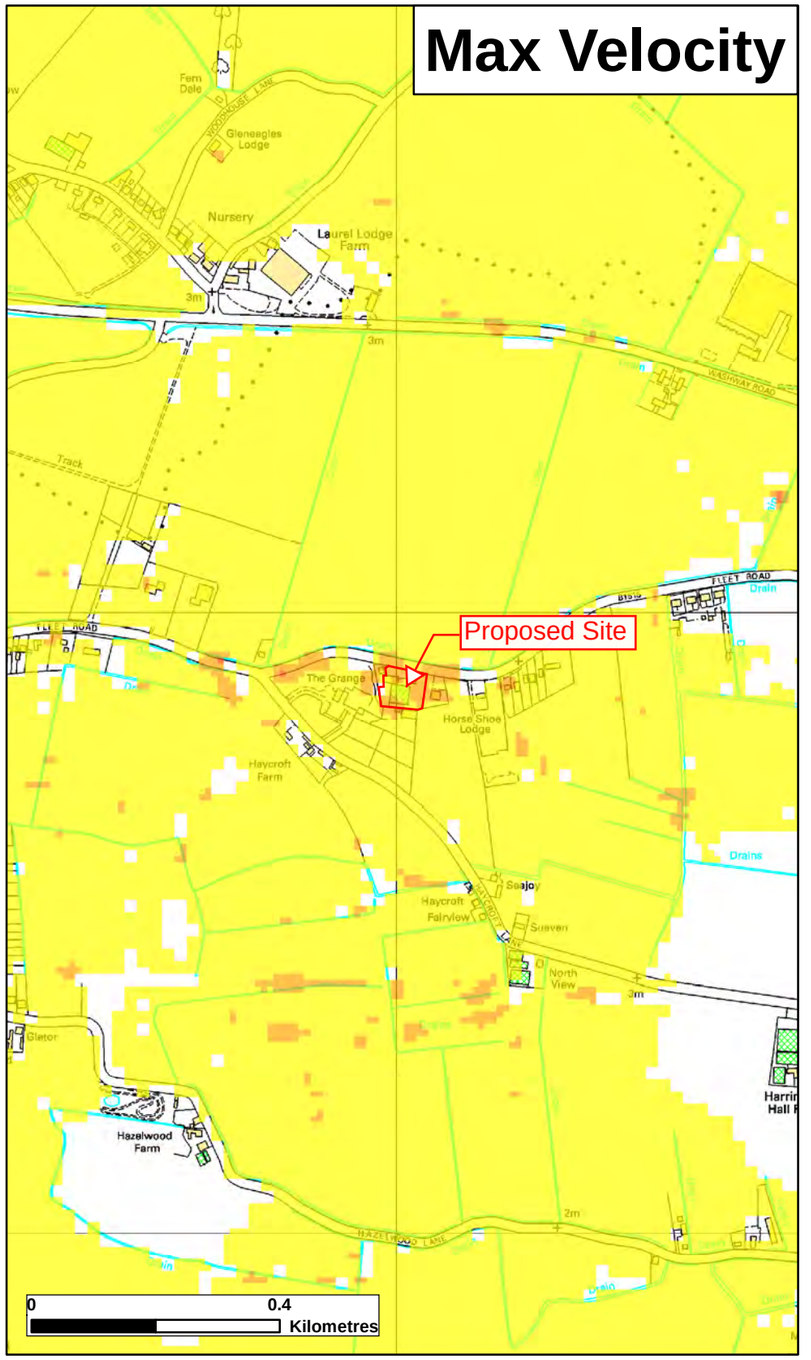
The table below shows still water levels for locations, from the above location map, around the South Humber Estuary, East Coast and The Wash. It is important to note the following:

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

Max Hazard (Flood Risk to People : FD2320)	Max Depth (m)	Max Velocity (m/s)
Less than 0.75 (Low Hazard)	0 - 0.25	0 - 0.3
Between 0.75 and 1.25 (Danger for Some)	0.25 - 0.50	0.3 - 1.0
Between 1.25 and 2.0 (Danger for Most)	0.50 - 1.0	1.0 - 1.5
Greater than 2.0 (Danger for All)	1.0 - 1.6	1.5 - 2.5
	1.6 +	2.5 +

Date Printed	July 2017	Scenario year	2115	Scenario Annual Chance	0.5% (1 in200)	CCN Number	CCN-2017-51883

