

Breckland Council Strategic Flood Risk Assessment Level 2 Report – Thetford Town Centre

Final Report
October 2009



Prepared for

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Abbreviations

Acronym	Definition
TAAP	Thetford Area Action Plan
DPD	Development Plan Document
EA	Environment Agency
GIS	Geographical Information Systems
LDF	Local Development Framework
LiDAR	Light Detection and Ranging
LPA	Local Planning Authority
PPS25	Planning Policy Statement 25: Development and Flood Risk
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

Glossary

Acronym	Definition
1D Hydraulic Model	Simulates the flow of water, including water levels, within the river channel.
2D Hydraulic Model	Simulates multi-directional flows, normally used to model the floodplain.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
Flood Zone 1	This zone comprises of land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (0.1%).
Flood Zone 2	This zone comprises land assessed as having between a 1 in 100 year and 1 in 1000 year annual probability of river flooding (1% - 0.1%) or between a 1 in 200 year and a 1 in 1000 year annual probability of sea flooding (0.5% - 0.1%) in any year.
Flood Zone 3a	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.
Flood Zone 3b – Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).
Flood defence	Infrastructure such as floodwalls and embankments used to protect land from flooding. Flood defences are normally designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Fluvial flooding	Flooding by a river or a watercourse.
Local Development Framework (LDF)	The core of the updated planning system (introduced by the Planning and Compulsory Purchase Act 2004). The LDF comprises the Local Development Documents, including the development plan documents that expand on policies and provide greater detail. The development plan includes a core strategy, site allocations and a proposals map.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence.
Sustainable Drainage System	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.

1 Introduction

1.1 Overview

Planning Policy Statement 25: Development and Flood Risk (PPS25)¹ published in December 2006 emphasises the active role Local Planning Authorities (LPAs) have in ensuring flood risk is considered in strategic land use planning. PPS25 encourages LPAs to undertake a Strategic Flood Risk Assessment (SFRA) as part of their evidence base for the Local Development Framework (LDF) process and to use the findings of SFRAs to inform strategic land use planning.

The Level 1 SFRA² for Breckland Council was completed in 2005 and further updated in 2007 to comply with PPS25. The Level 1 report has allowed Breckland Council to determine the variations in flood risk across the entire administrative area for spatial planning purposes and to undertake the Sequential Test as set out in PPS25.

The emerging Thetford Area Action Plan³ (TAAP) identifies proposals for development and regeneration of Thetford Town Centre. The Council are aware of fluvial flooding issues within the town centre, these flooding issues require further investigation before decisions on suitable development sites and development types can be made.

This Level 2 report focuses on Thetford Town Centre and presents the methodology and findings of a flood risk mapping exercise, which has investigated the strategic flood risk associated with the watercourses located within Thetford Town Centre. The Level 2 SFRA mapping is based on outputs from a flood risk mapping exercise of the River Thet and the Little Ouse undertaken for the Environment Agency (EA) in 2006, and additional flood extent outlines produced in 2007, to inform the updated Level 1 SFRA. The Level 2 SFRA mapping provides additional flood depth and hazard mapping to inform the strategic land allocation process.

1.2 Aim of Level 2 SFRA

The aim of this study is to provide supplementary information to the Breckland Level 1 SFRA on flood risk issues specific to Thetford Town Centre. This Level 2 SFRA and accompanying GIS data should be used by Breckland Council in conjunction with the Level 1 SFRA to assess key areas of interest development potential in areas of flood risk.

1.3 Level 2 SFRA Objectives

The aim of this Level 2 SFRA will be achieved through the following objectives:

- Identify the depth of flooding within each area of interest;
- Indicate the flood hazard within each area of interest;
- Advise on potential safe access and egress routes from each area of interest;
- Identify where specific mitigation measures are required;

¹Communities and Local Government (2006) 'Planning Policy Statement 25: Development and Flood Risk', TSO: London.

²Breckland Council (2007) Breckland Strategic Flood Risk Assessment 2007 Update. Prepared by Mott MacDonald.

³Breckland Council (2009) Thetford Area Action Plan February 2009 – Preferred Options.

- Guidance on application of the Exception Test, where required;
- Guidance on residual risk mitigation;
- Guidance on site specific Flood Risk Assessments.

Scott Wilson Ltd are also undertaking the Stage 2 Water Cycle Study for Thetford.

1.4 Level 1 SFRA Critique

The Level 1 SFRA study area covers all the land within the administrative boundary of Breckland Council, which covers an approximate area of 1300 km² (Figure A1). However, the focus of the report is on proposed development areas within the five main settlements within the study area, namely Attleborough, Dereham, Swaffham, Thetford and Watton. These settlements, together with a number of larger villages, have been identified by the LDF as possible areas to accommodate significant growth.

Thetford has also been identified by Central Government as one of the original 29 National Growth Points which have the potential to accommodate 100,000 additional new homes and employment between them.

A considerable amount of data was collected from a number of stakeholders in order to determine the main sources of flooding within the study area. The main stakeholders include Breckland Council, the EA, the Norfolk Rivers and East Harling Internal Drainage Boards, the Highways Agency and Anglian Water. The predominant flood risk throughout the study area is from fluvial sources. However surface water flooding, sewer flooding and flooding due to infrastructure failure are significant within the study area.

The Level 1 SFRA focuses on five development sites in Thetford, to the north and south of the town. Although the flood risk posed to Thetford Town Centre by the River Thet and the Little Ouse River is acknowledged within the Level 1 report, it is not discussed in any detail. Information within the Level 1 SFRA report relevant to Thetford Town Centre is provided below:

- Fluvial flood extents provided by the EA identifying flooding on the River Thet at Thetford in 1947 and 1968;
- Anglian Water has reported the occurrence of sewer flooding in Thetford town centre at Bridges Walk in August 2006.

A flood risk mapping exercise of the River Thet and Little Ouse in Thetford was undertaken for the EA in 2006. A 1D iSIS hydraulic model was constructed to model the 1 in 100 year event, and a further 2D Tuflow model was used to model the 1 in 1000 year event. In addition the 1D model was re-run to produce the 1 in 25 year and the 1 in 100 year with climate change fluvial flood extents. These modelled flood extent outputs were used to inform the Level 1 SFRA 2007 Update report.

The Level 2 SFRA utilises these hydraulic model outputs to generate flood depth and flood depth hazard mapping of Thetford Town Centre to inform the strategic land allocation process. The methodology used to produce the Level 2 flood risk mapping outputs is provided in Chapter 3.

2 Study Area

2.1 Context

The Level 2 SFRA study area focuses on Thetford Town Centre, which has been identified within the TAAP as the preferred option for the location of new retail and leisure development. An overview of the study area is provided Figure A1 and in Diagram 1 below.

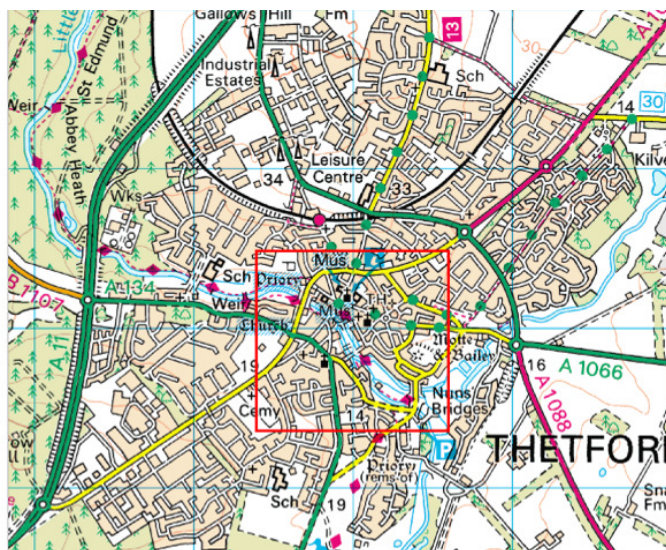


Diagram 1: Overview of study area (taken from Figure A1)

Breckland Council have identified areas of interest within the town centre which require further investigation with regards to flood risk. Figure A2 provides an overview of the areas of interest and the extent of each Flood Zone.

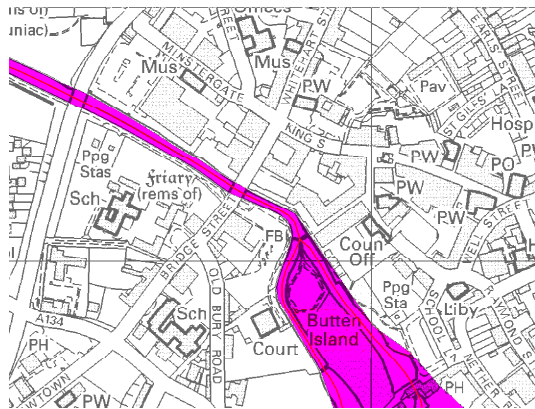
In addition to the provision of new retail and leisure development, the TAAP indicates that development / regeneration proposals should seek to enhance historic and natural assets which exist within the town centre, and allow for ease of access by sustainable modes of transport (e.g. walking and cycling). These additional aspirations have been considered when recommending suitable flood risk mitigation measures within each area of interest.

2.2 Overview of Flood Risk

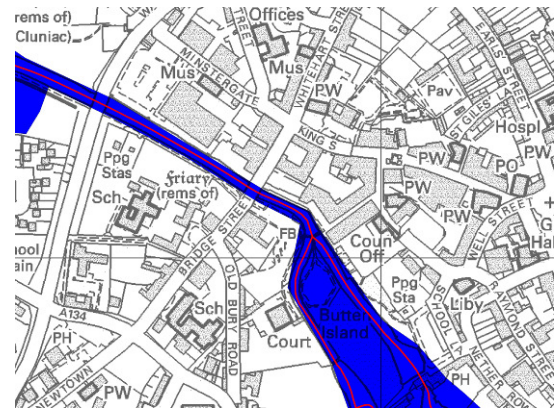
Thetford is located in the south west of Breckland, at the confluence of the River Thet and Little Ouse. The two rivers join in the town centre, before which they run parallel to each other, separated by an area of land, which has many sluice gates and channels allowing the transfer of water between the two rivers. The predominant flood risk to the town is from fluvial sources associated with these two rivers.

As discussed in Section 1.4, the flood risk posed by these two rivers was investigated through a flood risk mapping exercise undertaken for the EA in 2006, with additional flood risk mapping

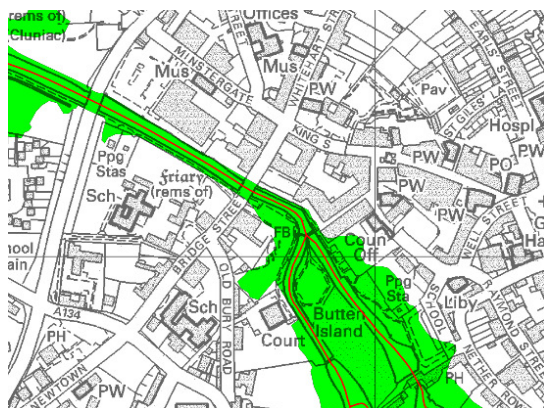
carried out to inform the Level 1 SFRA 2007 Update. The flood extents across Thetford Town Centre for a range of modelled scenarios are provided in the mapping below.



