

**FLOOD RISK ASSESSMENT  
FOR RESIDENTIAL DEVELOPMENT AT  
72 THE DROVE, BARROWAY DROVE**

**FINAL REPORT**

**ECL0634/MIKE HASTINGS BUILDING DESIGN**

**DATE NOVEMBER 2021**

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### DISCLAIMER

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## **1.0 INTRODUCTION**

This Flood Risk Assessment has been prepared in accordance with National Planning Policy Framework (NPPF) and supporting planning practice guidance (PPG) on Flood Risk and Coastal Change.

In areas at risk of flooding or for sites of 1 hectare or more, developers are required to undertake a site-specific Flood Risk Assessment to accompany an application for planning permission. This Flood Risk Assessment has been produced on behalf of Mike Hastings Building Design in respect of a development that consists of one replacement dwelling at 72 The Drove, Barroway Drove.

A full planning application for the proposed development is to be submitted by Mike Hastings Building Design.

## 2.0 SITE LOCATION AND DESCRIPTION

### 2.1 Site Location

The site is at 72 The Drove, Barroway Drove, Downham Market, PE38 0AJ. The National Grid Reference of the site is 55752/30394.

The location of the site is shown in Figure 1.

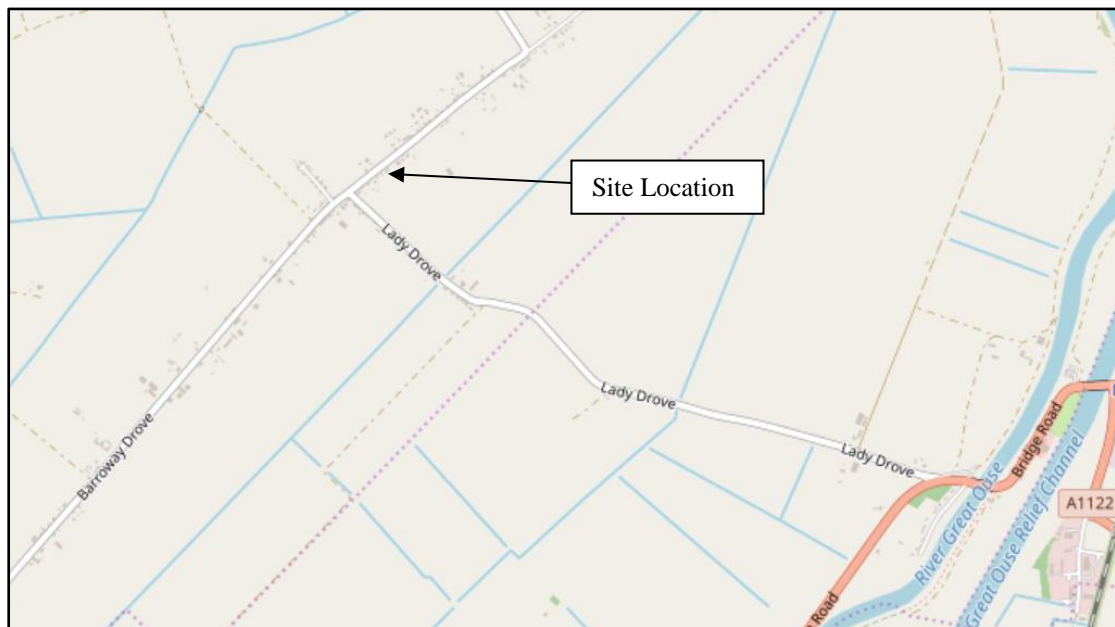


Figure 1 – Location Plan (© OpenStreetMap contributors)

### 2.2 Existing Site

The site is a residential dwelling on the south eastern side of The Drove. The site consists of the dwelling, garage, and surrounding garden. The area of the proposed development is approximately 0.06 hectares.

A topographic survey of the site has been undertaken and spot levels are provided in Attachment 1. Ground levels within the site range between -1.2m OD and -1.7m OD with the lowest levels close to the south eastern boundary of the site. Ground levels around the existing dwelling are -1.6m OD. The level of The Drove adjacent to the site is -0.9m OD.

The site is in the Downham and Stow Bardolph Internal Drainage Board's (IDB) district. Surface water at the site naturally drains through soakaway and hence to the IDB drain system. There is a riparian drain 30m south west of the site and the nearest IDB watercourse is 400m south east of the site.

The online British Geological Survey maps indicate that the site is likely to be underlain by the Kimmeridge Clay Formation mudstone. The bedrock is shown to be overlain with superficial deposits of clay and silt.

## 2.3 Proposed Development

The proposed development consists of one replacement dwelling. The dwelling will be 2 storeys. The proposed site plan is provided in Attachment 1.

## 2.4 Local Development Documents

The King's Lynn and West Norfolk Borough Council Local Development Framework - Core Strategy is the adopted Local Plan for the district. Policy CS08 for Sustainable Development states the requirements for flood risk reduction.

The King's Lynn and West Norfolk Borough Council Level 1 Strategic Flood Risk Assessment (SFRA) was prepared in November 2018. The Level 2 SFRA was prepared in March 2019.

The Norfolk Lead Local Flood Authority (LLFA) Statutory Consultee Guidance Document has been drafted to support the development of Norfolk County Council's LLFA role as a statutory consultee to planning and to inform stakeholders in this process such as Local Planning Authorities (LPA's) and developers.

## 2.5 Available Flood Risk Information

As shown in Figure 2, the site is located within Flood Zone 3, an area with a high probability of flooding, of the Environment Agency Flood Maps for Planning.