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 Breach Hazard mapping

Map Centred on TF 38008 24891

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Basic view | Detailed view

Location: Fleet Road Holbeach

Flood risk from rivers or the sea

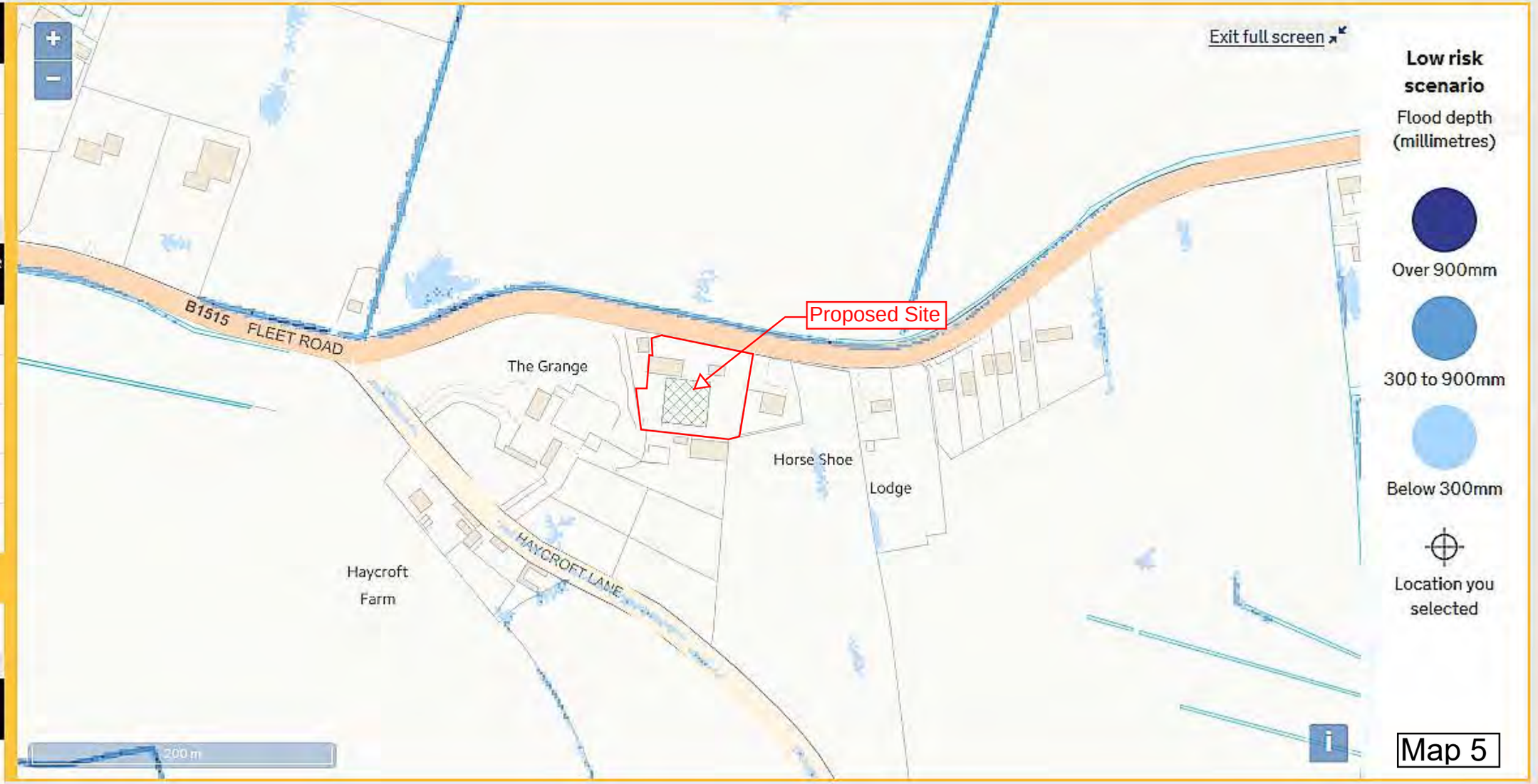
- Extent of flooding
- Depth and flow estimates at monitoring stations