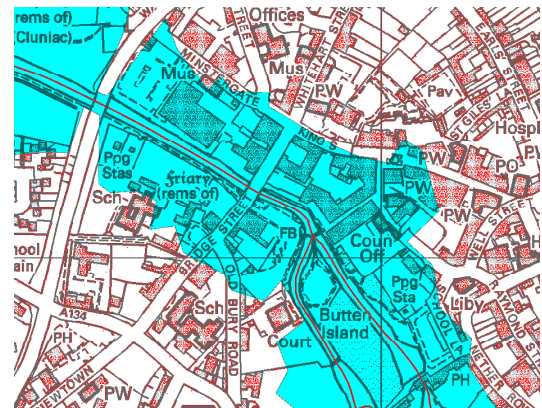
1 in 25 year (functional floodplain) fluvial flood extent



Current 1 in 100 year fluvial flood extent



1 in 100 year with climate change fluvial flood extent



1 in 1000 year fluvial flood extent

This flood risk mapping identifies that the flood extent from the 1 in 25⁴ year and current 1 in 100 year fluvial event remains predominantly within the river channel and therefore does not pose a significant flood risk to the areas of interest identified by Breckland Council. When considering the future 1 in 100 year accounting for climate change and 1 in 1000 year fluvial flood extents, both these scenarios cover a significant area of land within Thetford Town Centre.

Therefore further detailed investigation is required to understand the flood risk posed to these areas of interest, in terms of flood depth and associated hazard. This information is necessary to determine whether development will be safe, without increasing flood risk elsewhere.

2.3 Additional Considerations

The majority of Thetford Town Centre is previously developed land consisting predominantly of impermeable surfaces. The Level 1 SFRA indicates that underlying soils are naturally very

⁴ The 1 in 25 year flood extent was adopted as the Functional Floodplain through agreement between the LPA and EA as per PPS25

permeable within the vicinity of Thetford, allowing most of the rainfall to infiltrate through the ground.

Inspection of the EA Groundwater Source Protection Zones (SPZ)⁵ indicates that Thetford Town Centre is located within Zone 2 (Outer Protection Zone). SPZs are defined to protect areas of groundwater that are used for potable (drinking) supply from potential pollution.

Consideration of SPZs is important when determining the suitability of Sustainable Drainage Systems (SuDS). Depending on the nature of the proposed development, restrictions may be placed on the types of SuDS appropriate for use within the development. The suitability of various SuDS techniques within SPZ is discussed further in Chapter 6, which provides guidance on the preparation of site specific Flood Risk Assessments within the study area.

⁵ The Environment Agency SPZ can currently be found at: <http://www.environment-agency.gov.uk/homeandleisure/37833.aspx>

3 Methodology

3.1 Hydraulic Model Review

Flood risk mapping of the River Thet and Little Ouse has been produced using outputs from existing hydraulic models, to demonstrate the predicted flood extent and depths across each area of interest. This mapping will allow Breckland Council to make informed planning decisions with regard to flood risk.

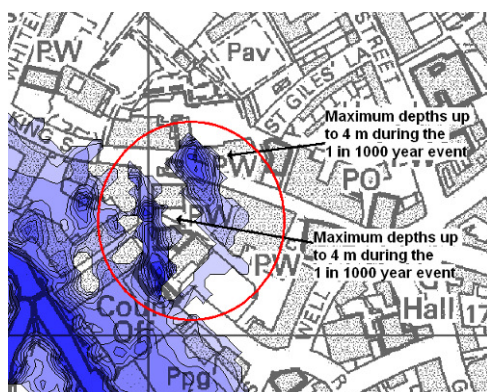
An inspection of peak flows indicates that the 1 in 25 year fluvial event accounting for the anticipated effects of climate change is less than the current 1 in 100 year flows. Therefore, as both the current 1 in 25 year and 1 in 100 year fluvial extents are similar, there will not be any significant difference between the current and future Functional Floodplain extent. Details of the hydraulic models, and the outputs used during the preparation of this Level 2 SFRA report are provided in Table 3-1.

Table 3-1: Existing Hydraulic models used within this Level 2 SFRA

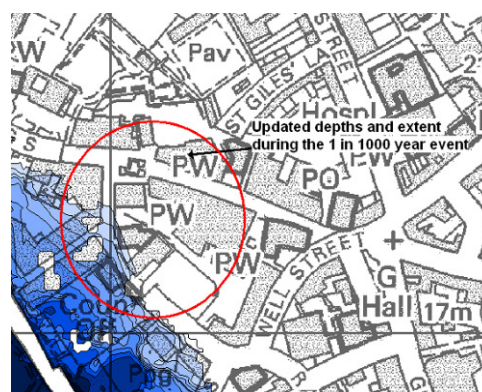
Flood event	Produced by	Modelling software	Model outputs used
1 in 100 year with climate change	Mott MacDonald	iSIS	Flood levels
1 in 1000 year	Halcrow	iSIS/Tuflow	Flood levels and flood depths

The hydraulic model outputs for both the 1 in 100 year with climate change (to 2115) event and the 1 in 1000 year event have been reviewed in consultation with Halcrow and Mott MacDonald, in order to gain a thorough understanding of the flood modelling methodology used, to ensure model outputs are suitable for this focused assessment.

Where erroneous flood extent and depths have been identified, LiDAR⁶ digital elevation data has been used to confirm whether outputs are realistic when compared to the flood extent and depths on neighbouring land at similar ground levels. The mapping extracts shown below provide an example of where the flood depths and extent have been updated following the flood risk mapping review process.



1 in 1000 year fluvial flood extent and depths prior to the Level 2 SFRA review



Updated 1 in 1000 year fluvial flood extent and depths following the Level 2 SFRA review

⁶ LiDAR data provided by the Environment Agency. Tile Reference; D0002617. Date flown: 13 February 1998. LiDAR accuracy +/- 0.25 m throughout the study area.

During the Thetford Town Centre walkover (June 26th 2009) further ground level observations were made at locations where erroneous flood depths had been identified. Photographs taken during the site walkover are provided in Appendix B.

This process was undertaken in liaison with the EA to confirm the approach and methodology used to produce the fluvial flood depths and extents for the 1 in 100 year with climate change event (to 2115) and the 1 in 1000 year fluvial events across each area of interest.

3.2 Flood Risk Mapping

The flood risk mapping showing the fluvial flood extent and flood depths for the modelled scenarios have been derived using the MapInfo GIS platform to generate the results in a diagrammatic form that are provided in Chapter 4 and Appendix C.

- A ground level elevation grid was generated within the GIS entirely from LiDAR digital elevation data (no additional topographic surveying was undertaken during the preparation of the Level 2 SFRA);
- A grid representing the flood levels for each flood event scenario was generated within the GIS using the 'triangulation and smoothing' interpolation method within MapInfo;
- The flood depth grid was produced within the GIS by subtracting the flood level grid from the ground level elevation grid.

The resultant flood depth grid was overlain onto Ordnance Survey 10k Map tiles focusing on the appropriate area of interest, to provide information on:

- Depth and extent of flooding across the area of interest;
- Level of flood depth hazard across the area of interest;
- Safe access and egress routes within and beyond the area of interest.

3.3 Flood Hazard Mapping

A flood hazard map has been produced for each area of interest based on predicted flood depths. Information with respect to depth of flooding and hazard is provided in 'Flood Risk Assessment Guidance for New Developments: Phase 2, FD2320/TR2'⁷. Table 3-2 illustrates the likely hazard to people based on flood depth.

Table 3-2: Existing Hydraulic models used within this Level 2 SFRA

Depth of Flooding*	At Risk
0.30m - 0.50m	Danger for some – includes children, the elderly and the infirmed
0.50m - 1.50m	Danger for most – includes the general public
>1.50m	Danger for all – includes emergency services

* Table 13.1 from 'Flood Risk Assessment Guidance for New Developments: Phase 2, FD2320/TR2'

⁷ <http://www.hydres.co.uk>

The flood hazard categories defined in Table 3-2 have been used to identify safe access and egress routes both inside and beyond the boundary of the new development. Flood depth hazard mapping was undertaken to provide a cost effective, pragmatic approach to assessing the hazard. The reasoning for this decision is outlined below:

Future 1 in 100 year fluvial event

The flood hazard from the future 1 in 100 year with climate change (2115) event based only on depth is predominantly low risk, a flood velocity of greater than 1 m s^{-1} would be necessary before a hazard of danger for some is reached in these areas. When considering the width of the flood extent and the adequate flood warning lead time (minimum of two hours), safe evacuation of the area would be achievable prior to the onset of the flood. Re-running the hydraulic model to derive velocities is unlikely to provide additional information that would benefit the study.

1 in 1000 year fluvial event

The 1 in 1000 year event is extreme and has a low probability of occurring during the development lifetime. The flood hazard associated with the 1 in 1000 year event based only on depth is danger for most / danger for all, re-running the model to include velocity would have little effect on the flood hazard. Where predicted flood depths indicate that there is danger for most / danger for all, assuming zero velocity, the consideration of flood velocities greater than zero will have the following effect:

- Danger for all – Hazard will remain the same;
- Danger for most – Hazard will either remain the same or increase to danger for all.

Velocity has therefore been assumed to be zero and the flood hazard maps are based on depth only.

This approach is appropriate at a strategic level to inform Breckland Council planning decisions. However, where possible, development should be steered away from such areas.

4 Flood Mapping Results

Breckland Council has identified four areas of interest in Thetford Town Centre for the purpose of this Level 2 SFRA. These sites have been grouped into four areas of interest for the purpose of this Level 2 SFRA. This section describes the results of the flood risk mapping exercise covering the areas of interest, which are at risk of varying degrees of fluvial flooding.

A GIS database is provided illustrating the flood zones, flood depth, flood hazard extents and areas of interest. This should be used as the primary source of information generated through this Level 2 SFRA.

The following mapped results are provided for the reader to gain an impression of the fluvial flooding issues within Thetford Town Centre. The maps present the flood depths and associated hazard from the future 1 in 100 year with climate change (2115) and 1 in 1000 year flood events across each area of interest. Mapping showing the full extent of these results across the whole of the study area is provided in Appendix C and the accompanying GIS.

For each area of interest a description of the results is provided, including guidance on the sequential test, safe access and egress and suitable mitigation measures appropriate for the type of development proposed as indicated within the TAAP. Further guidance on suitable mitigation measures and ensuring the development is safe are provided in the Chapter 6 and 7.