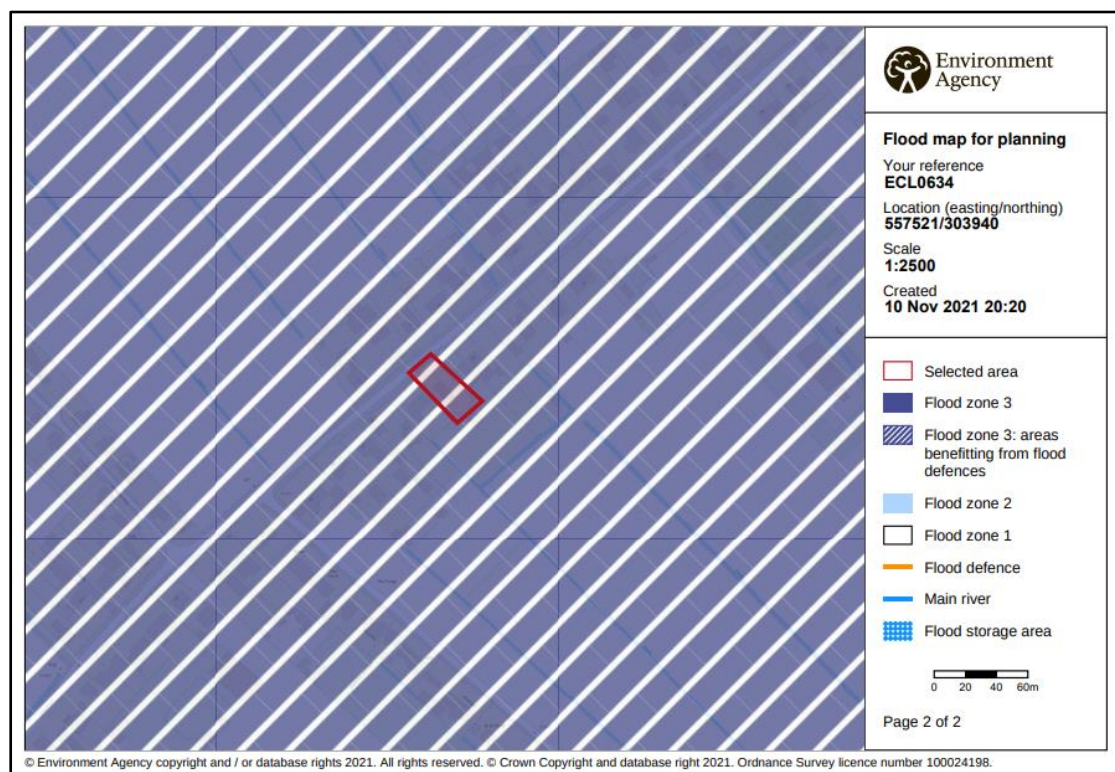


Figure 2 – Environment Agency Flood Map for Planning

The Environment Agency Long Term Flood Risk maps show that:

- the site has a medium risk of flooding from rivers or the sea (annual probability between 1% and 3.3%);
- the site has a very low risk of surface water flooding (annual probability less than 0.1%); and
- the site is within an area at risk of reservoir flooding when there is also flooding from rivers but not at risk of reservoir flooding when river levels are normal.

Barroway Drove is not one of the settlements considered within the King's Lynn and West Norfolk Borough Council Level 2 SFRA. As such the Level 1 SFRA has been used which shows that:

- the site is in Flood Zone 3a;
- the site is not at risk during a 1% annual probability (1 in 100 chance each year) fluvial including climate change;
- the site is not at risk during a 0.5% annual probability (1 in 200 chance each year) tidal event including allowance for climate change;
- the site is not at risk of surface water flooding including allowance for climate change;
- the site is not within an area that has a susceptibility to groundwater flooding;
- the site is within an area at risk from a tidal breach; and
- the site is within an area at risk from reservoir flooding.

Environment Agency Product 8 data was obtained for a nearby site and is provided in Attachment 2.

### **3.0 FLOOD RISK VULNERABILITY**

#### **3.1 The Sequential and Exception Test**

The NPPF requires the application of a Sequential Test to ensure that new development is in areas with the lowest probability of flooding.

The Exception Test is a method to demonstrate and help ensure that flood risk to people and property will be managed, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

#### **3.2 Vulnerability Classification**

Table 2 of the PPG Flood Risk and Coastal Change categorises different types of uses and development according to their vulnerability to flood risk. The proposed development is covered by the description of buildings used for dwellings and is classified as 'More Vulnerable'.

Table 3 of the PPG Flood Risk and Coastal Change sets out Flood Risk Vulnerability and flood zone 'compatibility'. The site is in Flood Zone 3 and the development is 'More Vulnerable' therefore it is necessary to complete the Exception Test.

PPG Flood Risk and Coastal Change defines that the lifetime of the development in terms of flood risk and coastal change is 100 years.

#### **3.3 Application of the Sequential Test and Exception Test**

It is for the Local Planning Authority, using the evidence provided and taking advice from the Environment Agency as appropriate, to consider whether an application passes the Sequential Test.

The proposed development is a replacement dwelling and therefore it is not necessary to apply the Sequential Test to the development.

The Exception Test requires consideration of the wider sustainability benefits of a development and that the development would be safe and residual risks managed.

Section 5 of this Flood Risk Assessment describes the flood mitigation measures and the management of the residual risks, demonstrating that this development will be safe and not increase flood risk elsewhere. The development is considered to pass the Exception Test.

## 4.0 SITE SPECIFIC FLOOD RISK

### 4.1 Local Flood Assets

The site is 2.2km from the River Great Ouse. The site is protected by the Great Ouse tidal defences. The River Great Ouse is the responsibility of the Environment Agency. There is a long-term strategy for the maintenance of the Environment Agency defences which is reviewed and updated periodically.

There is an extensive local drainage network managed by the Downham and Stow Bardolph IDB. The nearest Board drain is located approximately 400m south east of the site. The site, and surrounding land, drains by gravity to the Stow Bardolph Pumping Station and outfalls to the River Great Ouse.

During the operation and maintenance of its pumping stations, associated structures, and channel systems, the IDB seeks to maintain a general standard capable of providing flood protection to its district. A routine maintenance programme is in place to ensure that the Board's assets are commensurate with the standard of protection that is sought.