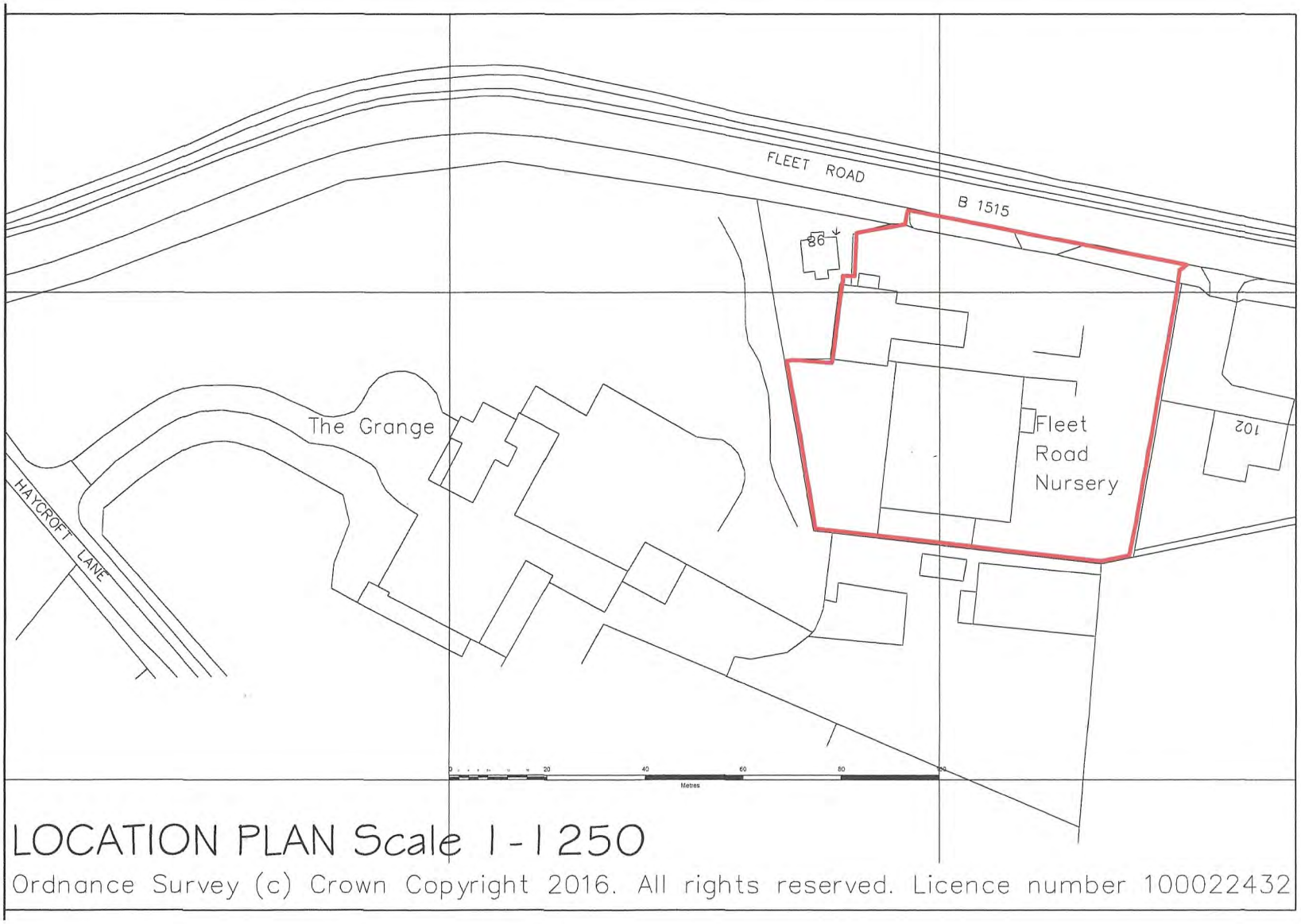
Flood risk from surface water

- Extent of flooding
- High risk: depth
- High risk: velocity
- Medium risk: depth
- Medium risk: velocity
- Low risk: depth
- Low risk: velocity

Flood risk from reservoirs

- Extent of flooding





LOCATION PLAN Scale 1-1250

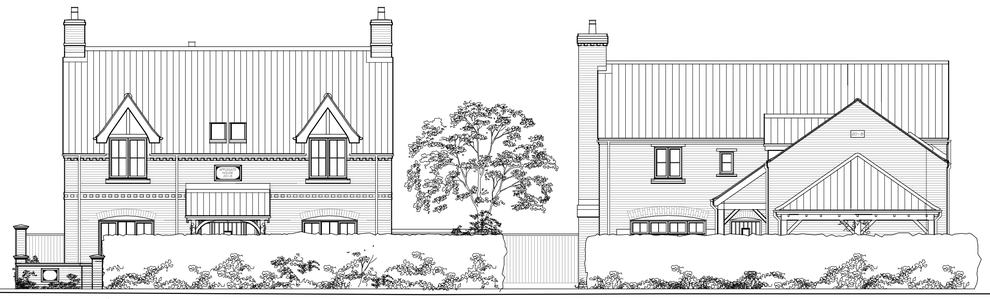
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Plan 1



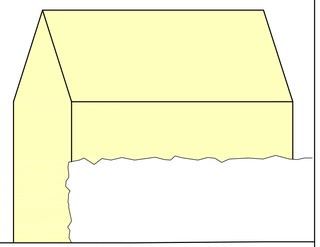
Plot 7

Plot 8



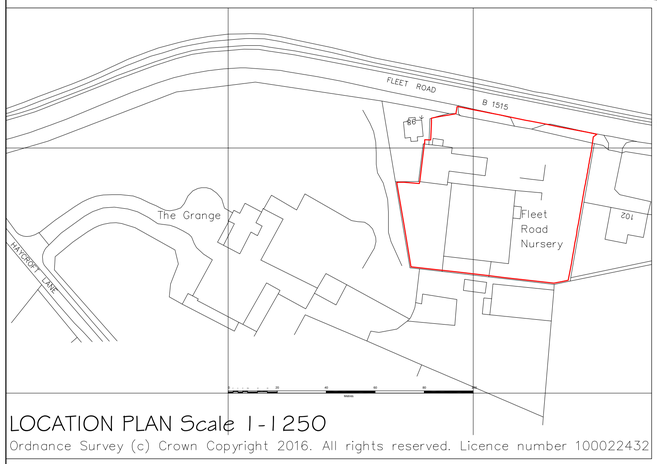
Plot 2

Plot 1



98 FLEET ROAD

FLEET ROAD STREET SCENE
Scale 1-100



LOCATION PLAN Scale 1-1250

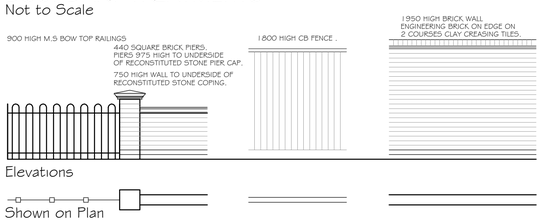
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N

EXISTING HEDGE RETAINED AND TRIMMED ON BOTH SIDES AND THE TOP TO THE NEIGHBOURS REQUIREMENTS.

BOUNDARY TREATMENTS
Not to Scale



Metres

SURVEY CARRIED OUT BY OTHERS

Rev.	Details	Date
B	Amend scheme for resubmission.	1-6-18
A	Leylandii hedge retained and trimmed to south and west boundaries.	18-10-17

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Contractors must check all dimensions on Site. Only figured dimensions are to be worked from. Any foundation depths indicated are indicative only and must be in accordance with the consulting engineers design and/or agreed on site with the local authority during excavations. Any discrepancies in the information contained herein must be reported to the Architect before work proceeds.

Drawings to be read with Engineers calculations / report where applicable.

Note: If drawing details existing structures, we have not inspected woodwork or other parts of the structure which are covered, unexposed or inaccessible and we are therefore unable to report that any such part of the property is free from defect.