Thetford Town Centre: Area of Interest 1		
1 in 100 Year with Climate Change (2115) Fluvial Flood Depth Map	1 in 100 Year with Climate Change (2115) Fluvial Hazard Map	Description of Results
		<p>Sequential Test</p> <p>Area 1 is located predominantly in Flood Zone 2 (Figure A2). As such, in accordance with PPS25 Area 1 is appropriate to accommodate all developments types, with the exception of highly vulnerable uses, where it would be necessary to apply the Exception Test. See PPS25 Table D.2 (Appendix D) for development flood risk vulnerability classifications. Although the Exception Test is unlikely to be required, the criteria for satisfying the PPS25 Exception Test are discussed in Chapter 5.</p> <p>Flood Defences</p> <p>The Level 1 SFRA indicates that there are no formal fluvial defences within Thetford Town Centre. Photographs shown in Appendix B show a natural earth bank along the river in the vicinity of this area. A surface water outfall discharges to the river at this location.</p> <p>Flood Depth and Hazard</p> <p>This area of interest is located outside the future 1 in 100 year fluvial flood extent. Inundation from the current 1 in 1000 year event is extensive with depths across the site ranging from 0.1 m up to 1.3 m. The associated hazard within the 1 in 1000 year event flood extent is predominantly danger for most.</p> <p>Safe Access and Egress</p> <p>Safe access and egress routes should be achievable (on foot and by car) to the north via Minstergate during the future 1 in 100 year fluvial flood event. During the 1 in 1000 year event safe access and egress would be restricted. The EA flood warning service, which covers the area, provides a minimum of two hours warning prior to the onset of a flood event. This would allow adequate time to evacuate the area during both the future 1 in 100 year fluvial event and the current 1 in 1000 year fluvial event. Further information regarding safe access and egress is provided in Chapter 7.</p> <p>Development Limitations</p> <p>This area of interest is currently used for parking (see Appendix B). Development at this location could include retail, leisure, residential and parking facilities. In accordance with PPS25, these types of development are considered appropriate in Flood Zone 2.</p> <p>Recommendations</p> <ul style="list-style-type: none"> • Incorporation of SuDS to ensure flood risk to third parties is not increased. SuDS attenuation techniques should be given priority over infiltration, to ensure groundwater SPZs are protected; • Where underground parking is proposed a site specific FRA should ensure that access points and any venting or other penetrations are situated 300 mm above the 1 in 100 year fluvial flood level when accounting for the anticipated effects of climate change for the life of the development; • A site specific FRA should provide details of flood warning and evacuation plans. Further information regarding site specific FRAs and mitigation options are provided in Chapters 6 and 7.
<p>Maximum Flood Depth (m)</p>	<p>Flood Hazard Classification</p>	
<p>1 in 1000 Year (2009) Fluvial Flood Depth Map</p>	<p>1 in 1000 Year (2009) Fluvial Flood Hazard Map</p>	

Thetford Town Centre: Area of Interest 2											
1 in 100 Year with Climate Change (2115) Fluvial Flood Depth Map	1 in 100 Year with Climate Change (2115) Fluvial Hazard Map	Description of Results									
		<p>Sequential Test</p> <p>Area 2 is located predominantly in Flood Zone 2 with areas located in the future Flood Zone 3a (Figure A2). In accordance with PPS25 Area 2 is appropriate to accommodate all development types, with the exception of highly vulnerable uses, where it is necessary to apply the Exception Test. Flood Zone 3a is appropriate for less vulnerable uses. The Exception Test would be required for more vulnerable and essential infrastructure. See PPS25 Table D.2 (Appendix D) for development flood risk vulnerability classifications. Although the Exception Test is unlikely to be required, the criteria for satisfying the PPS25 Exception Test are discussed in Chapter 5.</p> <p>Flood Defences</p> <p>The Level 1 SFRA indicates that there are no formal fluvial defences within Thetford Town Centre. Photographs shown in Appendix B, taken during the site walkover indicate that the river bank consists of a timber panel structure with concrete crest. A two stage channel is apparent in this location. The upper channel remains dry, except during peak flows, providing public access along the riverside. A number of steps (and also a slope) link this riverside area to the higher ground set back from the river.</p> <p>Flood Depth and Hazard</p> <p>The future 1 in 100 year event is limited to the riverside. Depths up to 0.25 m are experienced with the predominant hazard being low risk.</p> <p>Inundation from the current 1 in 1000 year event is extensive with depths ranging from 0.1 m up to 2 m. The associated hazard within the flood extent is predominantly danger for most with areas located adjacent to the river classified as danger for all.</p>									
<p>Maximum Flood Depth (m)</p>	<p>Flood Hazard Classification</p> <table border="0"> <tr> <td>Low Risk</td> <td>Danger for Some</td> <td>Danger for Most</td> <td>Danger for All</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>	Low Risk	Danger for Some	Danger for Most	Danger for All						
Low Risk	Danger for Some	Danger for Most	Danger for All								
<p>1 in 1000 Year (2009) Fluvial Flood Depth Map</p>	<p>1 in 1000 Year (2009) Fluvial Flood Hazard Map</p>	<p>Safe Access and Egress</p> <p>Safe access and egress routes are achievable (on foot and by car) to the north via Kings Street and White Hart Street during the future 1 in 100 year fluvial flood event. During the 1 in 1000 year event safe access and egress would be restricted. The 1 in 1000 year flood extent in this location has a maximum width of 85 m. The EA flood warning service provides a minimum of two hours warning prior to the onset of a flood event, which should be adequate time to evacuate flood risk areas. Further information regarding safe access and egress is provided in Chapter 7.</p> <p>Development Limitations</p> <p>This area of interest currently consists of leisure and retail development (see Appendix B). Development at this location could include retail, leisure and residential uses. In accordance with PPS25, these types of development are considered appropriate in Flood Zone 2. Although where possible, residential development should be located above less vulnerable development.</p> <p>Recommendations</p> <ul style="list-style-type: none"> • Development should be sequentially located based on flood risk vulnerability classification (PPS25 Table D.2), to areas of lowest risk; • Residential development should be located outside of the future 1 in 100 year extent, and where possible located above less vulnerable development, within Flood Zone 2; • Incorporation of SuDS to ensure flood risk to third parties is not increased. SuDS attenuation techniques should be given priority over infiltration, to ensure groundwater SPZs are protected; • A site specific FRA should provide details of flood warning and evacuation plans. <p>Further information regarding site specific FRAs and mitigation options are provided in Chapters 6 and 7.</p>									

Thetford Town Centre: Area of Interest 3		
1 in 100 Year with Climate Change (2115) Fluvial Flood Depth Map	1 in 100 Year with Climate Change (2115) Fluvial Hazard Map	Description of Results
		<p>Sequential Test</p> <p>Area 3 is located within both Flood Zone 2 and the future Flood Zone 3a (Figure A2). Flood Zone 2 is appropriate for all developments types, with the exception of highly vulnerable uses, where it is necessary to apply the Exception Test. Flood Zone 3a is appropriate for less vulnerable uses. The Exception Test would be required for more vulnerable and essential infrastructure if they were to be located in Area 3. See PPS25 Table D.2 (Appendix D) for development flood risk vulnerability classifications. See Chapter 5 for discussion of PPS25 Exception Test.</p> <p>Flood Defences</p> <p>The Level 1 SFRA indicates that there are no formal fluvial defences within Thetford Town Centre. Photographs shown in Appendix B show a timber structure with concrete crest along some sections of the river bank. Further upstream towards Bridges Walk the river bank consists of a substantial raised masonry wall. These informal defences offer some protection to the adjacent land in the vicinity of Bridges Walk.</p> <p>Flood Depth and Hazard</p> <p>The future 1 in 100 year event outline extends approximately 40 m from the river within this area. Depths up to 1 m with an associated hazard of danger for most are experienced.</p> <p>Inundation from the current 1 in 1000 year event is extensive with depths across this area ranging from 0.1 m up to 2.4 m. The associated hazard within the flood extent is predominantly danger for most – danger for all.</p> <p>Safe Access and Egress</p> <p>Safe access and egress routes should be achievable (on foot and by car) to the east via Tanner Street and School Lane during the future 1 in 100 year event. During the 1 in 1000 year event safe egress would be restricted. The EA flood warning service provides a minimum of two hours warning prior to the onset of a flood event, which should be adequate time to evacuate flood risk areas, during the 1 in 1000 year event. Further information regarding safe access and egress is provided in Chapter 7.</p> <p>Development Limitations</p> <p>This area of interest currently consists of green open space adjacent to the river, with car parking and some private development set back from the river (see Appendix B). Development within this area of interest should retain existing green open space, with major development set back from the river.</p> <p>Recommendations</p> <ul style="list-style-type: none"> • Development should be sequentially located based on flood risk vulnerability classification (PPS25 Table D.2), to areas of lowest risk. Land at high risk adjacent to the river should be retained as existing green open space; • Finished floor levels should be set above the future 1 in 100 year flood level when accounting for the anticipated effects of climate change for the life of the development, including an additional 300 mm freeboard allowance; • More vulnerable development should be located outside of the future 1 in 100 year extent, and where possible located above less vulnerable development, within Flood Zone 2; • Where small-scale less vulnerable development is proposed adjacent to the river, flood resilient construction measures should be adopted; • Incorporation of SuDS to ensure flood risk to third parties is not increased. SuDS attenuation techniques should be given priority over infiltration, to ensure groundwater SPZs are protected; • A site specific FRA should provide details of flood warning and evacuation plans. <p>Further information regarding site specific FRAs and mitigation options are provided in Chapters 6 and 7.</p>
<p>Maximum Flood Depth (m)</p>	<p>Flood Hazard Classification</p>	
<p>1 in 1000 Year (2009) Fluvial Flood Depth Map</p>	<p>1 in 1000 Year (2009) Fluvial Flood Hazard Map</p>	