The site is 3.4km from the Middle Level Main Drain, an embanked channel which flows to St German Pumping Station to discharge to the tidal River Great Ouse. The Middle Level Main Drain and St Germans Pumping Station are the responsibility of the Middle Level Commissioners.

The site is 5.3km from the Ouse Washes, a washlands providing flood storage to manage flood risk. The Middle Level Barrier Bank that protects the site is inspected and maintained in accordance with the standards of the Reservoirs Act.

Current maintenance standards of the Downham and Stow Bardolph IDB's, the Middle Level Commissioners and the Environment Agency's defences are generally good.

### 4.2 Sources of Flooding

The following potential sources of flooding have been identified during this assessment:

- local blockages to the IDB main drain system;
- an event in the local drainage network that exceeds the standard of protection;
- failure of the Stow Bardolph Pumping Station;
- failure of St Germans Pumping Station;
- overtopping and/or breaching of the Middle Level Main Drain;
- overtopping and/or breaching of the Middle Level Barrier Bank; and
- overtopping and/or breaching of the River Great Ouse tidal defences.

The likelihood of overtopping and/or breach of the Middle Level Main Drain or the Middle Level Barrier Bank is considered less likely and less significant than a tidal breach. As such they have not been considered further in this assessment.



### 4.3 Probability of Flooding

The probability of flooding associated with blockages in the IDB's drainage system is low due to the maintenance standards already achieved and managed by the IDB.

The standard of drainage provided by Downham and Stow Bardolph IDB is assessed at 2% annual probability (1 in 50 chance each year). This is compatible with the Department of the Environment, Food and Rural Affairs (DEFRA) target level of service for rural drainage and flood defence works. The risk associated with flooding due to events greater than 2% annual probability (1 in 50 chance each year) is lowered due to the Board drains incorporating freeboard. This provides storage during events greater than 2% annual probability (1 in 50 chance each year).

St Germans Pumping Station offers protection against the 1% annual probability (1 in 100 chance each year) fluvial event with an allowance for climate change. St Germans Pumping Station was replaced in 2011 so that a standard of protection against the 1% annual probability (1 in 100 chance each year) event could be maintained.

The site benefits from defences on the River Great Ouse that provide protection during an event with a 0.5% annual probability (1 in 200 chance each year).

### 4.4 Historic Flooding

During the preparation of this assessment, no evidence was discovered of the site being flooded.

### 4.5 Climate Change

Climate change is likely to impact the site through increased rainfall intensity and duration affecting the local drainage network and increased flood levels in the River Great Ouse.

The SFRA maps show that the site is not at risk during the 0.5% annual probability (1 in 200 chance each year) tidal event with climate change. When this event is considered in the River Great Ouse it is likely to lead to some overtopping of the defences. However, the level of overtopping is such that it would not affect the site.

In summary the existing systems and defences are appropriate for the design life of the development (i.e., 100 years).

### 4.6 Residual Risk

The SFRA indicates that the site is at risk of flooding during a breach. The Environment Agency Hazard Mapping indicates the maximum flood depths in the event of a combined breach. The maximum flood depth at the site for the 0.5% annual probability (1 in 200 chance each year) event with climate change and combined breaches is between 1.0m and 2.0m as shown in Figure 3.

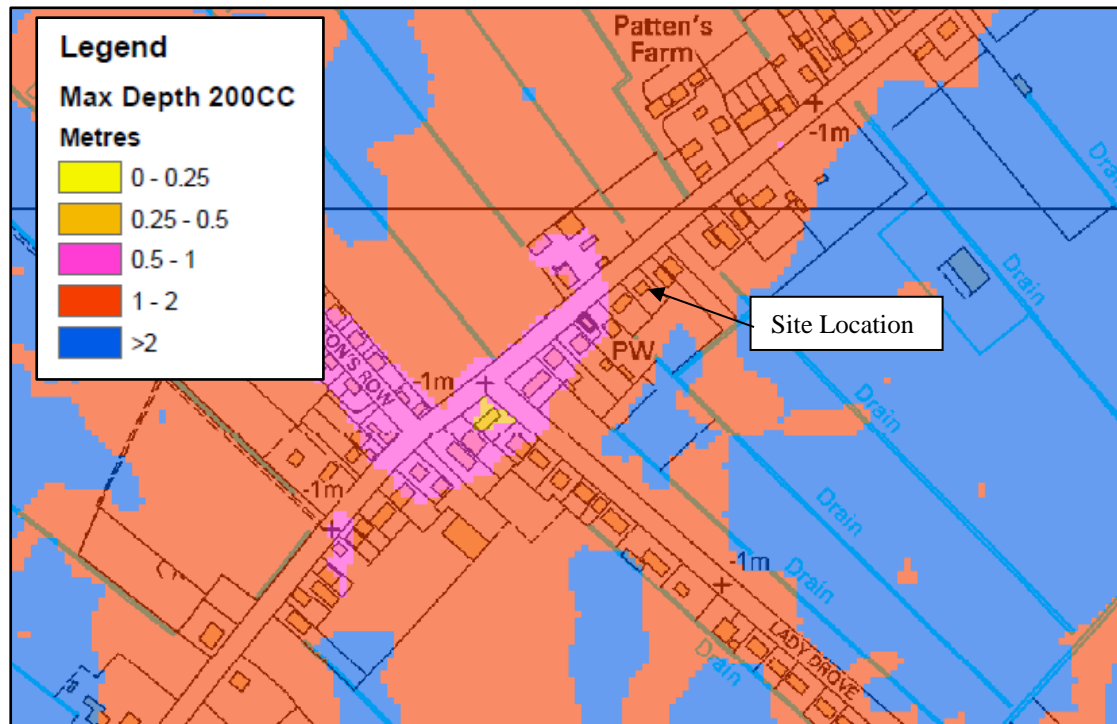


Figure 3 – Environment Agency Hazard Map Maximum Flood Depth

The 2015 Tidal Hazard Mapping merged model extents provided by the Environment Agency have also been used to estimate the flood level. At three locations the tidal hazard mapping model depth and LiDAR ground level have been used to estimate the flood level.