Project	PROPOSED HOUSING FLEET ROAD NURSERY, FLEET
Drwg.	SITE AS PROPOSED
Scale	1:200 @ A1
Date	April.'17
Drg No.	16-2335-02
Rev.	B

architects • designers • planning consultants
Old School House · 36 Boston Road · Sleaford
Lincolnshire · NG34 7EZ · Tel: 01529 414141
Fax : 01529 415757

clive wicks associates

©

324950N

538000E

0 2 4 6 8m 12 16 20

Metres
1:200

Legend

- Boundary
- Building
- Channel with grate
- Fence
- Foliage
- Gate
- Lamp post
- Post (BT)
- Sign
- Gully
- Inspection cover (with cover level)
- Kerbface (transition/ dropped kerb)
- Kerbtop
- Eaves level
- Floor level
- Ground level
- Ridge level
- Road edge
- Tree (girth, spread, height)

Dyke

Inv 2.14

4m high hedgerow beyond fence from here

4m high hedgerow beyond fence from here

TOLETHORPE

Surveying • Engineering • Environmental

T.W. Barker Ltd
Hall Farm Cottages
Little Casterton, Stamford
Lincolnshire PE9 4BE
M 07736 009237
E enquiries@tolethorpe.net

www.tolethorpe.net

Client

Applegate Homes Ltd.
7 Endeavour House
Enterprise Way
Pinchbeck
Spalding
PE11 3YR

Rev	Description	Date	By
.	.	.	.

Survey Control

The survey grid has been derived from GPS observations and related to Ordnance Survey National Grid (OSTN15). All levels relate to O.D.N. (OSGM15).

All dimensions given in metres.

Project
Fleet Road Garden Centre
Fleet Road
Holbeach
Spalding. PE12 7AX

Title
Topographical Survey of Main Features

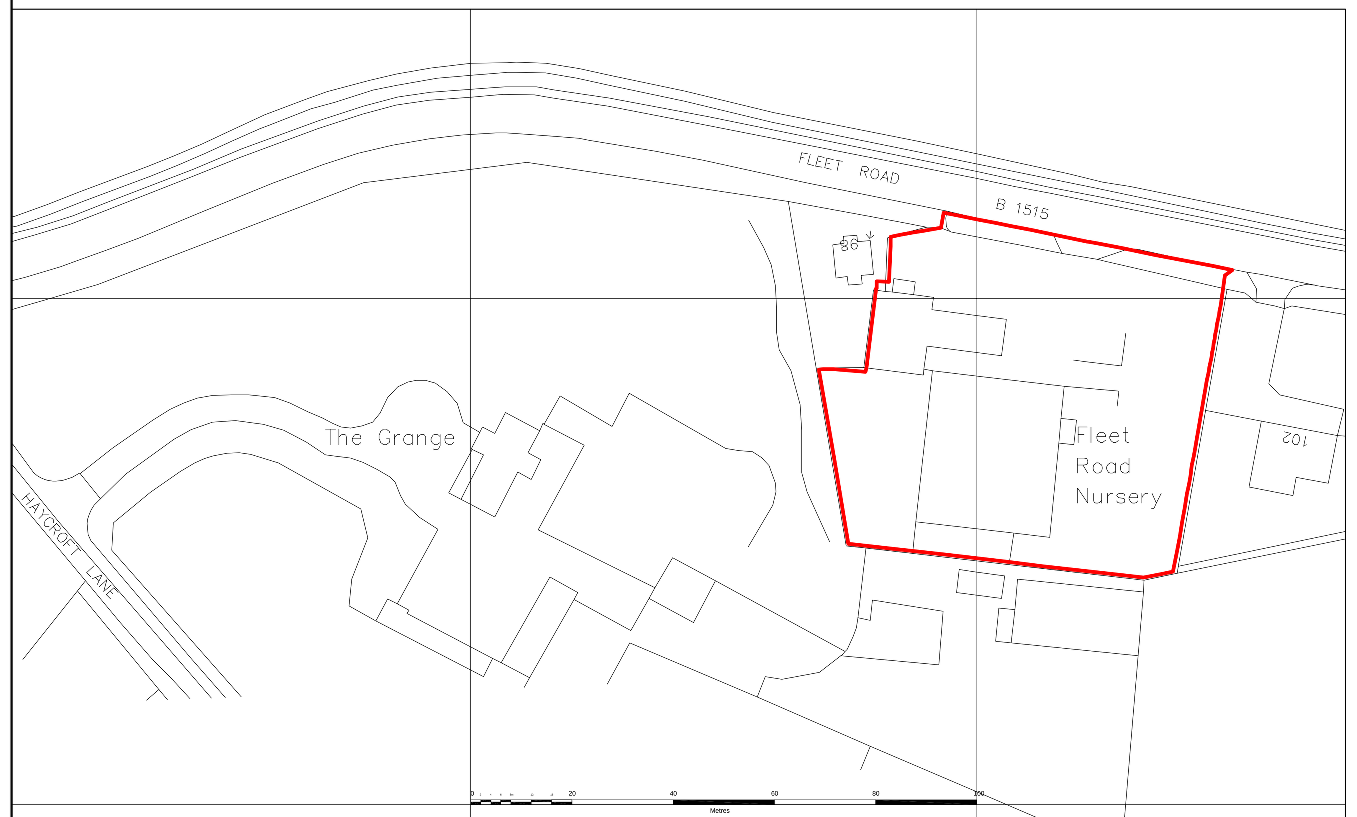
Drawing No.	*Rev.*
FRG151116-001	00
Date	*Drawn By*
15/11/2016	TWB