Thetford Town Centre: Area of Interest 4		
1 in 100 Year with Climate Change (2115) Fluvial Flood Depth Map	1 in 100 Year with Climate Change (2115) Fluvial Hazard Map	Description of Results
		<p>Sequential Test</p> <p>Area 4 is located predominantly in Flood Zone 2 with land also located in the future Flood Zone 3a (Figure A2). Flood Zone 2 is appropriate for all developments types, with the exception of highly vulnerable uses, where it is necessary to apply the Exception Test. Flood Zone 3a is appropriate for less vulnerable uses. The Exception Test is required for more vulnerable uses and essential infrastructure, proposed within Flood Zone 3a. See PPS25 Table D.2 (Appendix D) for development flood risk vulnerability classifications. See Chapter 5 for discussion of PPS25 Exception Test.</p> <p>Flood Defences</p> <p>The Level 1 SFRA indicates that there are no formal fluvial defences within Thetford Town Centre. Photographs shown in Appendix B indicate the presence of informal defences, consisting of concrete and masonry walls (raised in sections) along the river bank.</p> <p>Flood Depth and Hazard</p> <p>Inundation from the future 1 in 100 year event occurs towards the north and east of area 4, adjacent to the river. Depths up to 0.3 m are experienced; the predominant hazard is low risk.</p> <p>The current 1 in 1000 year flood extent covers the majority of area 4 with depths ranging from 0.1 m up to 2 m. The associated hazard within the flood extent is predominantly danger for most – danger for all.</p> <p>Safe Access and Egress</p> <p>Safe access and egress routes should be achievable to the north east via Bridge Street and Old Bury Road during the future 1 in 100 year event. Safe access and egress during the 1 in 1000 year event would be restricted. The 1 in 1000 year flood extent width in this location has a maximum of 90 m. The EA flood warning service provides a minimum of two hours warning prior to the onset of a flood event, which should be adequate time to evacuate flood risk areas. Further information regarding safe access and egress is provided in Chapter 7.</p> <p>Development Limitations</p> <p>Existing development within this area of interest includes the Anchor Hotel. This area is also used as a public car park and Bus Station. Development within this area of interest should retain existing riverside access, with major development set back from the river.</p> <p>Recommendations</p> <ul style="list-style-type: none"> • Development should be sequentially located based on flood risk vulnerability classification (PPS25 Table D.2), to areas of lowest risk. Land at high risk adjacent to the river could become green open space, increasing amenity value and attractiveness of the site; • Finished floor levels should be set above the future 1 in 100 year flood level when accounting for the anticipated effects of climate change for the life of the development, including an additional 300 mm freeboard allowance; • Incorporation of SuDS to ensure flood risk to third parties is not increased. SuDS attenuation techniques should be given priority over infiltration, to ensure groundwater SPZs are protected; • A site specific FRA should provide details of flood warning and evacuation plans. <p>Further information regarding site specific FRAs and mitigation options are provided in Chapters 6 and 7.</p>
<p>Maximum Flood Depth (m)</p>	<p>Flood Hazard Classification</p>	
1 in 1000 Year Fluvial (2009) Flood Depth Map	1 in 1000 Year Fluvial (2009) Flood Hazard Map	

5 Sequential Approach to Site Allocation

The TAAP (Preferred Options) identifies Thetford Town Centre as the main location for new retail and leisure development within the town. Guidance on applying the Sequential Test, when formulating a redevelopment strategy is outlined in paragraphs 4.33 to 4.35 of the PPS25 Practice Guide⁸.

The Exception Test should be applied only after the Sequential Test has been applied and in the circumstances shown in PPS25 Table D.1, when more vulnerable development and essential infrastructure cannot be located in Flood Zone 1 or 2 and highly vulnerable development cannot be located in Flood Zone 1.

5.1 Exception Test

When considering the regeneration proposals for Thetford Town Centre identified within the TAAP (Preferred Options), the Exception Test is only likely to be required for more vulnerable development (residential, hotels and educational establishments) proposed within Flood Zone 3a when accounting for climate change.

PPS25 states that for the Exception Test to be passed, three main criteria must be satisfied in order for the development to be considered acceptable:

- Part A – It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the Development Plan Document (DPD) has reached the ‘submission’ stage – see Figure 4 of PPS12: Local Development Frameworks – the benefits of the development should contribute to the Core Strategy’s Sustainability Appraisal;
- Part B – The development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land;
- Part C - A FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible will reduce the flood risk overall.

The outputs of this Level 2 SFRA can be used by Breckland Council to assess where a development may satisfy Part C of the Exception Test at the strategic level. The presented information can be used by Breckland Council to refine the strategic land allocation process. Clear demonstration of satisfaction of Part C of the Exception Test should be achieved through a robust and thorough site specific FRA prepared in consultation with the local planning authority and EA.

For successful application it is important that the arguments presented for justification through the Exception Test are in line with current policies within the LPA area.

⁸ <http://www.communities.gov.uk/documents/planningandbuilding/pdf/pps25practiceguide.pdf>

6 Site Specific Flood Risk Assessment Guidance

A site specific Flood Risk Assessment (FRA) aims to refine available information and minimise these risks through site design, layout and where required, mitigation. This chapter presents the principle requirements for site specific FRAs for submission with planning applications within the study area.

6.1 Site Specific Flood Risk Assessment Requirements

Once a development/site is considered to be appropriate for a development type, a site specific flood risk assessment will be required to accompany the planning application. As a minimum in the preparation of a site specific flood risk assessment for developments located in a flood risk area the developer and/or their consultant should work in consultation and partnership with the local planning authority and EA to:

- Further refine the definition of flood hazard local to the development site (to account for model inaccuracies);
- Define the flooding frequency/probability for the site;
- Assess the risk to the site from all other flood sources;
- Determine the rate of on-set of flooding for the range of flood events and flood sources the site is subject to;
- Include demonstration of how the site and occupants will be safe for the developments lifetime without exacerbating flood risk elsewhere; and,
- Preparation of a flood emergency plan developed in consultation with the local planning authority and emergency services.

The EA website provides standing advice on the requirement of FRAs for developers and LPAs⁹.

6.2 Site Vulnerability and Site Layout

Breckland Council and developers should use the Level 2 flood risk mapping (Chapter 4 and Appendix C) at the master planning stage to, where possible, sequentially located development based on flood risk vulnerability classification (PPS25 Table D.2, see Appendix D), to areas of lowest risk e.g. residential developments should be restricted to lowest risk areas and parking and open space areas can be placed on lower ground with a higher probability of flooding.

Structures such as (bus, bike) shelters, park benches and refuse bins (and associated storage areas) located in areas with a high flood risk should be flood resilient and be firmly attached to the ground.

⁹ <http://www.environment-agency.gov.uk/research/planning/82584.aspx>

6.3 Finished Floor Levels

Where developing in flood risk areas is unavoidable, the most common method of mitigating flood risk to people is to ensure floor levels are raised above the 1 in 100 year plus climate change flood water level derived for the immediate vicinity within the site (i.e. relative to the extent of a site along a watercourse as flood levels are likely to vary with increasing distance downstream).

An additional freeboard allowance of 300 mm should be included as a precautionary approach to take account of the uncertainty of climate change effects on peak river flows in the future.

It is recommended that internal access is provided to upper floors to provide safe refuge in a flood event (it is appreciated that this may not always be possible where commercial properties are to be located underneath privately owned residential accommodation).

Further consultation with the EA will be required during the undertaking of any detailed site specific FRA. For both less and more vulnerable developments where internal access to higher floors is provided, the associated plans showing this should be included within any site specific FRA.

6.4 Raising Ground Levels

It is potentially possible to raise ground levels within areas of interest 3 and 4 to reduce flood depths to acceptable levels during the future 1 in 100 year event. Ground levels adjacent to the river could be lowered, whereas land set back from the river could be raised. This approach could increase green open space adjacent to the riverside and reduce potential flood risk posed to more developable land set back from the river.

Developers should consult the EA and Breckland Council drainage engineer's when considering feasible flood alleviation options. A site specific FRA would have to demonstrate that raising ground levels or constructing a flood wall would not pose an increased flood risk to the development or to any existing buildings at risk from flooding.

6.4.1 Flood Storage Capacity

The site specific FRA should include calculations to demonstrate the impact that mitigation options have on floodplain storage volumes, and show how the design and layout of the development mitigates any impacts.

An example calculation is provided below, (based on area of interest 4) demonstrates the impact of loss of floodplain storage resulting from raising ground levels above the future 1 in 100 year flood water level:

- Site area located within the future 1 in 100 year flood extent: 0.3 ha;
- Size of flood cell¹⁰ within which the site is located: 13.6 ha;
- Typical flood depth onsite, during the future 1 in 100 year event: 0.25 m.

$$0.25 \times (0.3/13.6) = 0.0055 \text{ m higher}$$

¹⁰ The area of the flood cell, which extends from Nuns' Bridges (upstream extent) to A1075 road bridge (downstream extent) is based on the area of land covered by the future 1 in 100 year flood extent when accounting for the anticipated effects of climate change.

As the increase in flood level is shown to be negligible, compensatory storage should not be necessary. However, a site specific FRA should demonstrate that the development design and layout has been carefully planned to ensure that loss of floodplain storage is minimal. For example, development should be sequentially located by steering less vulnerable development (car park/amenity areas) towards land which experiences most significant flood depths. This would reduce the amount of land raising required, and therefore reduce loss of floodplain storage.

6.5 Surface Water Management

Surface water management arrangements for new developments in the Town Centre should be such that the volumes and peak flow rates of surface water leaving a developed site are no greater than the rates prior to the proposed development, unless specific off-site arrangements are made and result in the same net effect. PPS25 recommends the use of Sustainable Drainage Systems (SuDS) to be incorporated into the development at the design stage. This will ensure that flood risk to third parties is not increased.

Thetford Town Centre is located within a SPZ, an area that recharges existing public water supply wells. The SuDS design will need to prevent possible groundwater contamination within the SPZ, by preventing infiltration of contaminated runoff. Therefore, SuDS attenuation techniques should be used, with a discharge (no greater than the rates prior to the proposed development) to the nearest surface water receptor (River Thet / Little Ouse).

The EA have a duty to protect groundwater resources and should be consulted as early as possible in the planning process to ensure SuDS are appropriate for the development type / location and to ensure space can be provided to accommodate SuDS.

Due to the large roof areas associated with the development type proposed within Thetford Town Centre (retail, leisure, educational) additional attenuation and water capture can be achieved effectively using source control measures such as rainwater harvesting and green roofs. These techniques should not be relied upon as stand alone systems, but should be viewed as additional storage to ensure runoff control.

Further guidance on which SuDS techniques are appropriate under different circumstances is provided in CIRIA publication C697, The SUDS Manual (2007). The legislation and regulation of discharges to groundwater is contained within the EA's Groundwater Protection: Policy and Practice (2007) document.

7 Residual Risk Mitigation

Residual risks are those that remain with flood mitigation measures in place. As previously discussed, none of the areas of interest are located behind defences and therefore are not at risk of flooding through failure or overtopping of formal flood defences.

7.1 Flood Resilience and Resistance Measures

PPS25 Annex E states that where there is a low probability of limited shallow depth water entry, but not severe inundation to buildings, the use of flood-resilient construction may be considered.

Within the design of buildings in areas where the probability of flooding is low or in areas where flood risk management measures have been put in place, guidance has been outlined in paragraphs 6.29 to 6.35 of the PPS25 Practice Guide and by the Department of Communities and local Government in 'Improving the Flood Performance of New Buildings' (May 2007)¹¹.

Flood proofing is a technique by which buildings are designed to withstand the effects of flooding. There are two main categories of flood proofing; dry proofing and wet proofing. Dry proofing methods are designed to keep water out of the building, and wet proofing methods are designed to improve the ability of the property to withstand the effects of flooding once the water has entered the building.

Further guidance is also provided in the CIRIA Research Project 624 'Development and Flood Risk: Guidance for the Construction Industry' (2004). Table 7-1 summarises recommendations made within Table A3.6 of the report for flood proofing measures which can be incorporated within the design of buildings (subject to compliance with Building Regulations).