	<b>Easting</b>	<b>Northing</b>	<b>Ground Level</b>	<b>Depth</b>	<b>Water Level</b>
1	557510	303945	-1.57m OD	1.56m	-0.01m OD
2	557530	303930	-1.81m OD	1.63m	-0.18m OD
3	557530	303915	-2.08 m OD	1.84m	-0.24m OD

Table 1 – Estimated Flood Water Level during a breach

The approximate locations of the Points are shown in Figure 4.

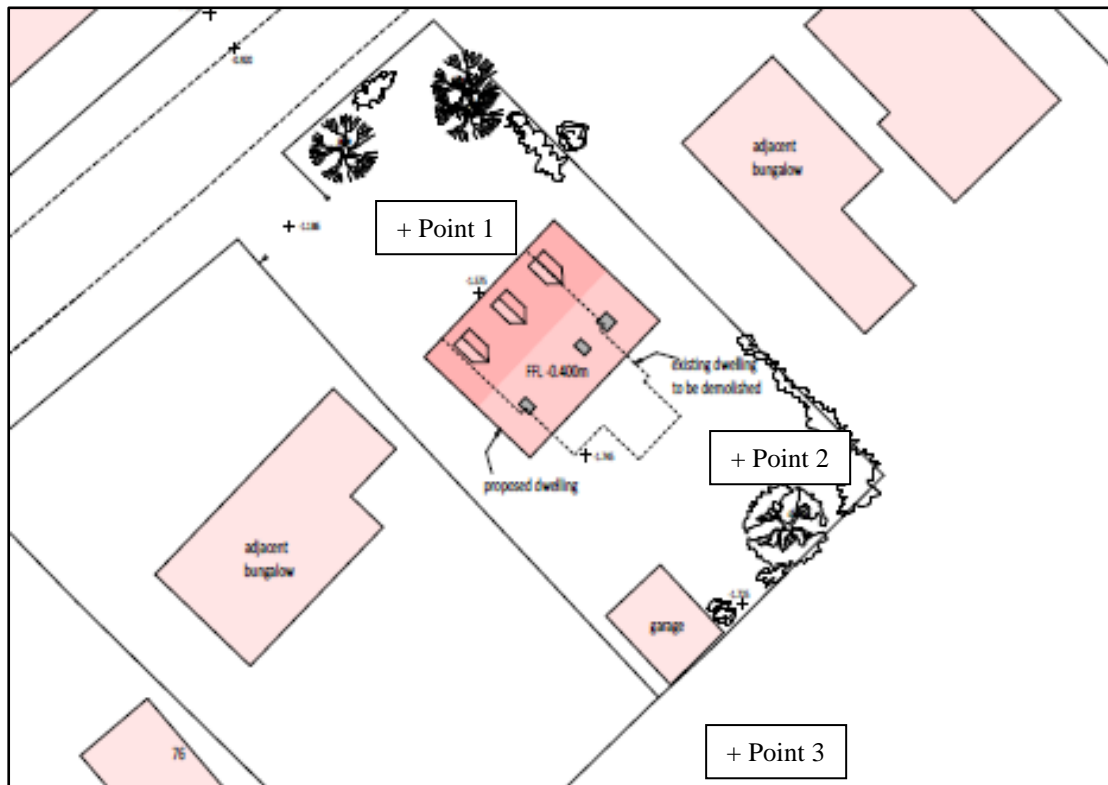


Figure 4 – Locations Used to Estimate Flood Water Level During a Breach

The analysis shows that a conservative estimate of the flood level at the site is 0.0m OD. Based upon the ground levels around the proposed development being +1.6m OD a maximum flood depth of 1.6m can be estimated.

## 5.0 FLOOD RISK MITIGATION

### 5.1 Summary of Risks

The probability of this development flooding from localised drainage systems is low. Failure of Stow Bardolph Pumping Station or St Germans Pumping Station would increase the level of risk at the site.

The probability of the site flooding from the River Great Ouse is less than 0.5% annual probability (1 in 200 chance each year) because of the standards of the existing flood defence systems. Over time there will be a gradual increase in risk to the site due to climate change. During the design life of the development the site is not at risk during the 0.5% annual probability (1 in 200 chance each year) event.

The SFRA considers the residual risk associated with a breach in the defences. The tidal hazard maps show that the potential flood level at the site is 0.0m OD. This is a depth of 1.6m.

The proposed arrangement increases the impermeable area so there will be an increased volume of surface water. This has the potential to increase flood risk.

### 5.2 Mitigation Measures

The dwellings neighbouring the site are bungalows and therefore the maximum height that floor levels can be raised is limited. Based upon the information available during the preparation of this flood risk assessment, it is recommended that floor level of the dwelling is at -0.6m OD and there is 0.6m of flood resistant and flood resilient construction above finished floor level.

The risk of flooding is also mitigated by the proposed dwellings having two storeys. Sleeping accommodation will be on the first floor above the potential flood level.

The developer should ensure that the eventual occupier of the dwelling is sufficiently aware of the risk of flooding, and the standard of the existing defences. The Environment Agency provides a Flood Warning Service which includes Flood Warning Codes and uses direct warning methods where the risks and impacts of flooding are high.

In addition to direct and indirect flood warnings, the Environment Agency operates a 24 hour a day Floodline Service providing advice and information on flooding. The occupier of the dwelling should register with the Floodline Direct Warnings Service to receive any future flood warnings.

During an extreme event it is anticipated that sufficient time would be available to take precautionary actions to limit the potential impact of flooding. Egress from the site in a breach or exceedance event would be south westerly direction on Barroway Drove Road and then westerly on the A1122 to Outwell which is in Flood Zone 1.

Failure of Stow Bardolph Pumping Station or St Germans Pumping Station may occur due to long term mechanical breakdown or power supply being disrupted. However, in these circumstances, if conditions were such to put properties and land at risk of flooding, the IDB would take emergency action to maintain the drainage level of service by using temporary pumping equipment.