Drawing Scale
1:200 @ A1

Plan 3



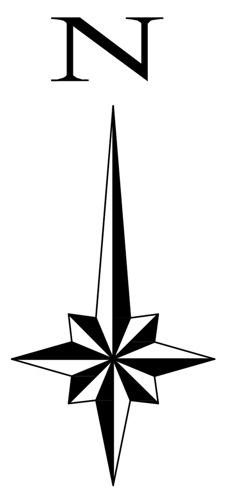
FLEET ROAD STREET SCENE
Scale 1-100



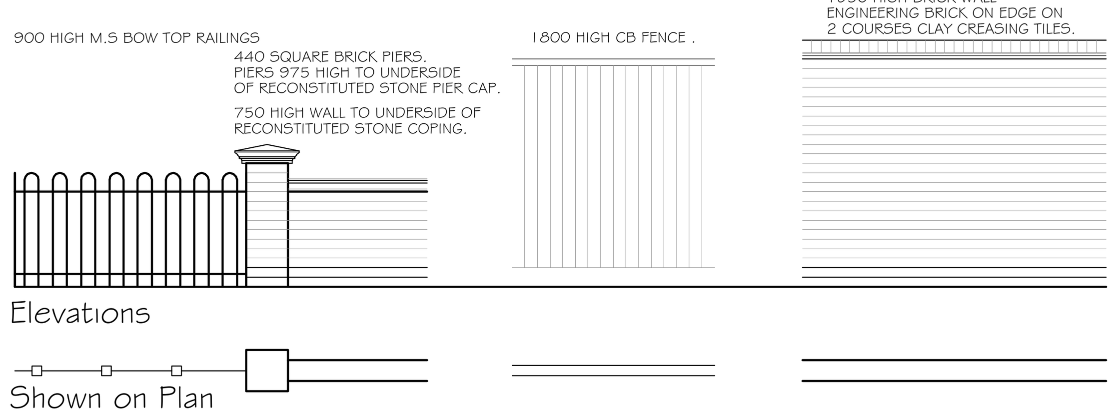
LOCATION PLAN Scale 1-1250

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BOUNDARY TREATMENTS
Not to Scale



0 2 4 6 8m 12 16 20
Metres

SURVEY CARRIED OUT BY OTHERS

Rev.	Details	Date
-	-	-

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Contractors must check all dimensions on Site. Only figured dimensions are to be worked from. Any foundation depths indicated are indicative only and must be in accordance with the consulting engineers design and/or agreed on site with the local authority during excavations. Any discrepancies in the information contained herein must be reported to the Architect before work proceeds.

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Drwg.	SITE AS PROPOSED
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Date	April.'17
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Rev.	-

architects • designers • planning consultants
Old School House · 36 Boston Road · Sleaford
Lincolnshire · NG34 7EZ · Tel: 01529 414141
Fax : 01529 415757

clive wicks associates

Plan 4

Document 1

Brett Landscaping and
Building Products
Sileby Road
Barrow upon Soar
Loughborough
Leicestershire
LE12 8LX

Customer Service Center
Tel 0845 6080 570
Fax 0845 6080 575

General Administration
Tel 01509 817 187
Fax 01509 817 197

PermCalc

PERMEABLE PAVEMENT DESIGN SUGGESTION

PROJECT: Fleet
Fleet Road
Holbeach
Lincolnshire
PE12 8LD

CONTACT: RM Associates
TEL NO: 07967304737
ADDRESS: 10
Main Street
Thorpe on the Hill
Lincoln
LN6 9BG

Region: England

DATE: **2** Aug 2018 05:13 PM

Notes:-

This design suggestion is given on the basis that the recipient has read, understood and accepts the disclaimer at the end ofthis document.

Directors: W. J. Brett J.Gilbert
Registered Office: 150 Aldersgate Street, London, EC1A 4AB
Brett Landscaping and Building Products is a trading name of Brett Landscaping Limited
Registered Company No: 227266

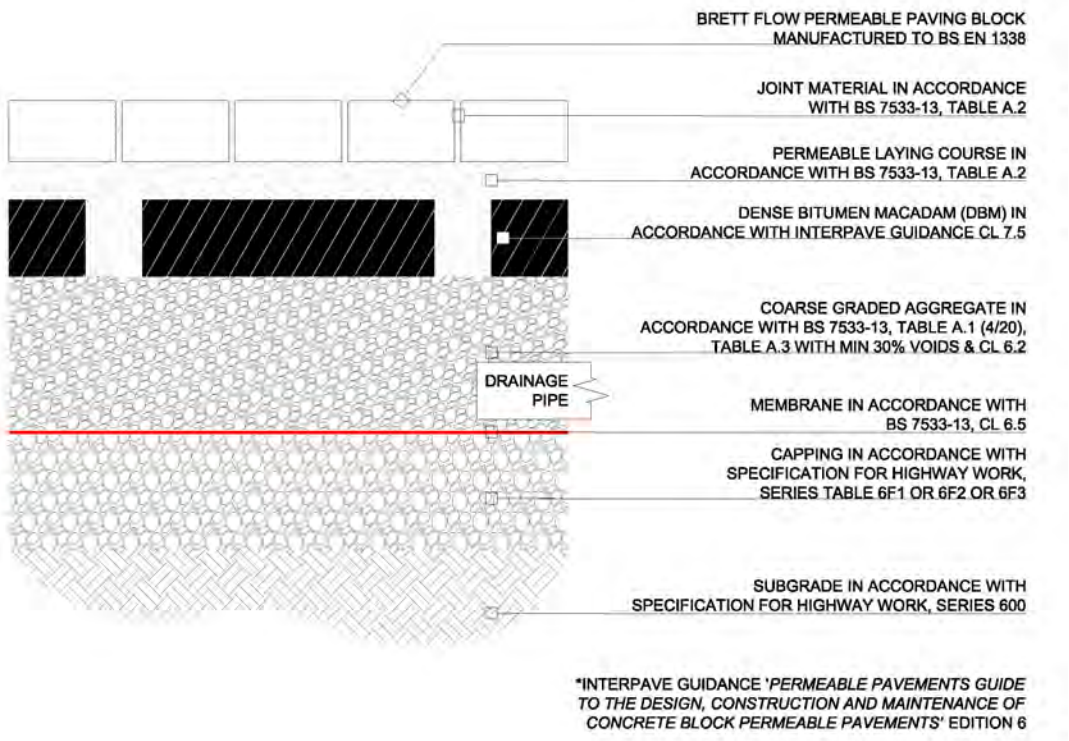
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Suggested Pavement Solution