Table 7-1: Flood Proofing Options

Feature	Considerations To Improve Flood Proofing
External Walls	Careful consideration of materials: use low permeability materials to limit water penetration if dry proofing required. Avoid using timber frame and cavity walls. Consider applying a water resistant coating. Provide fittings for flood boards or other temporary barriers across openings in the walls (dry proofing).
Internal Walls	Avoid use of gypsum plaster and plasterboard; use more flood resistant linings (e.g. hydraulic lime, ceramic tiles). Avoid use of stud partition walls.
Floors	Avoid use of chipboard floors. Use concrete floors with integrated and continuous damp proof membrane and damp proof course. Solid concrete floors are preferable; if a suspended floor is to be used, provide facility for drainage of sub-floor void. Use solid insulation materials.
Fitting, Fixtures and Services	If possible, locate all fittings, fixtures and services above design flood level. Avoid chipboard and MDF. Consider use of removable plastic fittings. Use solid doors treated with waterproof coatings. Avoid using double-glazed window units that may fill with flood water. Use solid wood staircases. Avoid fitted carpets. Locate electrical, gas and telephone equipment and systems above design flood level. Fit anti-flooding devices to drainage systems.

¹¹ <http://www.floodforum.org.uk/improvingfloodresilienceofnewbuildings.pdf>

7.2 Safe Access and Egress

The ability for occupants and users of a development to gain safe access and egress to higher ground outside of the floodplain during a flood event is of primary concern. It is also important to consider whether emergency services will be able to access the development to provide assistance during a flood event.

For less vulnerable development (retail, leisure) it is considered that dry access and egress from the site will be desirable during times of extreme floods. For more vulnerable development (residential, hotel, educational), it is considered that dry access and egress from the will be essential during times of extreme floods from each residential unit to an area outside of the floodplain. New properties within a 'dry island' of the fluvial floodplain will also require dry access due to the disruption to essential services (gas, water, etc.) that would be experienced during a flood event.

It is necessary to ensure that proposed road levels are such that emergency access and egress routes are maintained or where possible constructed to the 1 in 100 year plus an allowance for climate flood level, as a minimum. This can significantly reduce the risk of the proposed development becoming inundated by flooding.

Details of how this will be achieved should be clearly described in site-specific FRAs. This should include:

- Further review of detailed river models;
- Comparison of flood extents/levels with local ground levels from topographical survey or digital elevation models.

The flood risk mapping shown in Chapter 4 and Appendix C has identified that access and egress is possible during the future 1 in 100 year fluvial event, but may be restricted during the 1 in 1000 year fluvial event. A site specific FRA should further investigate the feasibility of safe access and egress routes both within and beyond the proposed development.

7.3 Flood Warning and Evacuation Plans

Fluvial flood risk from the River Thet and Little Ouse is the predominant source of flood risk in Thetford Town Centre. The EA flood warning service monitors rainfall and river levels to forecast the possibility of flooding in the area. The EA aim to provide a minimum of two hours warning prior to the onset of a flood event. Approximate times of travel for flood peaks on the River Thet and Little Ouse provided by the EA¹² during the preparation of this Level 2 SFRA indicate flood warnings for Thetford Town Centre could be up to 20 hours in advance.

The advanced warning provided by the EA indicates that it is feasible for Breckland Council to formulate and implement a Flood Plan. The Flood Plan should set out specific actions based on the level of flood warning. All residents and business should be encouraged to register with the

¹² AFWDO Information Work Guide. Approximate times of travel for flood peaks on the River Thet and Little Ouse. Data is based on 1998, 2000 and 2001, and have a margin of error of at least 20%.

EA Floodline Warnings Direct¹³ (Tel. 0845 988 1188) to receive early alerts of a possible flood event.

The Flood Plan should be prepared in consultation with the EA and Norfolk County Council emergency planning team¹⁴. The plan should also be reviewed at regular intervals to ensure it is based on the most up to date information and still recommends the most appropriate actions.

Site specific Flood Plans should be provided for developments located in areas which are designed to flood, such as ground floor car parking or amenity areas adjacent to the riverside, to ensure site users are safe during a flood event. Flood warning signs highlighting the flood risk and clearly marked flood evacuation routes should be included in the design and layout of the development. A site specific FRA should include details of an adequate maintenance regime to ensure flood warning signs are kept visible and flood evacuations routes are kept clear.

7.4 Sewer Flooding

For all proposed development sites, a site specific FRA should assess the risk posed by sewer flooding in more detail. Mitigation measures such as using sealed manhole covers to prevent potentially contaminated water from overflowing into surrounding land and property should be considered.

The Level 1 SFRA notes that a sewer flooding incident occurred in Thetford Town Centre at Bridges Walk in August 2006 (Figure A2).

¹³ <http://www.environment-agency.gov.uk/homeandleisure/floods/38289.aspx>

¹⁴ <http://www.normit.org/>

8 Policy Guidance

For the purpose of development control, detailed policies will need to be set out by Breckland Council to ensure that flood risk is taken account of appropriately during the planning process. This chapter provides guidance on the preparation of such policies for sites, including requirements and conditions to be considered at the planning stage.

- Breckland Council should adopt the 1 in 100 year event with climate change flood extent (see accompanying GIS layers) as Flood Zone 3a;
- Development should be safe throughout its life, to achieve this dry pedestrian egress and emergency vehicular access should be achievable above the 1 in 100 year flood level, when accounting for the anticipated effects of climate change;
- Where development is proposed within the 1 in 1000 year flood extent, an evacuation plan should be prepared in liaison with the EA and Norfolk County Council emergency planners. The Flood Plan should set out specific actions based on the level of flood warning;
- In accordance with PPS25, development should be sequentially located based on flood risk vulnerability classification (PPS25 Table D.2, see Appendix D), to areas of lowest risk. Opportunities to increase biodiversity and improve amenity value (e.g. pedestrian / cycle routes along the river) should be sought in areas of higher risk adjacent to the river;
- A development should not increase flood risk on site or elsewhere, and where possible, opportunities should be taken to decrease overall flood risk;
- The EA requires compensation (level for level and volume for volume) for loss of floodplain storage in Flood Zone 3a/b. A site specific FRA should demonstrate that loss of floodplain will have no risk on existing third party developments;
- SuDS should be implemented to ensure that runoff from the site (post development) is either to greenfield runoff rates where the site is undeveloped at present or provide betterment, where possible, where the site is previously developed. This should include space set-aside within the confines of the site to accommodate SuDS;
- In the application of SuDS techniques it is recommended that attenuation techniques are given priority, due to Thetford Town Centre being located within a SPZ. In general, infiltration techniques should not be used in areas where the underlying groundwater is considered sensitive;
- Developments should look to incorporate water re-use and minimisation technology for example green roofs and rainwater harvesting. This will aid developments in the adoption of source control SuDS as part of PPS25 requirements;
- Basements should not be used for habitable purposes. Where an underground car park is proposed, it is necessary to ensure that access points and any venting or other penetrations are situated 300 mm above the 1 in 100 year fluvial flood level when accounting for the anticipated effects of climate change for the life of the development;
- The EA requires development to be set-back a distance of 9 m from a watercourse to allow appropriate access for routine maintenance and emergency clearance, if necessary;

- The Environment Agency should be consulted on development involving the carrying out of works or operations in the bed of, or within 20 metres of the top of a bank of, a main river¹⁵;
- Development should not have a detrimental impact on the water environment through changes to water chemistry or resource and this should be ensured through the use of drainage systems which limit the occurrence of pollution to the water environment.

¹⁵ [Introduced by Statutory Instrument 2006 No.2375 "The Town and Country Planning \(General Development Procedure\) \(Amendment\) \(No.2\) \(England\) Order 2006". Available at www.opsi.gov.uk/si/si2006/uksi_20062375_en.pdf](http://www.opsi.gov.uk/si/si2006/uksi_20062375_en.pdf)

9 Discussion and Conclusions

To ensure a holistic approach to flood risk management and make sure that flooding is taken into account at all stages of the planning process, the findings of this report should be incorporated into the emerging LDF for Breckland Council and read in conjunction with the 2008 Level 1 SFRA.

The TAAP (Preferred Options) identifies Thetford Town Centre as the preferred location for new retail and leisure development. This Level 2 report has focused on four areas of interest within Thetford Town Centre, which have been identified as requiring further investigation in terms of flood risk.

Flood risk maps have been produced for the future 1 in 100 year climate change (to year 2115) fluvial event and the current 1 in 1000 year fluvial event, which pose a flood risk to the town centre. The flood risk maps indicate flood extent and depths across each area of interest to allow Breckland Council to make informed planning decisions with regard to flood risk.

- Area 1 – Predominantly located within Flood Zone 2. Appropriate development types in this area could include retail, leisure, residential and parking facilities. In accordance with PPS25, these types of development are considered appropriate in Flood Zone 2.
- Area 2 – Predominantly located within Flood Zone 2 with small areas located within future Flood Zone 3a. Appropriate development types in this area could include retail, leisure and residential uses. Where proposed, it is recommended that more vulnerable development such as residential and hotel development types should be located outside the future 1 in 100 year event flood extent. If more vulnerable development is proposed in Flood Zone 2 it should be located above less vulnerable development where possible;
- Area 3 – Located both within Flood Zone 2 and future Flood Zone 3a. Where proposed, development in this area should be sequentially located to retain existing green open space, adjacent to the river, with major development set back. The same development principles should be used in this area as those stated above for area 2. However where small-scale less vulnerable development is proposed, such as a riverside café within the future Flood Zone 3a a site specific FRA should include flood resilient construction measures to ensure the development is safe;
- Area 4 – Predominantly located within Flood Zone 2 with land also located within Flood Zone 3a. Appropriate development types in this area could include retail, leisure, residential and parking facilities. It is recommended that the development layout should be sequentially located. Land at high risk adjacent to the river should be used as green open space and parking, with development set back from the river. Finished floor levels for more vulnerable development should be set above the future 1 in 100 year event fluvial flood water level plus a 300 mm freeboard allowance. Raising ground levels, within this area of interest may also be an option to reduce flood risk to acceptable levels. A site specific FRA should demonstrate that any loss of floodplain storage does not pose an increased flood risk to the development or to third parties.

The Exception Test is only likely to be required for more vulnerable development (residential, hotels and educational establishments) proposed within Flood Zone 3a when accounting for climate change.

Development proposed within each area of interest will require a detailed site specific FRA at the planning application stage to investigate the flood risk issues identified within this Level 2 SFRA. It is recommended that if underground parking is proposed within the areas of interest identified a site specific FRA should ensure that access points and any venting or other penetrations are situated 300 mm above the future 1 in 100 year (2115) fluvial flood event.

It should be noted that the statements made in this report are based on the best available data at the time of writing and therefore further study prior to allocation may be beneficial to confirm the viability of potential development.

9.1 Maintenance and Update

SFRAs should be considered as 'live' documents where regular review and monitoring should be undertaken to ensure that the best available data on flood risk issues is being used to inform Breckland Council planning decisions.

It is recommended that an Environment Agency data request is undertaken on an annual basis to identify additional flooding information (from all flood sources) and flood risk management information (e.g. new flood alleviation schemes, or flood warning advice).

It is recommended that during the Annual Monitoring Report process, a review of existing Planning Policy Statements or associated guidance is undertaken to identify where significant updates may require significant revision of the SFRA.