It is recommended that the surface water run-off is managed so that stormwater from the development will not affect any adjoining properties or increase the flood risk elsewhere.

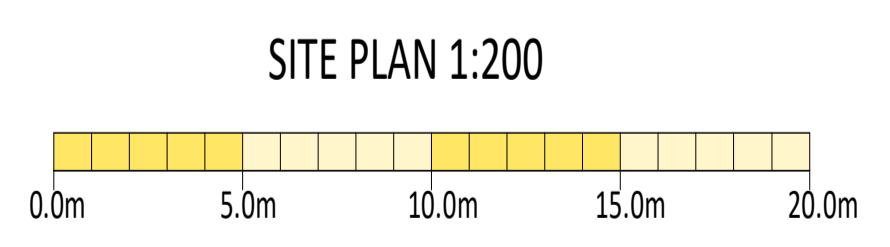
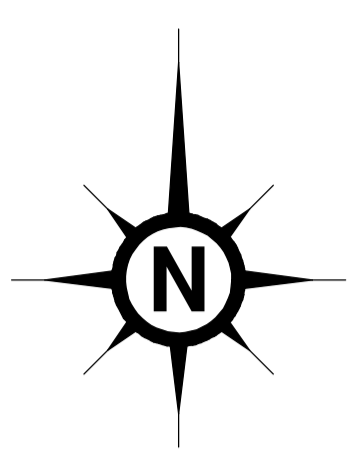
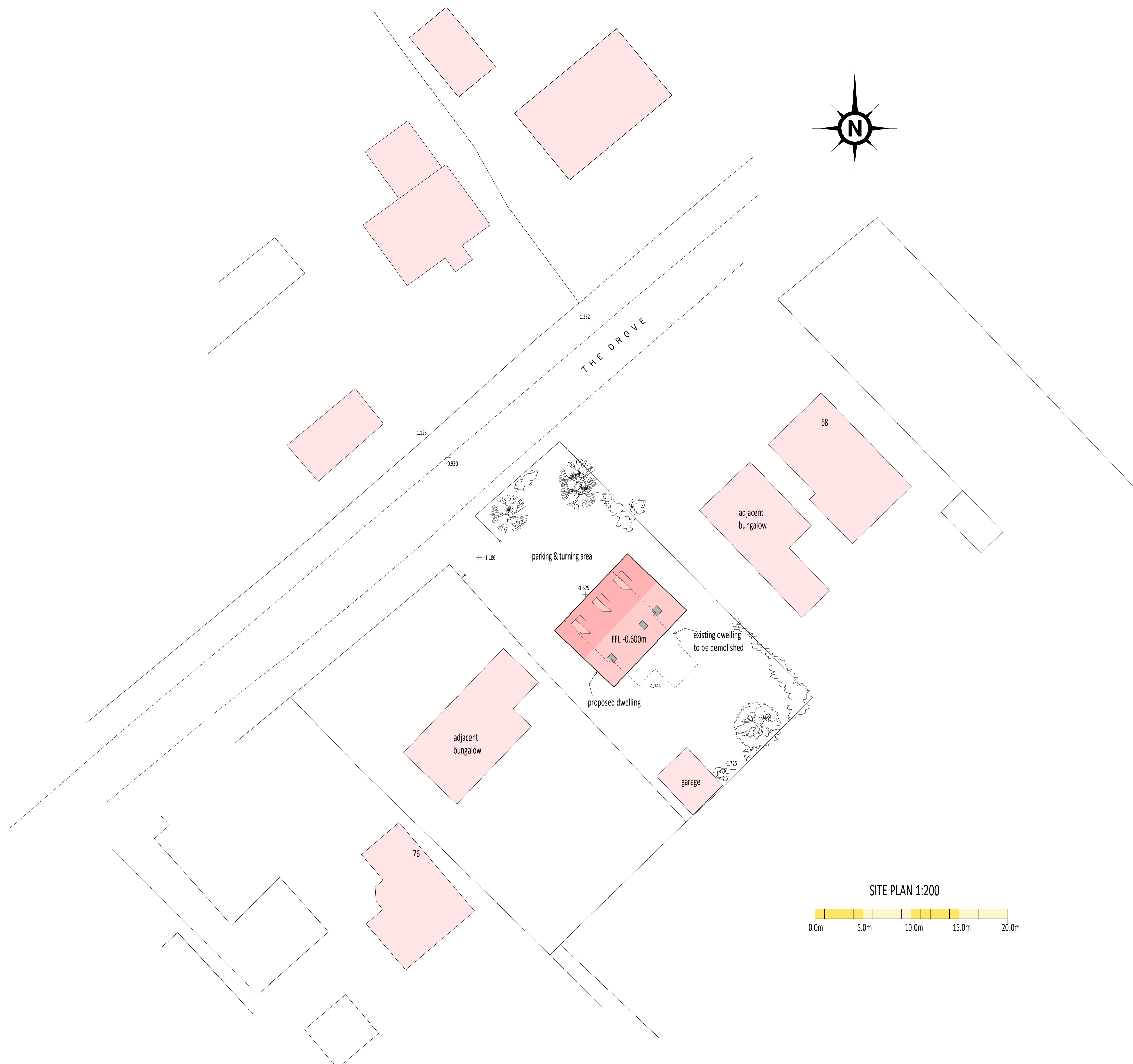
## 6.0 CONCLUSIONS

As a result of this assessment, the following conclusions have been reached.

- The proposed development consists of one 2 storey replacement dwelling at 72 The Drove, Barroway Drove.
- The proposed development is in Flood Zone 3a. The site benefits from defences on the Tidal River Great Ouse which provide protection during the 0.5% annual probability (1 in 200 chance each year) event including climate change.
- The site is located within an IDB catchment with a minimum standard of drainage of 2% annual probability (1 in 50 chance each year) which accords with DEFRA guidelines for rural development. The risk of flooding is lowered further due to the Board drains incorporating a significant freeboard. This provides storage during events greater than 2% annual probability (1 in 50 chance each year).
- There is a residual risk associated with a breach of the defences. It is recommended that the floor level of the dwelling is -0.6m OD. It is recommended that there is 0.6m of flood resistant and flood resilient construction above finished floor level.
- The development passes the Sequential Test and Exception Test and is therefore suitable for the proposed location.