Permeable Pavement Design Suggestion

Alpha Flow	80mm
Laying Course	50mm
Dense Bitumen Macadam	130mm
Coarse Graded Aggregate	250mm
Membrane	Yes
Capping	250mm

System C with DBM and Capping Layer



Summary of pavement requirements

Depth needed for Structural design (excluding capping)	280mm
Depth needed for hydraulic design	250mm
Is there spare hydraulic capacity	No

Summary of hydraulic requirements

Available hydraulic storage	88,490 litres
Hydraulic storage require	88,490 litres
Spare hydraulic storage	0 litres
Half empty time	14.73 hours

Notes

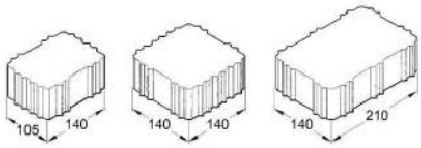
To achieve a run-off rate of 7.0 l/s/ha at 1 number outlet the orifice plate must be 17mm.
The above calculations were based upon a level site.

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Block Specification

Alpha Flow Permeable Block Paving

Q24 12 115 117 119



Alpha Flow Block Plan Dimensions

Paving block available in three sizes specifically designed to create the appearance of a traditional aged pavement whilst the interlocking nib design provides enhanced permeability rates for use within Sustainable Drainage Systems.

Alpha Flow blocks come with a number of complimentary products including circle packs and kerbs as well as an impermeable option which can be machine laid.

The Alpha Flow range is manufactured and tested to comply with BS EN 1338: 2003.

When tested to BS DD 229: 1996 for Surface Permeability Alpha Flow achieved 3386 mm/h.

Brett Landscaping operate an integrated management system covering accreditation to BS EN ISO 9001: 2008 Quality Management System, a BS EN ISO 14001: 2004 Environmental Management System as well as an OHAS 18001: Health and Safety Management System.

Since 2010 Brett Landscaping also hold BES 6001 Responsible Sourcing of Construction Products certification to 'Very Good' which feeds into BREEAM along with the typical A+ / A Green Guide Rating for concrete block paving constructions.

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Permeable Construction Materials

Permeable Construction Materials	Quantity	Unit
Alpha Flow 80 mm	1192.0	m²
Jointing aggregate	9.9	ton
Laying course	77.5	ton
Dense Bitumen Macadam	356.4	ton
Course Graded Aggregate	383.5	ton
Membrane	1668.8	m²
Capping	536.4	ton

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Summary of design information

Site

Adjacent paving area draining onto permeable pavement	0 m²
Roof water draining onto Permeable Pavement	0 m²
Permeable area	1192 m²
CBR Value	3%
Is there any history of pollution on site?	No
If so what is the classification of the waste material?	n/a
Has the water table been recorded within 1000mm below the top of formation? or Risk of contaminated water? or Sub grades susceptible to water infiltration and/or repeated loading?	No

Loading

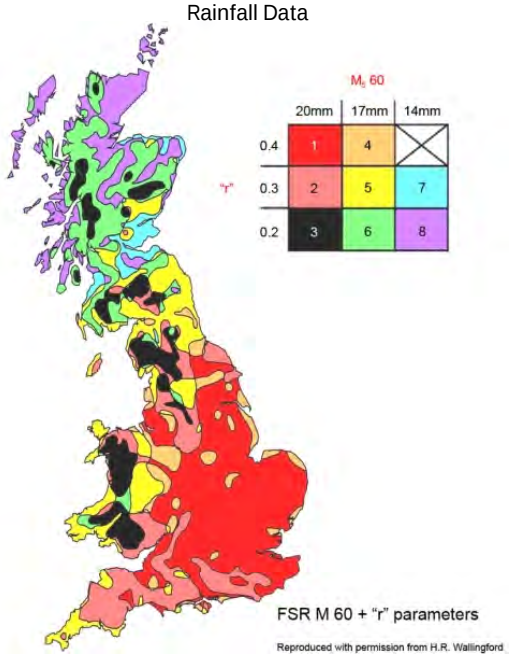
Traffic Loading category	Category 3, 0.015 msa
Is a DBM layer required for construction traffic to run on ?	Yes

System

Type of system	System C
Discharge rate	7.0 l/s/ha

Water Storage

Rainfall Data



Area Selected	1	M5-60 = 20mm, 'r'=0.4
Design return period	1 in 100 year event	
% for climate change	40%	

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Additional Comments

1/2 Empty time

For lower allowable discharge rates (below 7 l/s/ha) and greater return periods (in excess of 1 in 100 year) the half empty time for the water storage can be in excess of 24 hours (typically up to 40 hours and sometimes greater). The SUDS Manual (Section 3.2.4) indicates that temporary storage should empty from full within 24 to 48 hours so that it can receive runoff from subsequent storms. Commonly a half empty time of 24 hours is used by design engineers. However the origins of this requirement need to be considered before applying it to storage designed for more extreme events. The requirement was initially stated in BRE 365 for soakaways designed to a 1 in 10 year storm event. The chance of such events following each other is quite high. However the chance of a 1 in 100 year +30% event being followed by a similar magnitude storm is much smaller and it is questionable whether the half empty requirements should be applied. Even if the storage does not half empty in 24 hours, there will still be significant storage capacity after this time to deal with smaller follow on storms.