In addition, it is also recommended that a data request to Anglian Water is undertaken on an annual basis to identify additional information on sewer flooding from their DG5 register. This may identify where either new issues have been identified or known issues have been resolved.

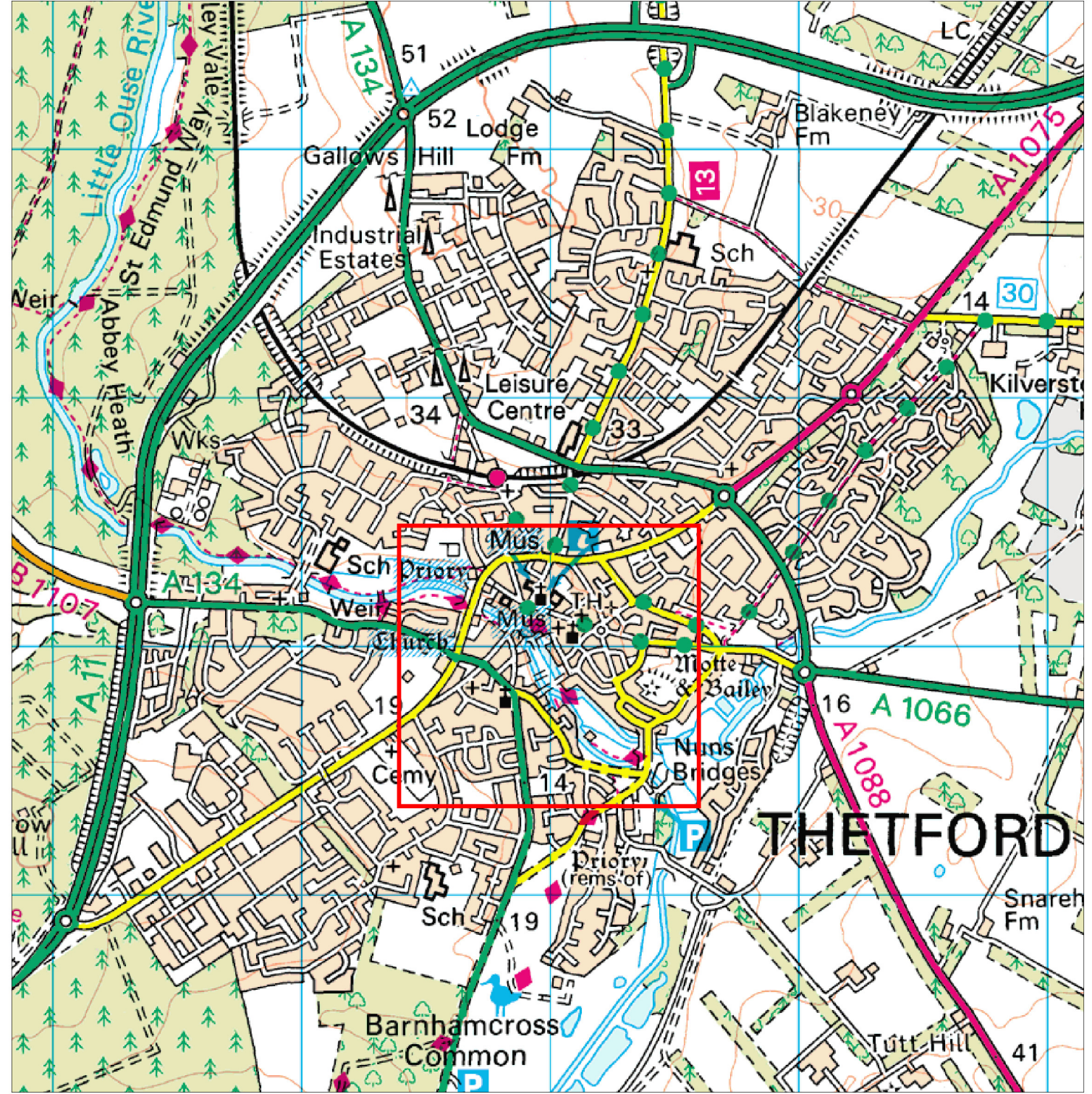
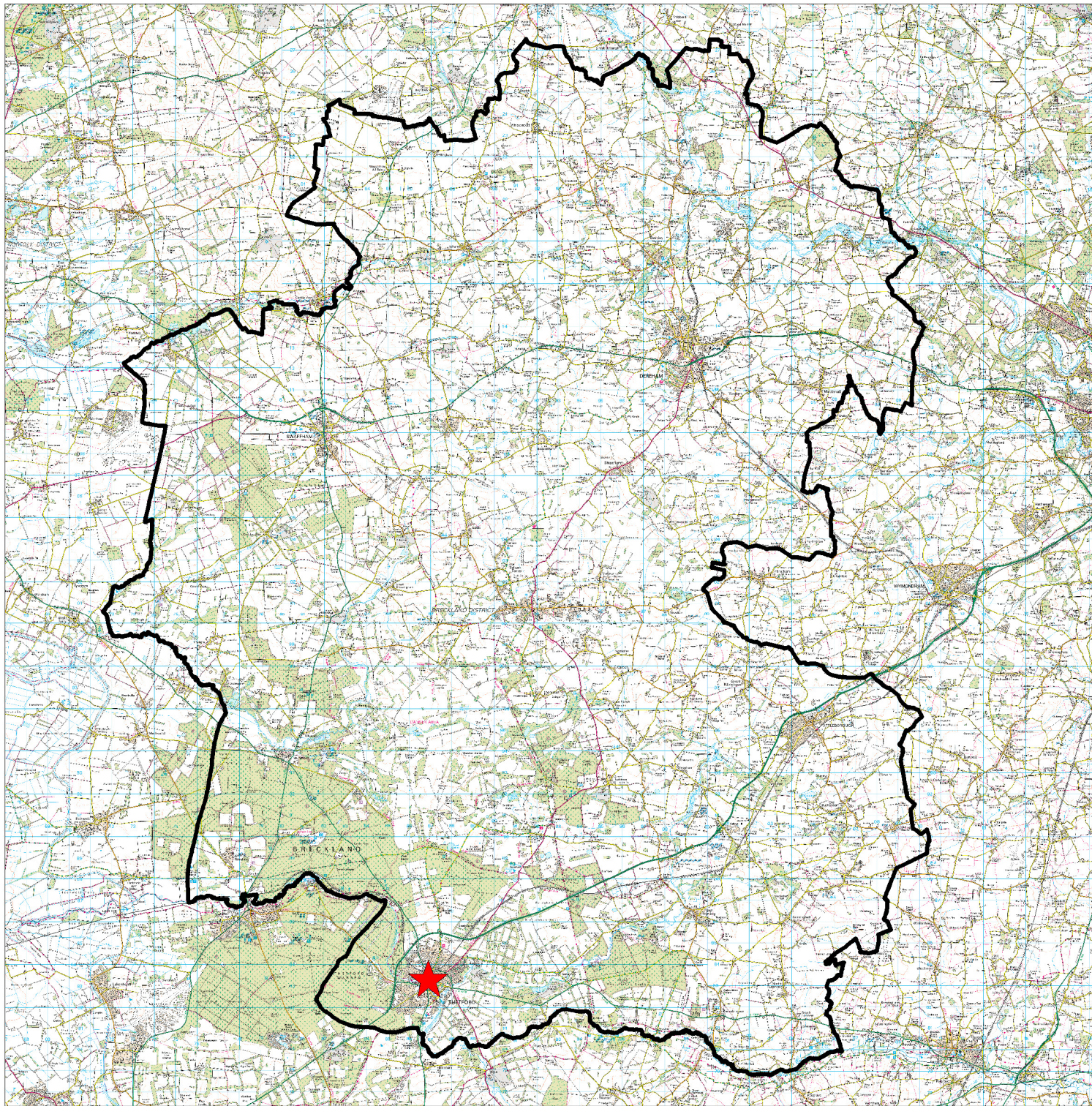
10 References




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- Breckland Council (2009) Thetford Area Action Plan February 2009 – Preferred Options;
- Environment Agency (2007) Groundwater Protection: Policy and Practice;
- CIRIA Publication C697 (2007) The SUDS Manual;
- CIRIA Research Project 624 (2004) Development and Flood Risk: Guidance for the Construction Industry;
- Department for Communities and Local Government (2006) Planning Policy Statement 25: Development and Flood Risk (PPS25), The Stationary Office, London;
- Department for Communities and Local Government (2008) Planning Policy Statement 25: Development and Flood Risk Practice Guide, Communities and Local Government Publications, Wetherby;
- Department for Environment Food and Rural Affairs (2005) Flood Risk Assessment Guidance for New Developments: Phase 2, R & D Technical Report FD2320/TR2;
- Department for Communities and Local Government (2007) Improving the Flood Performance of New Buildings, May 2007.

Appendices

Appendix A

Study Area Overview Maps



	District Boundary		Study Area
	Thetford		

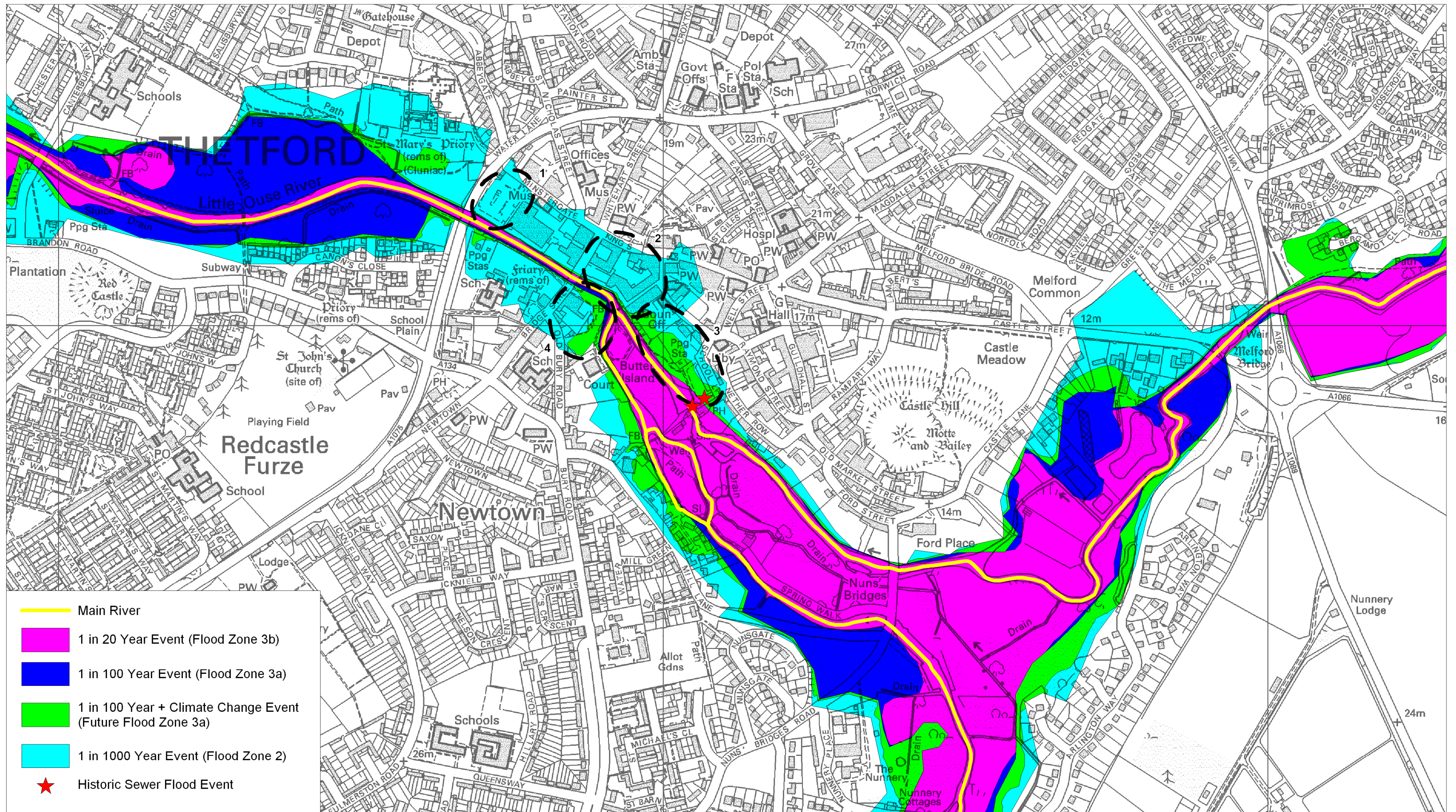
Project:
Breckland Council Level 2 Strategic Flood Risk Assessment