**ATTACHMENT 1**

**PROPOSED SITE LAYOUT  
(Dwg 14118)**



Original drawing created using DX2022 software. Original drawing size A1. Drawing scale shown

**PROPOSED SITE LAYOUT**  
 72 THE DROVE  
 BARROWAY DROVE  
 DOWNHAM MARKET  
 PE38 0AJ

**MIKE HASTINGS Building Design**  
 58 Sluice Road, Denver,  
 Downham Market  
 Norfolk PE38 0DY  
 Tel: 01366 388715  
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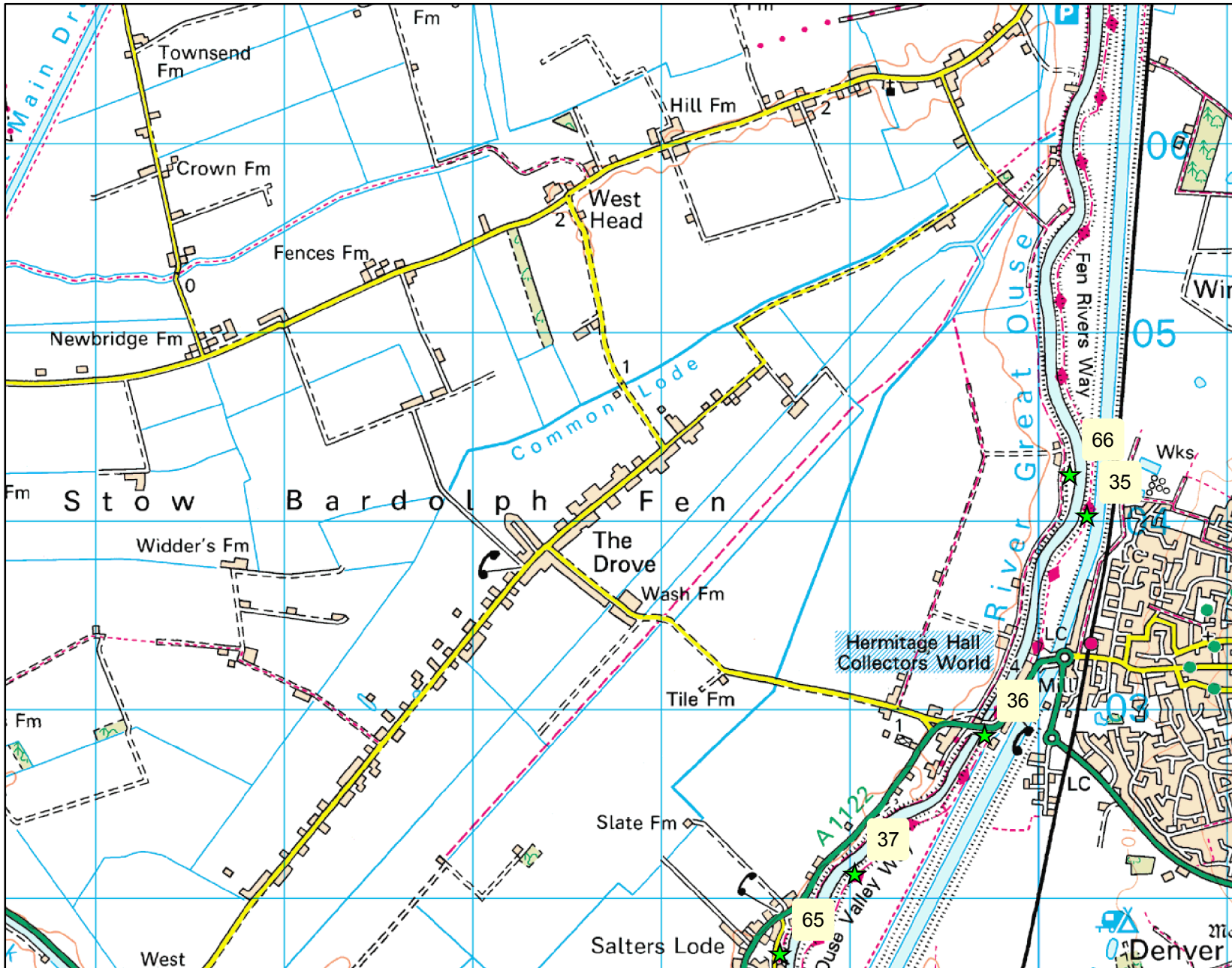
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14118	



## **ATTACHMENT 2**

### **ENVIRONMENT AGENCY FLOOD RISK INFORMATION**

**Modelled Breach Locations centred on Barroway Drive, Downham Market.**  
**NGR TF 57807 04176. Ref CCC/2015/22697. Created on 01/10/2015.**