This needs careful consideration and discussion with clients before deciding to increase available storage capacity.

With concrete block permeable paving the thickness of subbase is often dictated by the structural requirements of the pavement which often results in excess storage capacity already provided within the subbase. Typically if the subbase thickness is 10% to 20% greater than that required for hydraulic storage then half of the required storage will be available after 24 hours (for a 5 l/s/ha discharge).

The tables highlight where half empty times exceed 24 hours. If extra capacity is deemed necessary the subbase thickness can be increased to provide half the required storage capacity 24 hours after the end of the design storm. This is achieved as follows:

- Calculate total volume of water flowing out of subbase in 24 hours (i.e. storage that is available after 24 hours)
- Calculate 50% of design storage (i.e. storage required after 24 hours)
- Extra storage required = 50% of design storage – total water flowing out in 24 hours
- The extra storage should be added to the design storage to give a new total volume of storage.

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Additional Comments Continued

Code for Sustainable Homes (CfSH)

The Code for Sustainable Homes is an environmental assessment method for rating and certifying the performance of new homes in England and Wales. It is a mandatory standard for use in the design and construction of new homes and is aimed at encouraging continuous improvement in sustainable home building as we move towards the target of Zero Carbon homes.

The Code for Sustainable Homes defines targets across a wide spectrum of new home construction and the use of permeable paving solutions can help to gain a significant number of points for the designer.

The most obvious of these comes from Category 4: Surface Water Run-off. This is a mandatory category and requires surface water drainage for housing developments which avoid, reduce and delay the discharge of rainfall run-off to watercoarses and public sewers using Sustainable Drainage techniques (SUDS). This will thereby protect receiving waters from pollution and minimise the risk of flooding as well as other environmental damage in watercoarses.

Compliance with Category 4 provides up to two credits, more importantly a failure to comply will render the whole project as unable to comply with the Code.

Additional credits can be achieved from other areas:

- One credit can be awarded by ensuring that there is no discharge from the developed site for rainfall depths up to 5 mm.
- One credit can be awarded by ensuring that the run-off from all hard surfaces shall receive an appropriate level of treatment in accordance with the CIRIA SUDS Manual to minimise the risk of pollution.
- Permeable paving can also be combined with other technologies such as water recycling or the development of natural habitats where it can play a part in improving the Code rating of the completed site.
- As a business Brett Landscaping are also able to supply information on the installation, operation and maintenance requirements of any permeably paved areas in a new development. This will then feed into the Site Management Plan which can help to gain additional points for the completed site.

These areas, allied to the typical A+ / A Green Guide Rating for concrete block paving products mean that these products can significantly help the developer to maximise the Code for Sustainable Homes rating for their project. Our Technical Support Team are always willing to assist in this aspect of design:

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Overview of PermCalc Software

Introduction

Concrete block permeable pavements have a dual role acting as the drainage system as well as supporting traffic loads. They allow water to pass through the surface (between each block) and into the underlying permeable sub-base (either coarse graded aggregate and/or hydraulically bound coarse graded aggregate) where it is stored and released slowly, either into the ground, to the next SUDS management stage or to a drainage system. In the case of System C, no infiltration, the water captured can be harvested, as encouraged by the Code For Sustainable Homes.

Pavement Types

There are three principal systems suitable for concrete block permeable pavements – described as Systems A, B and C as defined in BS7533:13 *Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers*, published by the British Standards Institute.

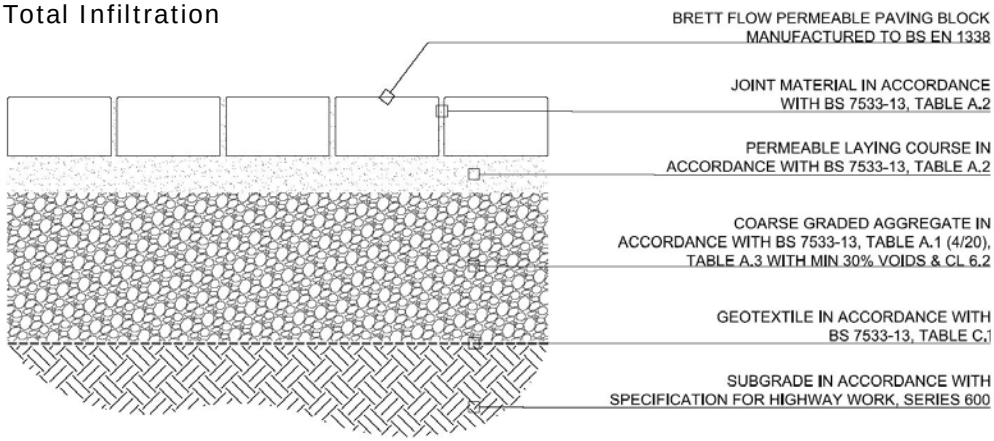
PermCalc can provide design suggestions for System A or System C permeable pavements.

System A is sometimes known as 'Zero Discharge' or total infiltration. This system allows all surface water on the pavement to infiltrate down through the joints between the blocks, passing through the sub-base layers below and eventually into the subgrade. Some retention of water will occur temporarily in the permeable sub-base layer allowing for initial storage before eventually infiltrating into the subgrade.