Title:
District and Study Area Overview

Figure A1				
Scale at A3: 1:22,000				
Drw	MJC	App	RJS	Rev 0002
Chk	RJS	Date	06/07/09	Date 12/10/09



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Project:

Breckland Council Level 2 Strategic Flood Risk Assessment

Title:

Overview of Thetford Town Centre Areas of Interest and Flood Risk

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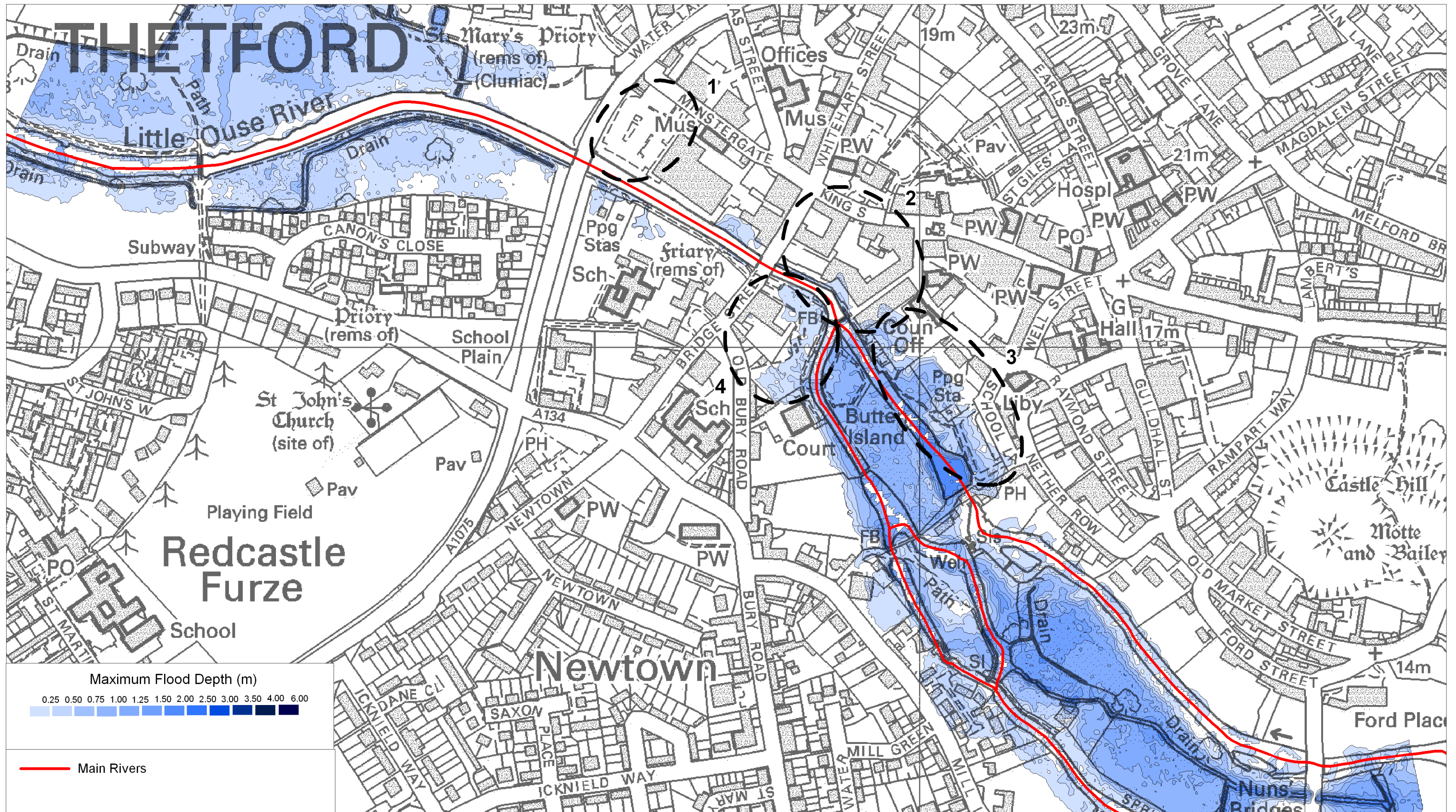
Figure A2

Scale at A3: 1:6,000

Drw	MJC	App	RJS	Rev	0002
Chk	RJS	Date	04/06/09	Date	12/10/09



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Project: **Breckland Council Level 2 Strategic Flood Risk Assessment**

Title: **Thetford Town Centre: 1 in 100 Year with Climate Change (2115) Fluvial Flood Depth Map**

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Figure C1

Scale at A3: 1:3,500

Drw	MJC	App	RJS	Rev	0002
Chk	RJS	Date	25/06/09	Date	15/10/09



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Appendix B

Site Walkover Photographs

Area of Interest 1



Photo 1: Looking north west into supermarket car park, from Minstergate.



Photo 2: Looking north east into supermarket car park, from riverbank.



Photo 3: Standing on left bank, looking across the river to existing supermarket car park. Surface water outfall is located along the river bank at this location.



Photo 4: Standing on left bank, looking downstream towards the A1075 Road Bridge. Supermarket car park located on right bank upstream of road bridge.

Area of Interest 2



Photo 5: Looking south west down Bridge Street towards the river.



Photo 6: Standing on the left bank looking across the river. Two stage channel is apparent along the riverside providing pedestrian access. Private car park and hotel is located beyond.



Photo 7: Standing on left bank looking towards existing shopping precinct. Two stage channel is again apparent. Man-made river bank consists of timber structure with concrete crest.



Photo 8: Standing on foot bridge, looking east, towards the existing shopping precinct.



Photo 9: Standing on right bank, looking north towards foot bridge, with shopping precinct on right. The two stage channel continues in this location, providing pedestrian access along the riverside.



Photo 10: A number of surface water outfall pipes are situated along the riverside within this area of interest.

Area of Interest 3



Photo 11: Looking upstream of the river, towards area of interest 3. The upstream limit of the two stage channel is shown in the foreground. Beyond is green open space with car parking set back from the river.



Photo 12: Man-made river bank consists of timber structure with concrete crest. Green open space adjacent to the river bank currently provides pedestrian access along the river.



Photo 13: Green open space along the riverside with small-scale food and drink establishments.



Photo 14: Standing on bridge along Bridges Walk, looking downstream towards area of interest 3.



Photo 15: Standing within area of interest 3, looking upstream towards Bridges Walk. Raised masonry wall offers protection to adjacent land.



Photo 16: Looking down School Lane from Tanner Street. Tanner Street and School Lane provide egress routes from area 3.

Area of Interest 4



Photo 17: Standing on Bridge Street, looking south towards the Anchor Hotel.



Photo 18: Standing on foot bridge, looking north west towards existing car park. Man-made concrete wall exists along the river bank (raised in sections).



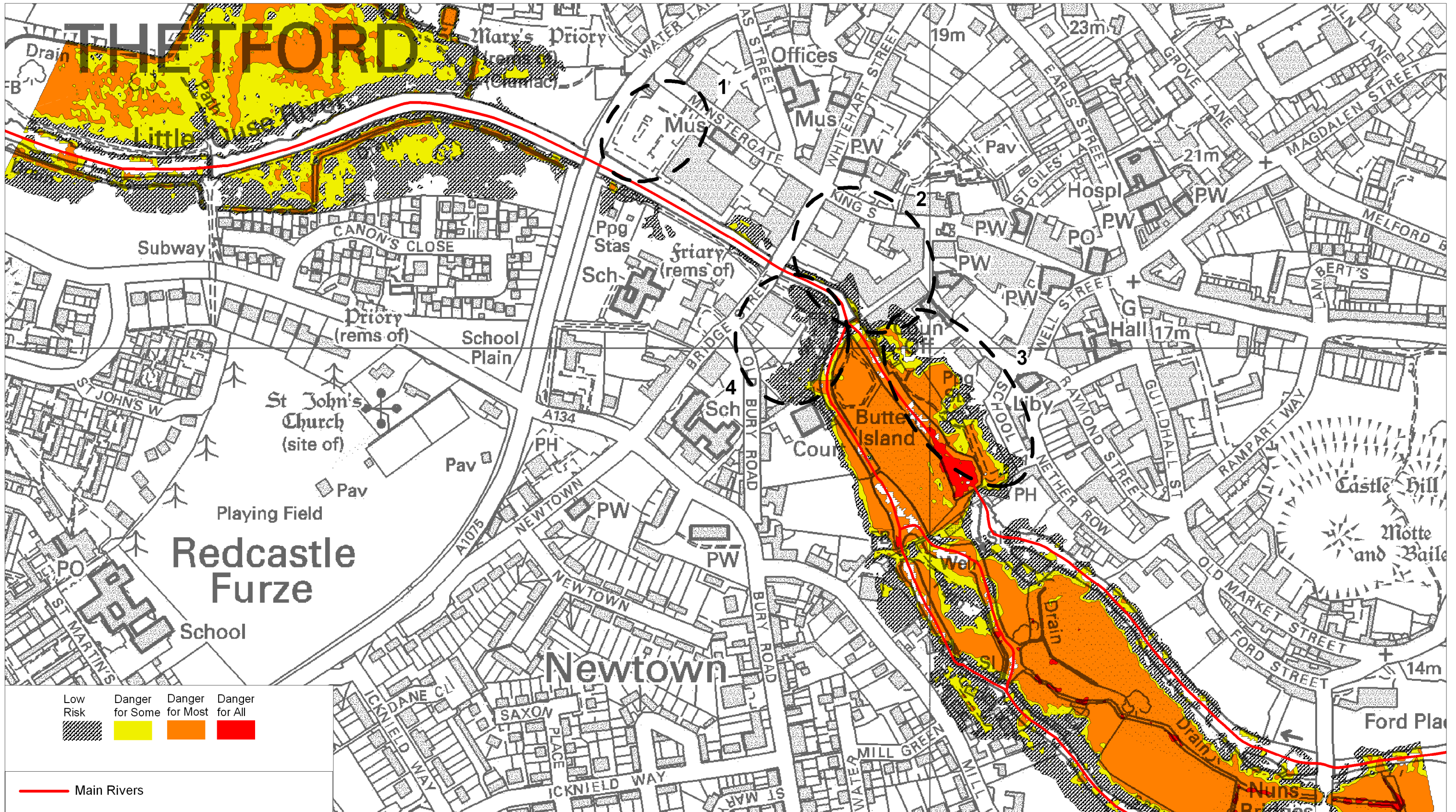
Photo 19: Standing on foot bridge, looking upstream of river. Man-made masonry wall with raised concrete wall sections exist along the river bank.



Photo 20: Standing within area 4, looking south west, towards Bridge Street. Bridge Street provides an egress route from area 4.

Appendix C

Flood Risk Mapping Outputs



Project: **Breckland Council Level 2 Strategic Flood Risk Assessment**

Title: **Thetford Town Centre: 1 in 100 Year with Climate Change (2115) Fluvial Flood Depth Hazard Map**

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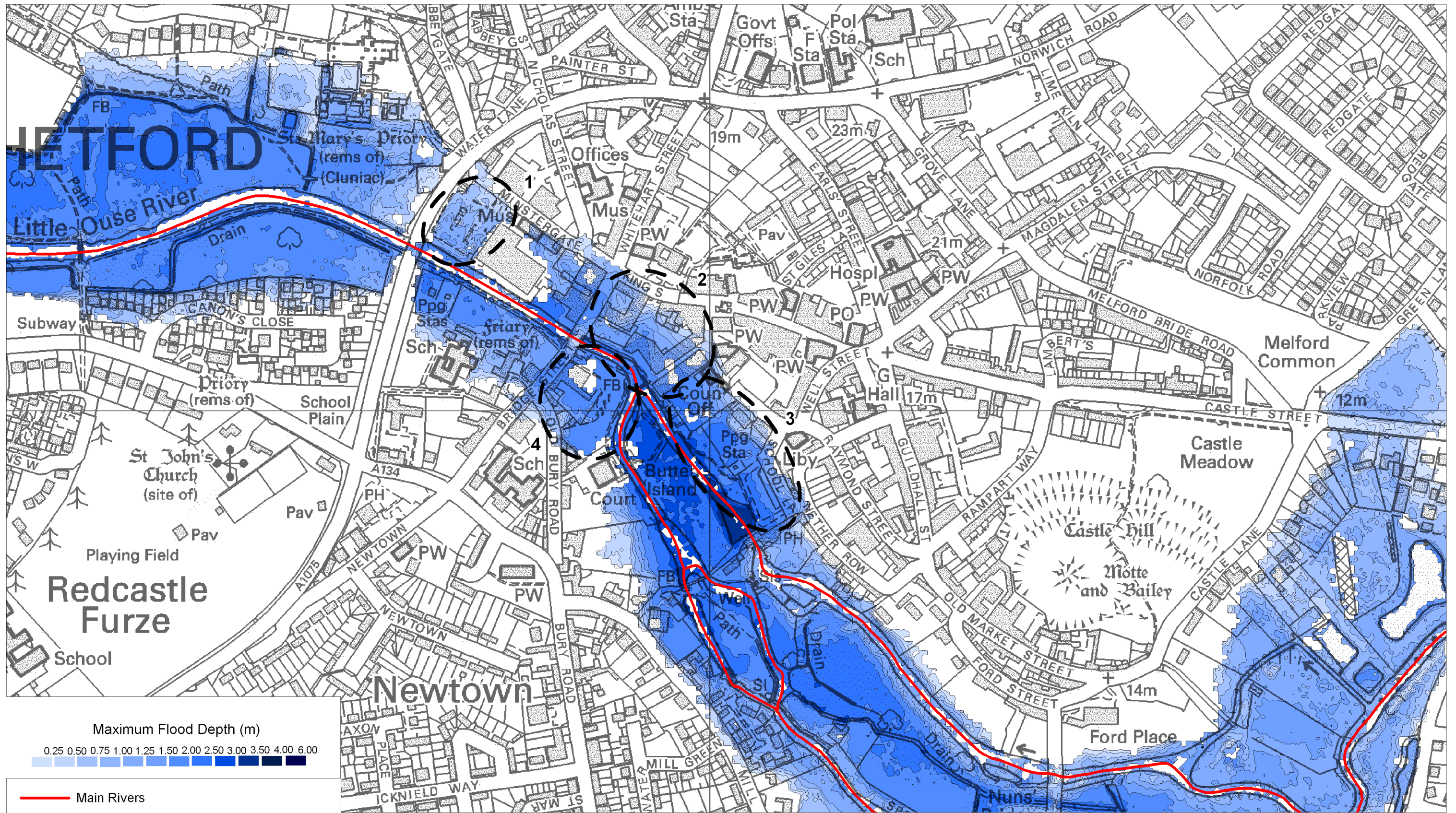
Figure C2

Scale at A3: 1:3,500

Drw	MJC	App	RJS	Rev	0002
Chk	RJS	Date	25/06/09	Date	15/10/09



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Title: **Thetford Town Centre: 1 in 1000 Year (2009) Fluvial Flood Depth Map**

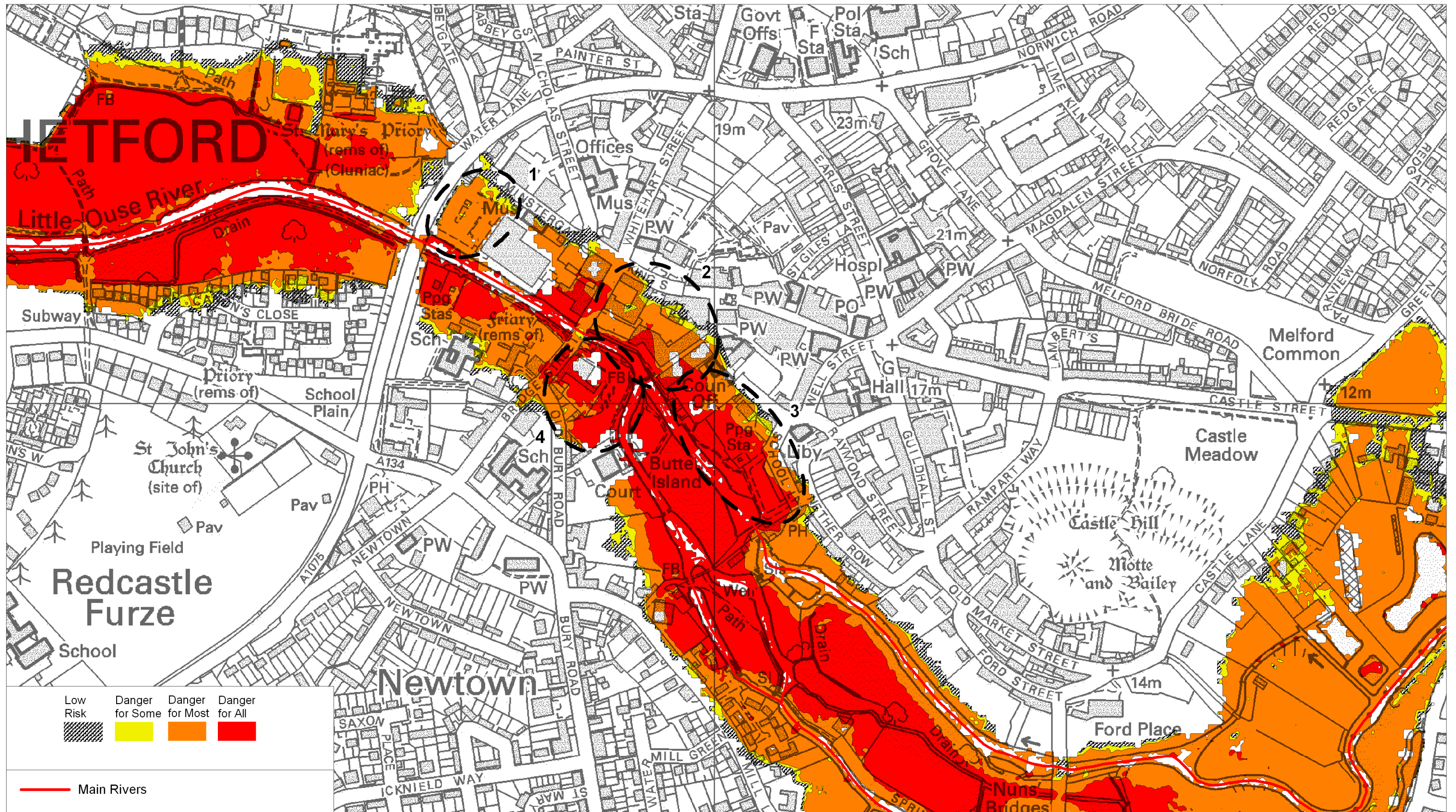
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Figure C3				
Scale at A3: 1:4,000				
Drw	MJC	App	RJS	Rev 0002
Chk	RJS	Date	29/06/09	Date 12/10/09



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Title: **Thetford Town Centre: 1 in 1000 Year (2009) Fluvial Flood Depth Hazard Map**

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Figure C4				
Scale at A3: 1:4,000				
Drw	MJC	App	RJS	Rev 0002
Chk	RJS	Date	29/06/09	Date 12/10/09



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Appendix D

Table D.2: PPS25 Flood Risk Vulnerability Classification

Table D.2: PPS25 Flood Risk Vulnerability Classification

Essential Infrastructure	<ul style="list-style-type: none"> • Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk, and strategic utility infrastructure, including electricity generating power stations and grid and primary substations.
Highly Vulnerable	<ul style="list-style-type: none"> • Police stations, Ambulance stations and Fire stations and Command Centres and telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings. • Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.
More Vulnerable	<ul style="list-style-type: none"> • Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls or 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. • Site used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	<ul style="list-style-type: none"> • Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non-residential institutions not included in 'more vulnerable'; and assemble and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants. • Sewage treatment plants (if adequate pollution control measures are in place).
Water-compatible Development	<ul style="list-style-type: none"> • Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations.

Water-compatible Development	<ul style="list-style-type: none">• Sand and gravel workings.• Docks, marinas and wharves.• Navigation facilities.• MOD defence installations.• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.• Water-based recreation (excluding sleeping accommodation).• Lifeguard and coastguard stations.• Amenity open space, nature conservations and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.• Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.
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