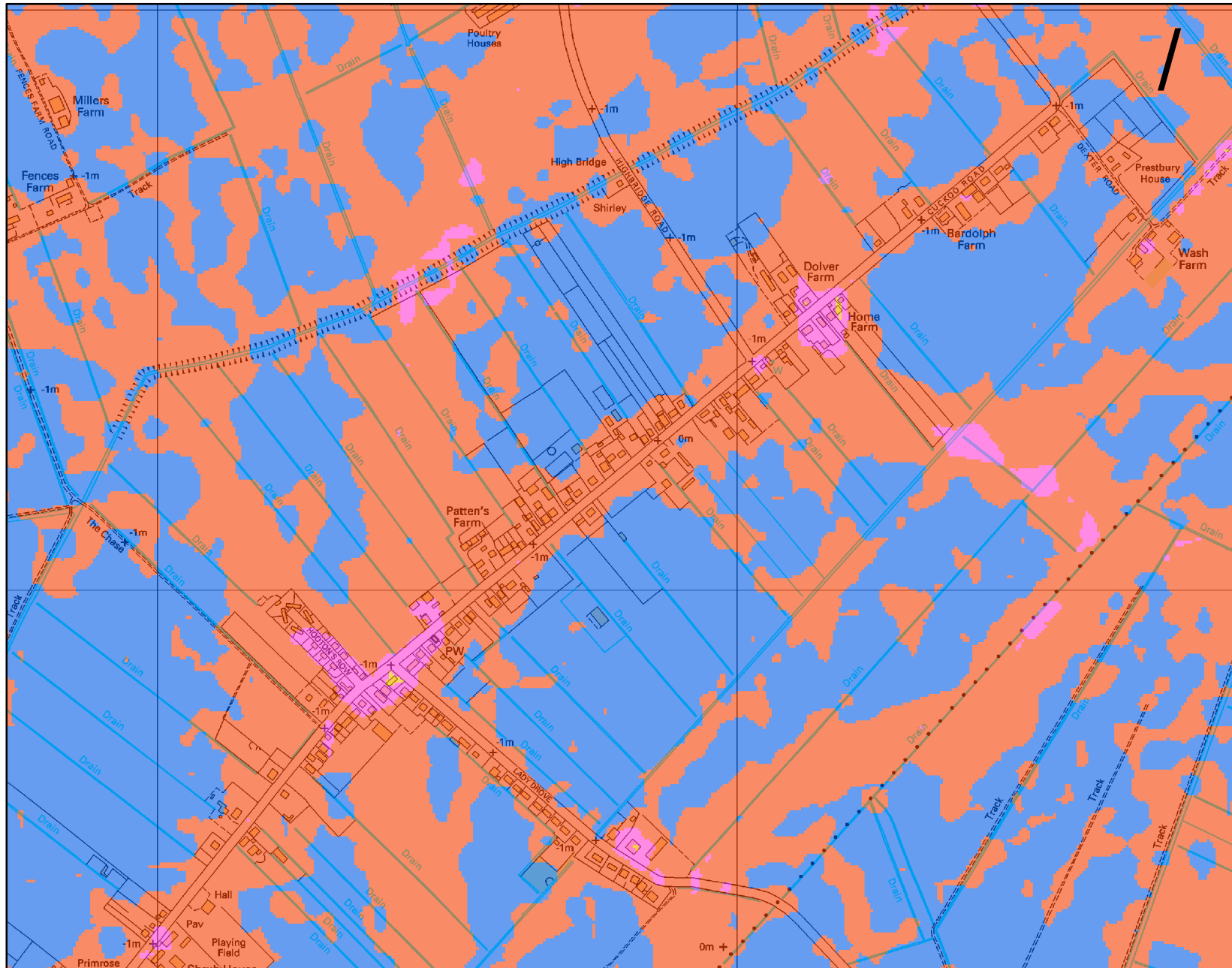
Scale 1:20,000



**Legend**

- ★ Breach locations

**Map Showing the Maximum Flood Depth (combined breach) centred on Barroway Drove, Downham Market. NGR TF 57807 04176. Ref CCC/2015/22697. Created on 30 September 2015.**