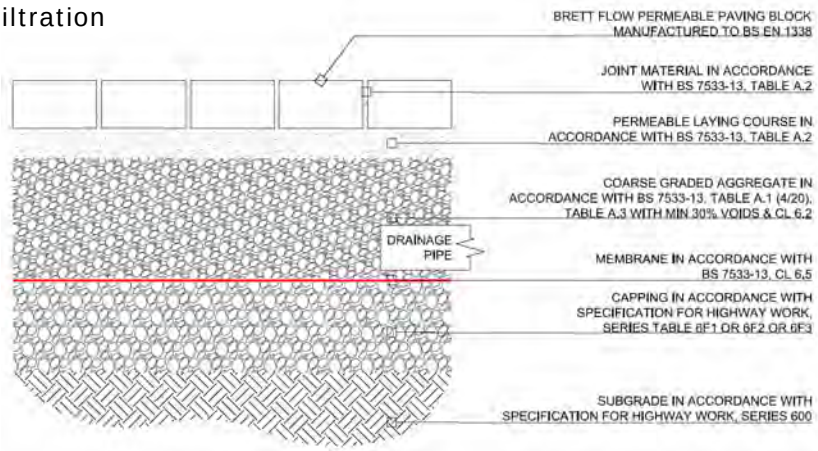
System C is sometimes known as no infiltration. This system allows for all surface water on the pavement to infiltrate down through the joints between the blocks, passing into the sub-base layers below complete, complete capture of the water is achieved using an impermeable, flexible membrane placed on top of the subgrade and up the side of the permeable sub-base to effectively form a storage tank.

System C is used in situations where the existing subgrade has a low permeability or low strength and would therefore be damaged by the introduction of additional water. It can also be useful for water harvesting or to prevent water soaking into the ground in sensitive locations such as water extraction zones. Outlet pipes are constructed through the impermeable membrane at suitable locations to transmit the water to sewers, watercourses or other parts of the SUDS management train.

System A - Total Infiltration



System C - No Infiltration



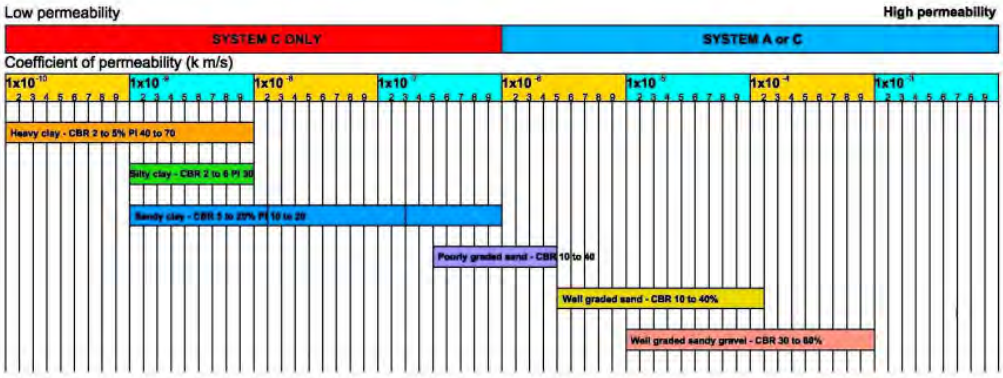
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Selection of a Pavement System

One of the key criteria in selecting a pavement system is subgrade permeability which is established from appropriate tests on site.

The tables below give guidance on the appropriate selection of pavement systems (Systems A or C) for a range of sub-grade permeability, level of water table and the presence of pollutants in the ground.

		System A Total Infiltration	System C No Infiltration
Permeability of subgrade Coefficient of permeability k (m/s)	10^{-6} to 10^{-3}	✓	✓
	10^{-10} to 10^{-6}	x	✓
Highest recorded water table within 1.0m of the formation level		x	✓
Pollutants present in the ground		x	✓



Design Methodology

Permeable pavements must be designed to achieve two aims:

Support the traffic loads over the design life of the pavement (structural design) and manage surface water effectively (hydraulic design). Therefore it is necessary to undertake a structural design and a hydraulic design and select the greater thickness of the permeable material from these calculations to determine the design thickness of the pavement. PermCalc automatically selects the design thickness.

Summary of the Permeable Pavement Design Procedure

Structural Design

- Assessment of traffic loading pre and post construction
- Assessment of sub-grade Californian Bearing Ratio (CBR) value
- Determination of sub bases thicknesses and material types
- If temporary access for construction traffic is to be provided, determination of the thickness of dense bitumen macadam (DBM)

Hydraulic Design

- Assessment of sub grade permeability *k*
- Selection of System A or System C
- Determine return period and rainfall characteristics
- Determine sub base thickness for water storage
- Allow for additional run off from adjacent areas and or roofs
- Check and if necessary increase the sub base thickness to allow for slopes
- Check and if necessary increase the sub base thickness to allow for a DBM layer

Select the greater permeable thickness

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The calculation methodology is based upon the information given in BS7533:13:2009 *Pavements constructed with clay, natural stone or concrete pavers Part 13: Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers*, published by The British Standards Institute.

The notes for guidance used within this tool have been taken from the Interpave document 'Permeable Pavements: Guide to the Design Construction and Maintenance of Concrete Block Permeable Pavements Edition 6'. If further clarification of any points is required the complete guidance document can be downloaded at no cost from http://www.paving.org.uk/permeable.php

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Brett Landscaping, Sileby Road, Barrow Upon Soar, Leicestershire, LE12 8LX

Registered Office:
Brett Landscaping, 150 Aldersgate Street, London EC1A 4AB