Scale 1:10,000

**Legend**

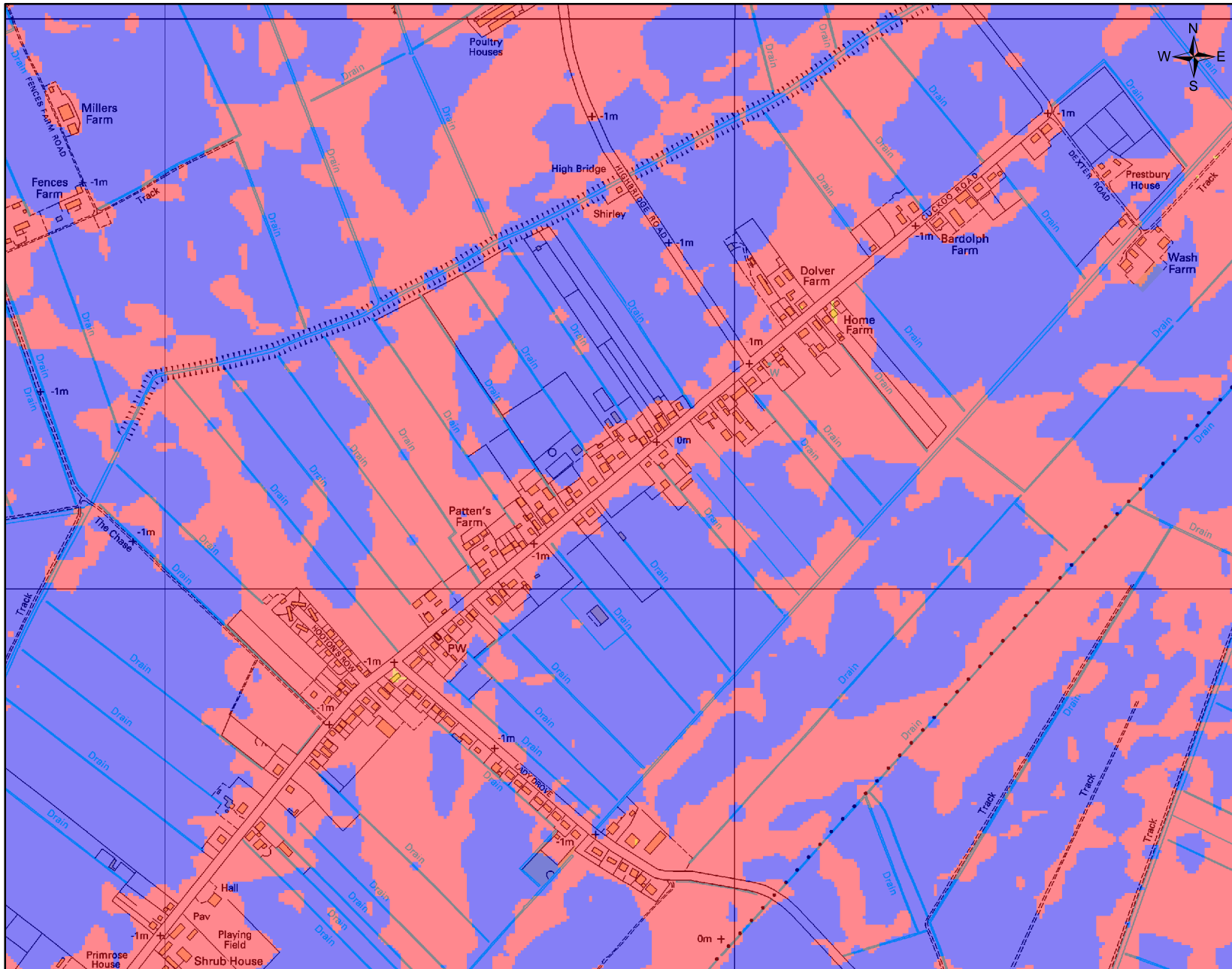
**Max Depth 200CC**

**Metres**



1. 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.
2. The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring.

**Map Showing the Maximum Hazard Rating (combined breach) centred on Barroway Drove, Downham Market. NGR TF 57807 04176. Ref CCC/2015/22697. Created on 30 September 2015.**



Scale 1:10,000

**Legend**

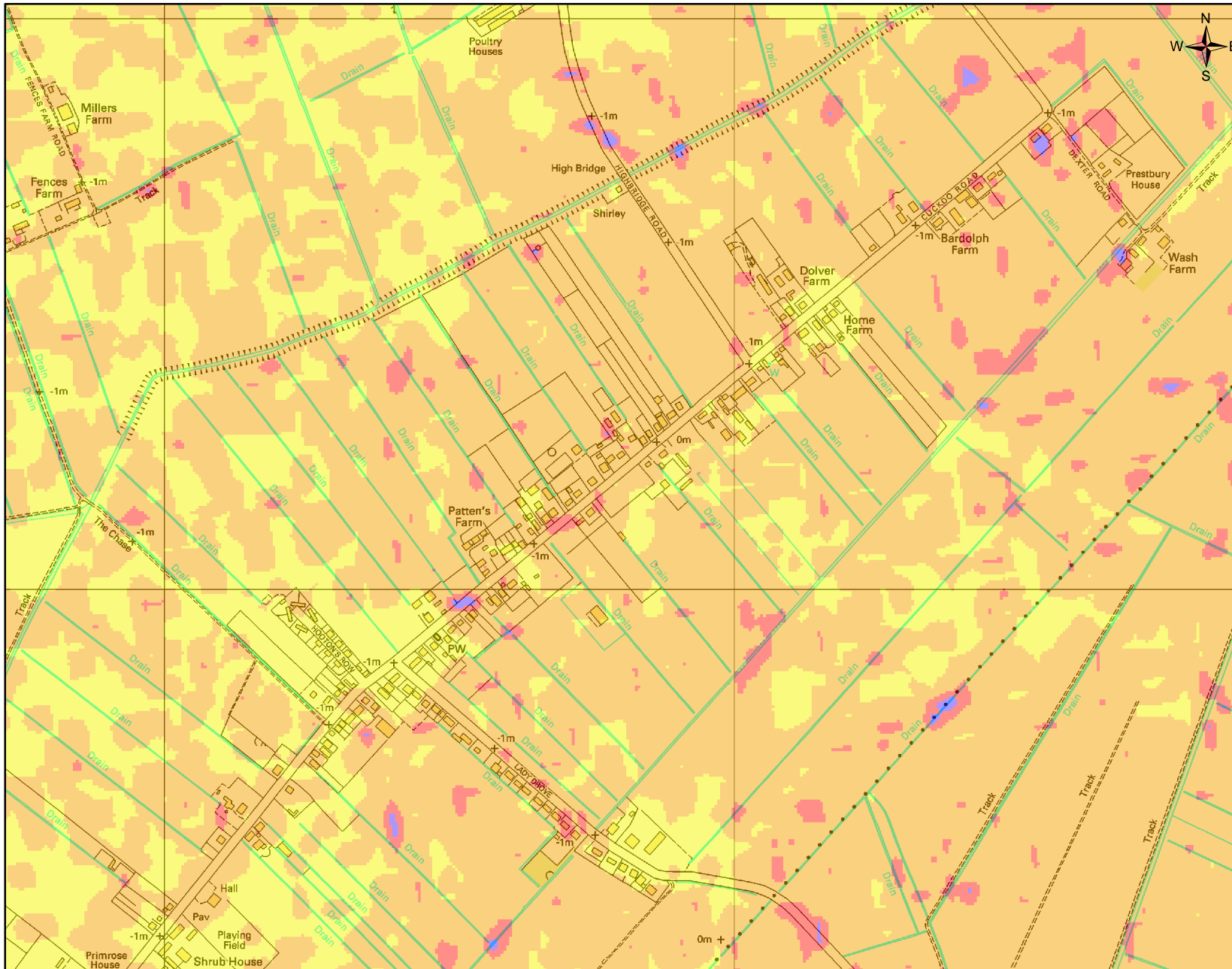
**Max Hazard Rating 200cc**

**Hazard Rating**

- 0 - 0.75 - Very Low Hazard
- 0.75 - 1.25 - Danger to Some
- 1.25 - 2 - Danger to Most
- > 2 - Danger to All

1. 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.
2. 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.
3. The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring.

**Map Showing the Maximum Water Velocity (combined breach) centred on Barroway Drove, Downham Market. NGR TF 61800 18255. Ref CCC/2015/22697. Created on 30 September 2015.**



Scale 1:10,000

**Legend**

**Max Velocity 200cc**

**m/s**



1. 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.
2. The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring.