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Breckland District Council Level 1 Strategic Flood Risk Assessment Update

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List of Acronyms

ABD	Areas Benefiting from Defences
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
AIMS	Asset Information Management System
AWS	Anglian Water Services
BGS	British Geological Survey
CFMP	Catchment Flood Management Plan
CC	County Council
DC	District Council
Defra	Department for Environment, Flood and Rural Affairs
DRN	Detailed River Network
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FWMA	Flood and Water Management Act 2010
IDB	Internal Drainage Board
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
LRF	Local Resilience Forum
NPPF	National Planning Policy Framework
RBD	River Basin District
PPG	Planning Policy Guidance
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
uFMfSW	Updated Flood Map for Surface Water
WCS	Water Cycle Study
WLMA	Water Level Management Alliance

Glossary of Terms

Glossary	Definition
Annual exceedance probability (AEP)	Chance of occurrence in any one year, expressed as a percentage. For example, a 1% annual probability event has a 1 in 100 chance of occurring in any given year.
Areas Benefitting from Defences (ABD)	Hatched areas on the Environment Agency Flood Map for Planning (Rivers and Sea) behind flood defences, which, if the flood defences were not present, would flood, in the event of a river flood with a 1 % (1 in 100) chance of happening each year, or a flood from the sea with a 0.5 % (1 in 200) chance of happening each year.
Asset Information Management System (AIMS)	Environment Agency management system of assets associated with main rivers including defences, structures and channel types. Information regarding location, standard of service, dimensions and condition.
Aquifer	A source of groundwater comprising water bearing rock, sand or gravel capable of yielding significant quantities of water.
Catchment Flood Management Plan (CFMP)	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Civil Contingencies Act	This Act delivers a single framework for civil protection in the UK. As part of the Act, Local Resilience Forums must put into place emergency plans for a range of circumstances, including flooding.
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions. For fluvial events a 20% increase in river flow is applied and for rainfall events, a 30% increase. These climate change values are based upon information within the NPPF and Planning Practice Guidance (PPG).
Culvert	A channel or pipe that carries water below the level of the ground.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Exception Test	A method set out in the NPPF to help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. The two parts to the Test require proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.
Flood and Water Management Act (FWMA)	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 Floods; the aim of which is to clarify the legislative framework for managing local flood risk (flooding from surface water, groundwater and ordinary watercourses) in England.
Flood Defence	Infrastructure used to protect an area against flooding such as floodwalls and embankments.
Resilience measures	Measures designed to reduce the impact of water that enters property and businesses and to promote fast drying and easy cleaning; for example raising electrical appliances, installing tiled flooring.
Resistance measures	Measures to prevent flood water entering a building or damaging its fabric, for example the use of flood guards. This has the same meaning as flood proofing.
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption).
Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood Zone	Areas defined by the probability of river and sea flooding, ignoring the presence of defences. Flood Zones are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea), available on the Environment Agency's web site.
Fluvial	Relating to the actions, processes and behaviour of a watercourse (river or stream).
Freeboard	The height of a flood defence crest level (or building level) above a particular design flood level.
Functional Floodplain	Land where water has to flow or be stored in times of flood. It is defined by LPAs within SFRAs. Functional floodplain (also referred to as Flood Zone 3b) is not separately

	distinguished from Zone 3a on the Environment Agency Flood Map for Planning.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Lead Local Flood Authority (LLFA)	As defined by the Flood and Water Management Act, in relation to an area in England, this means the unitary authority or where there is no unitary authority, the county council for the area. In this case, Norfolk County Council.
Local Planning Authority (LPA)	Body that is responsible for controlling planning and development through the planning system.
Main river	Watercourse defined on a 'main river map' designated by Defra. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for main rivers. However overall responsibility for maintenance lies with the riparian owner.
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
National Planning Policy Framework (NPPF)	The National Planning Policy Framework was published on 27 March 2012. It is a framework which sets out the Government's planning policies for England and how these are expected to be applied.
Ordinary watercourse	A watercourse that does not form part of a main river. This includes "all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows" according to the Land Drainage Act 1991.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Risk	Risk is a factor of the probability or likelihood of an event occurring multiplied by consequence: Risk = Probability x Consequence. It is also referred to in this report in a more general sense.
Sequential Test	An approach to future site planning whereby new development is directed towards areas with the lowest probability of flooding before consideration of higher risk areas. The Sequential Test helps ensure that development can be safely and sustainably delivered and developers do not waste their time promoting proposals which are inappropriate on flood risk grounds.
Sewer Flooding	Flooding caused by a blockage or overflowing of a sewer or urban drainage system.
Surface Water	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.
Surface Water Management Plan (SWMP)	A plan which outlines the preferred surface water management strategy in a given location. In this context surface water flooding describes flooding from sewers, drains, groundwater and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall.
Sustainable drainage systems (SuDS)	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Topographic survey	A survey of ground levels.

1 Introduction

1.1 Terms of Reference

AECOM has been commissioned by Breckland District Council (DC) to review and update the Level 1 Strategic Flood Risk Assessment (SFRA) and Water Cycle Study (WCS) for its administrative area. This Report comprises the updated Level 1 SFRA Report.

1.2 Project Background

The National Planning Policy Framework[1] (NPPF) and associated Planning Practice Guidance for Flood Risk and Coastal Change (PPG)[2] emphasise the active role Local Planning Authorities (LPAs) should take to ensure that flood risk is understood and managed effectively and sustainably throughout all stages of the planning process. The NPPF outlines that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and LPAs should use the findings to inform strategic land use planning.

In June 2005 Mott MacDonald Consultants prepared a SFRA for Breckland District Council based on the current planning policy at the time. An updated SFRA[3] was subsequently prepared in 2007 following the replacement of the Planning Policy Guidance 25 (PPG25) with Planning Policy Statement 25 (PPS25) by Central Government in 2006. In 2009 a separate Level 2 SFRA for Thetford Town Centre[4] was commissioned to inform the development of the Thetford Area Action Plan.

Since the preparation of these reports there have been a number of further changes in legislation and guidance relating to planning and flood risk. The introduction of the Localism Act in 2011 was intended to create a planning system oriented around consideration of local planning issues. Planning Policy Statements (PPS), covering all aspects of national planning policy have since been replaced by the NPPF. The accompanying technical guidance document relating to flood risk, originally derived from the PPS documents has also been recently replaced by the Planning Practice Guidance (PPG). Furthermore, the wider planning system has been subject to considerable change since 2008 with the withdrawal of the previous regional planning framework and the revocation of Regional Spatial Strategies in 2010.

The Flood and Water Management Act (FWMA) attained royal assent in 2010, with the intention of enabling the provision of more effective flood management following the flooding of July 2007. As such, Norfolk County Council (CC) is designated a Lead Local Flood Authority (LLFA) and has significant duties and powers in relation to flooding from local sources across Breckland, specifically surface water, groundwater and ordinary watercourses. The Environment Agency retains responsibility for leading and coordinating the management of flood risk associated with main rivers and the sea.

As well as legislative and planning policy changes, a number of new and revised datasets have been made available since the release of the previous Level 1 SFRA. Environment Agency flood risk mapping has been revised for the main river watercourses in Breckland and updated national surface water flood risk mapping has been released by the Environment Agency for use by LPAs in SFRAs.

The purpose of the Level 1 SFRA Update is to collate and analyse the most up to date readily available flood risk information for all sources of flooding, to provide an overview of flood risk issues across the district. This will be used by Breckland DC to inform the preparation of Local Plans, including the application of the Sequential Test to future site allocations. It is also intended that the revised Level 1 SFRA deliverables will assist prudent decision-making on flood risk issues by Development Management Officers on a day-to-day basis.

[1] Department for Communities and Local Government. 2012. *National Planning Policy Framework*. Available at: https://www.gov.uk/government/publications/national-planning-policy-framework--2

[2] Department for Communities and Local Government. 2014. *Planning Practice Guidance: Flood Risk and Coastal Change.* Available at: http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

3 Mott MacDonald, February 2008, Breckland Strategic Flood Risk Assessment 2007 Update.

4 Scott Wilson, October 2009, Breckland Council Thetford Town Centre Level 2 SFRA.

1.3 Approach to Flood Risk Management

The NPPF sets stringent tests to protect people and property from flooding which all LPAs are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed. The main steps to be followed can be summarised as **Assess**, **Avoid** and **Manage and Mitigate** flood risk. These steps are set out below, and are designed to ensure that if there are better sites in terms of flood risk, or a proposed development cannot be made safe, it should not be permitted.

Assess Flood Risk	LPAs should undertake a **SFRA** to fully understand the flood risk in the area to inform Local Plan preparation. For sites in areas at risk of flooding, or with an area of 1 hectare or greater, developers must undertake a **site-specific Flood Risk Assessment** (FRA) to accompany planning applications (or prior approval for certain types of permitted development).
Avoid Flood Risk	Breckland DC should apply the **sequential approach** to site selection so that development is, as far as reasonably possible, located where the risk of flooding from all sources is lowest, taking account of climate change and the vulnerability of future users to flood risk. In **plan-making this involves applying the Sequential Test**, and where necessary the **Exception Test** to Local Plans, as described in Section 4. In **decision-taking this involves applying the Sequential Test** and if necessary the **Exception Test** for specific development proposals.
Manage and Mitigate	Where alternative sites in areas at lower risk of flooding are not available, it may be necessary to locate development in areas at risk of flooding. In these cases, Breckland DC and developers must ensure that development is appropriately flood resilient and resistant, safe for its users for the lifetime of the development, and will not increase flood risk overall. Breckland DC and developers should seek flood risk management opportunities (e.g. safeguarding land), and to reduce the causes and impacts of flooding (e.g. through the use of sustainable drainage systems).

1.4 Partner Organisations

There are several organisations involved in development and flood risk management across the study area. These are identified below.

Breckland District Council is the LPA for the study area, responsible for long term strategic planning of future development through the preparation of Local Plans, as well as for determining planning applications within the district. In accordance with the FWMA and subsequent communication from Central Government, from 6th April 2015, Breckland DC is required to ensure that SuDS are implemented for all major developments where appropriate, and that through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

Norfolk County Council is designated the LLFA under the FWMA, and has a duty to lead and coordinate the management of local flood risk, which includes flood risk from surface water, groundwater and ordinary watercourses.

Environment Agency has a strategic overview role for all sources of flooding and coastal erosion which includes developing strategic plans, providing evidence and advice to inform Government policy and providing a framework to support local delivery.

Within Breckland, the Environment Agency has operational responsibility for managing flood risk associated with main rivers and reservoirs and is a statutory consultee for any development proposed within Flood Zones 2 or 3 and within 20m of the top of a bank of main rivers. The Environment Agency is continually improving and updating their flood map for main rivers and has permissive powers to carry out flood defence works, maintenance and operational activities for these main rivers. However, overall responsibility for maintenance lies with the riparian owner.

As part of taking a strategic overview for all sources of flooding the Environment Agency are involved in strategic flood risk mapping projects, such as the national mapping of surface water flood risk. The Environment Agency also has a key role in allocation of funding for flood and coastal erosion risk management projects.

Anglian Water Services (AWS) has a duty as a statutory body to provide clean and waste water services to the study area and is responsible for the management, maintenance and operation of flood control structures. Water Companies

are defined as a Risk Management Authority within the FWMA and are responsible for flood risk management functions in accordance with the Water Resources Act 1991 and the Land Drainage Act 1991. AWS is responsible for surface water drainage from development via adopted sewers and for maintaining trunk sewers into which many of the highway drainage in the study area connects.

East Harling Internal Drainage Board (IDB) and **Water Level Management Alliance (WLMA) Norfolk Rivers Internal Drainage Board** have permissive powers to manage water levels within their district and undertake works to reduce flood risk to people and property. The IDBs can provide advice on areas liable to flooding (non-main river); site specific FRAs in their area; and maintenance and adoption of surface water drainage facilities. However, overall responsibility for maintenance lies with the riparian owner. The administrative area for each of the IDBs is shown in **Appendix A Figure 1**. In addition to East Harling and Norfolk Rivers there are two additional IDBs, Downham Market Group and Waveney, Lower Yare and Lothingland IDB, which cover marginal areas of Breckland.

Highways Agency has responsibilities (under the Highways Act 1980) for the effectual drainage of surface water from adopted roads along red routes insofar as ensuring that drains, including kerbs, road gullies and ditches and the pipe network which connect to the sewers, are maintained. In relation to the SFRA, the Highways Agency was consulted to provide details of any known historic and recent flood risks along the highways in the District, areas that are susceptible to flooding, flood mitigation measures that have already been put in place and maintenance regimes.

The Level 1 SFRA is a desk-based study, using readily available existing information and datasets to enable the application of the Sequential Test and to identify where the Exception Test may be required. The main tasks in preparing the Level 1 SFRA are described below.

1.5 Level 1 SFRA Approach

The Level 1 SFRA is a desk-based study, using readily available existing information and datasets to enable the application of the Sequential Test and to identify where the Exception Test may be required. The main tasks in preparing the Level 1 SFRA are described below.

The remainder of Section 1 provides a description of the study area and identification of partner organisations involved in assessing and managing flood risk in Breckland. Section 2 provides a review of the legislative and planning policy context of managing flood risk in the district.

1.5.1 Gathering data and analysing it for suitability

Under Section 10 of NPPF, the risk of flooding from all sources must be considered as part of a Level 1 SFRA, including flooding from tidal sources, rivers (fluvial), land (overland flow and surface water), groundwater, sewers and artificial sources.

In order to provide this assessment of all sources of flooding in the study area, an extensive set of datasets was requested from a number of organisations, including Breckland DC, Norfolk CC (as the LLFA and Highways Authority), the Environment Agency, Anglian Water and the Highways Agency.

Datasets and information gathered as part of the preparation of the first iteration of the SFRA in 2005, and the subsequent update of the SFRA in 2007, have been retained where appropriate. This chiefly includes flood records collected from partner organisations, as well as findings from walkover surveys of small watercourses in the district undertaken by Mott MacDonald during December 2004.

The datasets are described further in Section 3, including detail regarding appropriate uses and limitations, and how they have been used within the Level 1 SFRA.

1.5.2 Producing strategic flood risk maps, GIS deliverables and a technical report

A series of GIS maps have been produced using the data gathered during the study. The mapping deliverables are summarised in Table 1-1 and should be referred to when reading Section 3 'Assessing Flood Risk' which provides an overview of flood risk across the district.

Table 1-1 Strategic Flood Risk Maps

Figure No.	Figure Title and Content
Figure 1	Study Area *(Administrative boundaries, IBD administrative boundaries, watercourses, water bodies, flood storage areas, development areas)*
Figure 2	Solid Geology
Figure 3	Drift Geology
Figure 4	Superficial Geology with Aquifer Designations
Figure 5	Flooding from Rivers *(NPPF Flood Zones, watercourses, historic records of fluvial flooding, emergency rest centres)*
Figure 6	Updated Flood Map for Surface Water *(uFMfSW)*
Figure 7	Groundwater Flooding *(Areas susceptible to groundwater flooding (AStGWF) dataset, historic records of groundwater flooding)*
Figure 8	Flood Warning Areas *(Flood Warning Areas, Emergency Rest Centres)*

1.5.3 Providing suitable guidance

Based on Section 3 'Assessing Flood Risk', Appendix C 'Area Assessments' and the supporting mapping deliverables, the Level 1 SFRA Report provides specific guidance for Breckland DC.

Section 4 provides guidance on 'Avoiding Flood Risk' through the appropriate application of the Sequential Test by Breckland DC when allocating future development sites as part of the plan-making process, as well as by developers promoting development on windfall sites.

Sections 5, 6 and 7 provide guidance for measures to 'Manage and Mitigate Flood Risk' on future development sites and to assist the preparation of site-specific FRAs.

Section 8 outlines a number of flood risk management objectives and policy recommendations for consideration by Breckland DC throughout the development of their strategic planning documents.

2 Legislative and Planning Policy Context

2.1 Introduction

This Section provides an overview of the legislative and national and local planning policy context specific to the Level 1 SFRA Update for Breckland DC. The information presented in the SFRA should be used by Breckland DC to establish robust policies in relation to flood risk as part of their emerging Local Plan.

2.2 Flood and Water Management Act

In response to the severe flooding across large parts of England and Wales in summer 2007, the Government commissioned Sir Michael Pitt to undertake a review of flood risk management. The Pitt Review – Learning Lessons from the 2007 Floods[5] and subsequent progress reviews outlined the need for changes in the way the UK is adapting to the increased risk of flooding and the role different organisations have to deliver this function.

The FWMA 2010[6], enacted by Government in response to The Pitt Review, designated unitary authorities, such as Norfolk CC, as LLFA. As LLFA, Norfolk CC has responsibilities to lead and co-ordinate local flood risk management. Local flood risk is defined as the risk of flooding from surface water runoff, groundwater and small ditches and watercourses (collectively known as ordinary watercourses).

The FWMA also formalises the flood risk management roles and responsibilities for other organisations including the Environment Agency, water companies and highways authorities. The responsibility to lead and co-ordinate the management of tidal and fluvial flood risk remains that of the Environment Agency.

2.2.1 National Strategy for Flood and Coastal Erosion Risk Management

In accordance with the FWMA, the Environment Agency has developed a National Strategy for Flood and Coastal Erosion Risk Management (FCERM) in England[7]. This Strategy provides a framework for the work of all flood and coastal erosion risk management authorities.

The National FCERM Strategy sets out the long-term objectives for managing flood and coastal erosion risks and the measures proposed to achieve them. It sets the context for, and informs the production of local flood risk management strategies by LLFAs, which will in turn provide the framework to deliver local improvements needed to help communities manage local flood risk. It also aims to encourage more effective risk management by enabling people, communities, businesses and the public sector to work together to:

- ensure a clear understanding of the risks of flooding and coastal erosion, nationally and locally, so that investment in risk management can be prioritised more effectively;
- set out clear and consistent plans for risk management so that communities and businesses can make informed decisions about the management of the remaining risks;
- encourage innovative management of risks taking account of the needs of communities and the environment;
- ensure that emergency responses to flood incidents are effective and that communities are able to respond properly to flood warnings; and,
- ensure informed decisions are made on land use planning.

The Environment Agency's 'Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities'[8] guidance is a supporting note for the National FCERM Strategy. The 2016 version of the document reflects an assessment completed by the Environment Agency between 2013 and 2015 using UKCP09 data, to produce more representative climate change allowances for each river basin district in England, and provides advice on applying climate change projections in the FCERM. It is essential that land use planning decisions consider the impact of a changing climate where appropriate.

[5] Cabinet Office (2008) Sir Michael Pitt Report 'Learning lessons learned from the 2007 floods' http://www.environment-agency.gov.uk/research/library/publications/33889.aspx
[6] HMSO (2010) The Flood and Water Management Act 2010 http://www.legislation.gov.uk/ukpga/2010/29/contents
[7] Defra, Environment Agency (2011) The National Flood and Coastal Erosion Risk Management Strategy for England.
[8] Environment Agency (2016) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities

2.2.2 Local Flood Risk Management Strategy

As the LLFA, Norfolk CC has a statutory duty to develop, maintain, apply and monitor a strategy for local flood risk management in their respective administrative areas. Norfolk CC has prepared a draft Local Flood Risk Management Strategy[9] (LFRMS) which is currently undergoing public consultation.

The aim of Norfolk CC's LFRMS is "to work with organisations, businesses and communities to manage flood risks and, where it is practicable, affordable and sustainable to do so, to reduce risks to life, property and livelihoods that may arise from local surface runoff, ordinary watercourse and groundwater flooding". The LFRMS will seek to implement the following strategic objectives:

1. Determine and communicate Local Flood Risk – Undertake projects to determine and understand the risks of flooding from surface run-off, ordinary watercourses and groundwater. Increase public awareness through the publication of clear and consistent information about local flood risk.

2. Partnership Working - Work with all Risk Management Authorities (RMAs) and other stakeholders to coordinate flood risk management roles, responsibilities and activities. Share best practice; raise the profile of Risk Management Authorities working within Norfolk and assist organisations in ensuring their plans and projects take proper account of all flood risk.

3. Partnership Programmes and Projects - Identify, secure and optimise resources to develop and deliver measures to manage flood risk. Assist organisations to establish and update long-term plans to manage flood risk.

4. Riparian Responsibilities - Work with Risk Management Authorities to encourage and where necessary enforce the management and maintenance of privately owned flood management structures and ordinary watercourses and minimise unnecessary constrictions and obstructions within local drainage networks.

5. Flood Risk and Development - Ensure that planning authorities are properly informed about local flood risk, that there is a consistent approach to the consideration of flood risk management in new development and that new developments seek to reduce existing flood risk and contribute to the achievement of sustainable development.

6. Water Framework Directive - Support the implementation of the 'Water Framework Directive' by ensuring that watercourse morphology, water quality and ecological status are not harmed by activities that are controlled by, or undertaken by, owners, occupiers and managers of Flood and Coastal Erosion Risk Management infrastructure. Facilitate measures to improve morphology, water quality and ecological status whenever it is practicable and necessary to do so.

7. Support Water and Sewerage Company infrastructure - Work closely with water and sewerage companies to minimise flood risks associated with their infrastructure and promote the development and management of sustainable water resources.

2.2.3 Surface Water Management Plan

A Surface Water Management Plan (SWMP) is a framework to understand the causes of surface water flooding and agree the most cost effective way of managing surface water flood risk. The main outputs are a co-ordinated Action Plan to prioritise projects to reduce surface water flood risk and detailed mapping of areas prone to surface water flood risk.

Norfolk CC has coordinated a number of SWMPs across the County, including Great Yarmouth BC, Kings Lynn and West Norfolk BC, North Norfolk DC, Norwich Urban Area and South Norfolk DC. To date none of the SWMPs cover the Breckland district area.

2.3 Flood Risk Regulations

As well as the duties under the Act to prepare a LFRMS, LLFAs have legal obligations under the EU Floods Directive[10], which was transposed into UK Law through the Flood Risk Regulations 2009[11] ('the Regulations').

[9] Norfolk County Council, March 2015, Norfolk Local Flood Risk Management Strategy, Consultation Draft. https://norfolk.citizenspace.com/consultation/draft-local-flood-risk-management-strategy
[10] European Union (2007) EU Floods Directive http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32007L0060:EN:NOT
[11] HSMO (2009) The Flood Risk Regulations http://www.legislation.gov.uk/uksi/2009/3042/contents/made

2.3.1 Preliminary Flood Risk Assessment

Under the Regulations, all LLFAs were required to prepare a Preliminary Flood Risk Assessment (PFRA) report. This is a high level screening exercise to identify areas of significant risk as 'Indicative Flood Risk Areas' across England where 30,000 people or more are at risk from flooding for reporting to Europe.

A PFRA was prepared for Norfolk CC in 2011[12]. The PFRA seeks to provide a high level overview of flood risk from local flood sources and includes flooding from surface water (i.e. rainfall resulting in overland runoff), groundwater, ordinary watercourses (smaller watercourses and ditches) and canals. It excludes flood risk from main rivers, the sea and reservoirs, as these are assessed nationally by the Environment Agency. The PFRA report looks at past flooding and where future flooding might occur across the area and the consequences it might have to people, properties and the environment. The report provides a useful baseline for the County to inform their LFRMS as well as the preparation of this revised Level 1 SFRA. PFRAs are revised on a six-yearly cycle, and an update to the Norfolk CC PFRA will start in 2016.

2.4 Anglian River Basin District draft Flood Risk Management Plan

Under the EU Floods Directive and UK Flood Risk Regulations, LLFAs must prepare FRMPs in formally identified Flood Risk Areas where the risk of flooding from local sources is significant (i.e. surface water, groundwater, ordinary watercourses). The Environment Agency is required to prepare FRMPs for all of England covering flooding from main rivers, the sea and reservoirs.

As such, the Anglian River Basin District FRMP[13] has been published for consultation by the Environment Agency and sets out the proposed measures to manage flood risk in the Anglian River Basin District from 2015 to 2021 and beyond. This document draws on existing reports and plans which have been prepared in the past such as the Catchment Flood Management Plans (CFMP) for the catchments in Breckland identified in Section 3.4..

The Anglian River Basin District covers 27,890 km^2 from Lincolnshire in the north to Essex in the south, and Northamptonshire in the west to the East Anglian coast. The river basin district comprises eleven 'management' catchments. These catchments flow from the high chalk and limestone hills through very low lying fenland areas, before finally reaching the sea.

CFMPs set out policies for the sustainable management of flood risk across particular catchments over the long-term (50 to 100 years) taking climate change into account. Of relevance to the Breckland study area are the Broadland Rivers CFMP and the Great Ouse CFMP. The preferred policies from these CFMPs for each of the sub-areas are presented in Table 2-1.

Table 2-1 Summary of CFMP Policies for Breckland

Broadland Rivers CFMP
Sub-area 2 River Wensum – Policy 6 "Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.
In this largely rural area, the aim is to manage flood risk by maximising the potential of the floodplain to retain water to benefit locations elsewhere in the catchment. Storing water on this floodplain can reduce flood risk to settlements downstream. This approach may involve: • restoring river channels, water meadows and the natural floodplain; • reducing runoff from agricultural land; • structural measures to control water levels and retain more water on the floodplains; • engineered schemes to store floodwater. Locally, the floodplain storage areas may provide long-term benefits for the river environment and wetland habitats. Within this sub-area reducing bank and channel maintenance will increase the ability of the floodplain to store water by improving the flow between the river and its floodplain. However, where flood risk may be more concentrated, such as in towns and villages, existing actions to manage flooding may be continued. To be able to use the floodplain for flood risk management, planners must prevent development that affects the

[12] Norfolk County Council, 26th July 2011, Preliminary Flood Risk Assessment Report,
[13] Environment Agency (October 2014) Anglian River Basin District Consultation on the draft Flood Risk Management Plan https://consult.environment-agency.gov.uk/portal/ho/flood/draft_frmp/consult?pointId=3063510

ability of the floodplain to retain water.

Proposed actions

Produce a flood storage study for this sub-area to investigate the most appropriate storage options and locations for floodplain storage. The study should also consider opportunities to enhance the environment by improving the natural state of the river and its habitat.

- Identify opportunities where bank and channel maintenance can be reduced to improve the flow between the river and its floodplain to increase water storage on the natural floodplain.
- Continue with the flood warning service including the maintenance of flood warning infrastructure (such as river flow gauging stations) and flood awareness plans.
- Continue with the River Wensum Restoration Strategy to restore the river to a more natural state.
- Work with partners to develop emergency response plans for transport links at risk from flooding.
- Reduce the consequences of flooding by improving public awareness of flooding
- Encourage planners to develop policies to prevent inappropriate development in the floodplain. Any new development should be resilient to flooding and provide opportunities to improve river environments and make space for water.

Sub-area 4 Fluvial Rivers – Policy 2 "Areas of moderate flood risk where we can generally reduce existing flood risk management actions".

In these rural reaches the current activity to manage flooding is out of proportion with the level of flood risk, or is not effective. In general, overall flood risk management activities will be reduced, however where flood risk is more concentrated (for example in towns and villages) existing actions to manage flooding may be continued.

The preferred approach is to reduce bank and channel maintenance in some locations. This will enable limited resources to be targeted to other areas of the catchment where the risks are greater, to ensure value for money. The preferred approach will also help improve the flow between the river and its floodplain and so improve wetland and aquatic habitats.

Flood warning is an important way of managing the consequences of flooding throughout the catchment. Therefore, the local flood warning infrastructure (such as river flow gauging stations) needs to be maintained.

Proposed actions

- Investigate options to cease or reduce current bank and channel maintenance and flood defence maintenance. In addition, changes in land use, development of sustainable farming practices and environmental enhancement should be investigated to mitigate an increase in flooding in the future.
- Continue with the flood warning service including the maintenance of flood warning infrastructure (such as river flow gauging stations) and public awareness plans.
- Work with partners to develop emergency response plans for critical infrastructure and transport links at risk from flooding.
- Encourage planners to develop policies to prevent inappropriate development in the floodplain using measures set out in Planning Policy Statement 25 (PPS25). Any new development must not increase risk to existing development, should be resilient to flooding and provide opportunities to improve river environments and make space for water.

Great Ouse CFMP

Sub-area 1 Bedford Ouse Rural and Eastern Rivers – Policy 3 "Areas of low to moderate flood risk where we are generally managing existing flood risk effectively".

Within this sub-area there are a number of main rivers and ordinary watercourses that are managed by different risk management authorities. Across this sub-area the risk of flooding varies. There are some local communities which have experienced regular flooding while in other areas there maybe opportunities for flood risk management activities to be reduced. Therefore, the key to managing flood risk across this sub-area will be working in partnership.

Selecting a policy option 3 allows each risk management authority to exercise their powers to continue routine maintenance and carry out essential works on watercourses to benefit local communities. This policy also gives risk management authorities flexibility to use their local knowledge and experience to manage flooding either through

existing or alternative actions. For the Environment Agency, alternative measures will include investigations to reduce flood risk maintenance in parts of the sub-area where there is a low risk of flooding and prioritising resources to areas where flood risk is more concentrated.

Proposed actions

- Investigate opportunities to reduce current levels of flood risk management on the main rivers in this sub-area.
- Continue with current levels of flood risk management on all ordinary watercourses (including Award Drains) in this sub-area.
- Continue with, and implement, the recommendations from the Cambridgeshire County Council Surface Water Management Scoping Study.
- Ensure any policies within the Local Development Framework or any revisions are in line with the CFMP policy.
- Continue with improvements to the flood warning service by extending the current Floodline Warnings Direct service and through the creation of community-based flood warnings.
- Work with partners to develop emergency response plans for critical infrastructure, community facilities and transport links at risk from flooding.
- Ensure that opportunities are taken within minerals and waste development/action plans to use mineral extraction sites to store flood water.
- Produce land management plans to explore opportunities to change land use and develop sustainable land management practices.
- Develop environmental enhancement projects to improve the natural state of the rivers and their habitats.
- Actions specific to Bedford Ouse Rural:
- Continue maintenance of Grafham Water and Foxcote Reservoir. Anglian Water must carry out their duties under the Reservoirs Act.
- Consider developing surface water management plans.

Sub-area 8 Saffron Walden and Thetford – Policy 3 "Areas of low to moderate flood risk where we are generally managing existing flood risk effectively".

The settlements in this sub-area have been built in the flood plain and as a result have a history of flooding. Maintenance work is carried out to reduce flood risk. Although flood risk is not expected to increase significantly in the future, as there is a concentration of people and property in the flood plain, it is still feasible and effective to maintain the current level of flood risk management.

This will be achieved by continuing with existing flood risk management activities as well as adopting new and more sustainable methods to manage the risk. For example, by managing the consequences of flooding through flood warning, flood awareness and adapting urban environments to make them more resilient to flooding.

Proposed actions

- Continue with improvements to the flood warning service by extending the current Floodline Warnings Direct service and through the creation of community-based flood warnings.
- Ensure any policies within the Local Development Framework, or any revisions, are in line with the CFMP policy.
- Consider developing a surface water management plan for Thetford.

2.5 National Planning Policy Framework

The NPPF is a framework within which councils and local people can produce local and neighbourhood plans that reflect the needs and priorities of their communities. The overall approach of the NPPF to flood risk is broadly summarised Paragraph 103:

"When determining planning applications, LPAs should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific FRA following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

- *within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location, and*
- *development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems."*

Further detail regarding the Sequential and Exception Tests is included in Section 4 of this report.

2.5.1 NPPF Guidance SuDS Policy (April 2015)

Sustainable Drainage Systems (SuDS) are an approach to managing rainwater and surface water that replicates natural drainage, the key objectives being to manage flow rate and volume of runoff to reduce risk of flooding and water pollution. From 6th April 2015, LPAs such as Breckland DC are required to ensure that SuDS are implemented for all major developments where appropriate, and that through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

As the LLFA, Norfolk CC is a statutory consultee for SuDS applications. Norfolk CC will need to be consulted on the drainage elements of planning applications for major development to ensure they conform to necessary national and local SuDS standards[14].

2.6 Local Planning Policy

The emerging areas identified by Breckland DC as locations for growth are:

Key Settlements

- Attleborough
- Thetford

Market Towns

- Dereham
- Swaffham
- Watton

Local Service Centres

Ashill Banham Bawdeswell Garboldisham	Great Ellingham Harling Hockering Kenninghall	Litcham Mattishall Narborough Necton	North Elmham Old Buckenham Shipdham Sporle	Swanton Morley Weeting Yaxham

2.7 IDB Policy

The Norfolk Rivers IDB and East Harling IDB have both established Byelaws under and by virtue of the powers and authorities vested in them by the Land Drainage Act 1991. The Byelaws are considered necessary for securing the efficient working of the drainage system in their District, regulating the effects of the environment in the Board's District of a drainage system, or securing the effectiveness of flood risk management work within the meaning of section 14A of the Act.

Of particular importance to the SFRA are the following Byelaws for the Norfolk Rivers IBD:

Byelaw 3 – Control of introduction of water and increase in flow or volume of water.

No person shall as a result of development (within the meaning of section 55 of the Town and Country Planning Act 1990 as amended ("the Act")) (whether or not such development is authorised by the Act or any regulation or order whatsoever or none of them) for any purpose by means of any channel, siphon, pipeline or sluice or by any other means whatsoever introduce any water into any drainage/flood risk management infrastructure so as to directly or indirectly

[14] Sustainable drainage systems: non-statutory technical standards - https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

increase the flow or volume of water in any drainage/flood risk management infrastructure in the District (without previous consent of the Board).

Byelaw 10 – No works within 9 metres of the edge of drainage/flood risk management infrastructure.

No person shall, without previous written consent from the Board, in, under, over or across any drainage/flood risk management infrastructure or in, under, over or on any bank of any drainage/flood risk management infrastructure or within nine metres (measured horizontally) of the landward toe of the bank where there is an embankment or wall or within nine metres (measured horizontally) of the top of the batter where there is no embankment of wall, or within nine metres (measured horizontally) of the closest point of the culvert, bridge or other structure where the drainage/flood risk management infrastructure is culverted, bridged, enclosed or is a structure, carry out any works.

2.8 Summary

Figure 2-1 provides a summary of the documents that have been reviewed within this section. The figure demonstrates that the main driver for the SFRA is the NPPF, and that documents and plans prepared by both the Environment Agency and Norfolk County Council under the requirements of the Flood and Water Management Act and the Flood Risk Regulations, provide key inputs to inform the preparation of the revised SFRA and Local Plans.

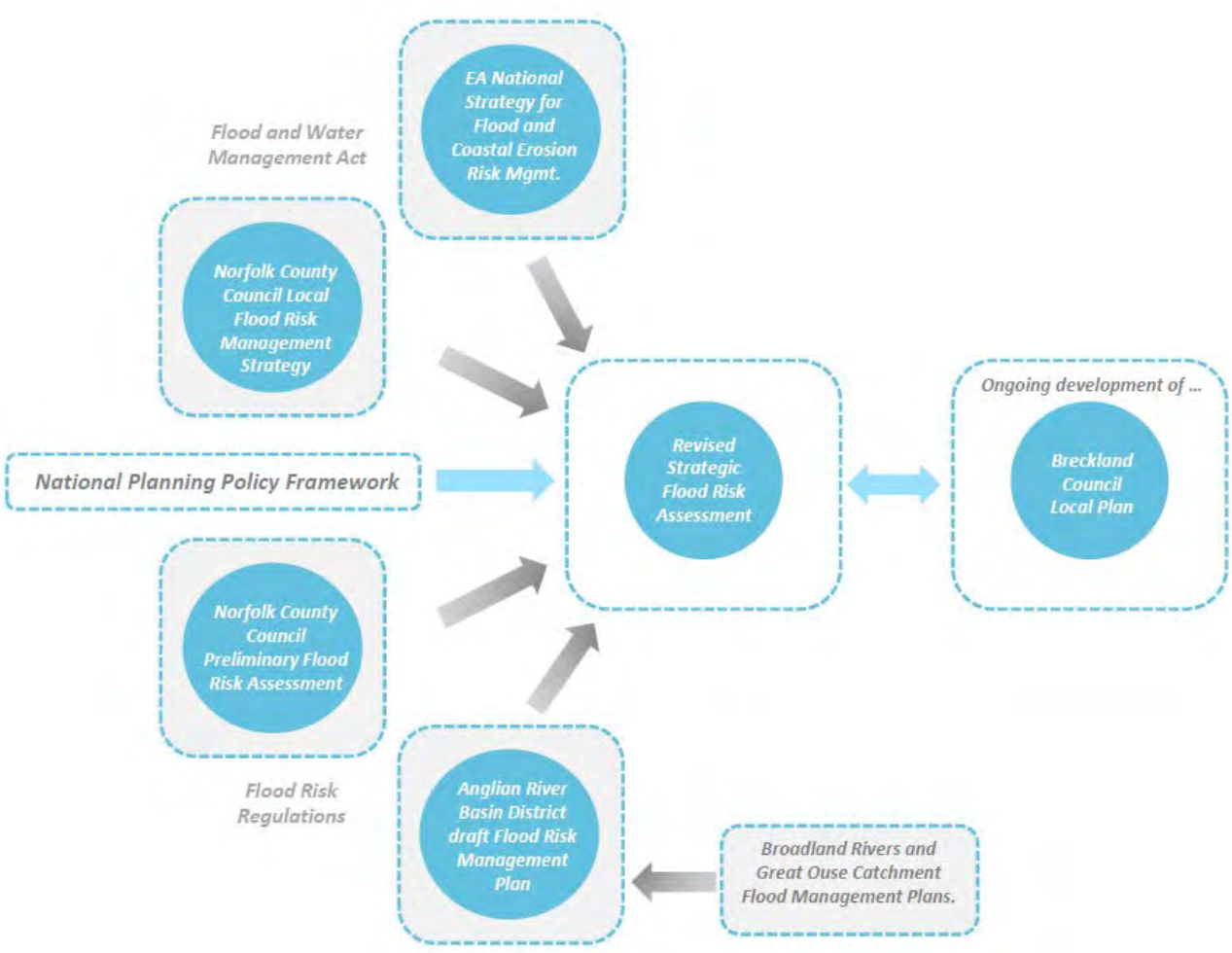


Figure 2-1 Summary of Legislative and Planning Context

3 Assessing Flood Risk

3.1 Introduction

This Section provides a strategic assessment of flood risk across the Breckland study area from each of the sources of flooding outlined in the NPPF. For each source of flooding, details of any historical incidents are provided, and where appropriate, the impact of climate change on the source of flooding is described. This Section should be read with reference to the figures in Appendix A and B and the Area Assessments in Appendix C.

3.2 Study Area

3.2.1 Landscape

The study area of Breckland District is shown in **Appendix A Figure 1**, together with the location of the principal watercourses and reservoirs. Breckland District forms part of the County of Norfolk, and is surrounded by the districts of Kings Lynn and West Norfolk to the west, North Norfolk and Broadland to the north and north east, South Norfolk to the east, and Mid Suffolk, St Edmundsbury and Forest Heath to the south.

Breckland is essentially rural in nature, and largely comprises heathland or agricultural land. There is a substantial amount of woodland to the west around Thetford. The lowland rural landscape is crossed by a series of broad, shallow river valleys with associated floodplains and grazing pastures[15].

3.2.2 Topography

In the west and south of the district, the floodplains of the River Wissey and River Thet lie at approximately 0-20 metres above ordnance datum (m AOD). The southern part of the district comprises gently sloping lowlands largely located at 30-40m AOD. Moving east, levels increase to 60-70m AOD towards Attleborough.

In the northern part of the district the land rises towards Swaffham, Dereham and Watton, with highest levels in the region of 70-100m AOD. The north eastern part of the district drains towards Norwich, with levels in the River Wensum floodplain declining to approximately 20-30m AOD.

3.2.3 Hydrogeology

As shown in **Appendix A Figure 2** the underlying bedrock of the entire district is chalk. The overlying drift deposits of chalky boulder clay, sand, diamicton and alluvium create local variation in the landscape (**Appendix A Figure 3**). In the south west of the district there are fewer drift deposits present, with only a thin layer of sand and gravel covering the chalk. This gives rise to the barren, sandy soils creating the heaths and forests.

The district receives very low annual rainfall; average annual amounts varying from 580 to 680mm across the area.

Among the heath landscapes to the north of Thetford, several small open groundwater-fed meres are found e.g. Ringmere. These meres and associated ponds probably originated through partial blockage of the floors of swallow holes by clay transported from glacial beds through erosion. Marl pits are a common feature around the areas of sand and gravel deposits as excavated chalky clay was used to add body and lime to the sandy soils.

3.3 Tidal Flooding

Of the settlements being studied in the Breckland district, only Narborough is considered to be under any risk of being affected by sea level rise. However, the outfall from the River Nar into the River Great Ouse is protected by a gated structure. This means that the River Nar is not directly affected by the tide.

During the preparation of the original SFRA, Royal Haskoning was consulted, as they had completed a modelling study of the River Nar upstream as far as Marham (downstream of the Breckland District). They confirmed that even with a major tidal event on the Great Ouse coincident with a fluvial event on the Nar causing it to back up behind the tidal outfall structure, water levels would not be affected as far upstream as Marham, due to the nature of the river gradient (Mott MacDonald 2007).

15 Land Use Consultants, May 2007, Breckland District Landscape Character Assessment.

The study area is therefore not considered to be at risk of tidal flooding.

3.4 Flooding from Rivers

3.4.1 Detailed River Network

The Environment Agency 'Detailed River Network' dataset has been used to identify watercourses in the study area and their designation (i.e. main river or ordinary watercourse). There are 11 designated main rivers in the study area, the approximate locations of which are shown in **Appendix A Figure 1.** Main rivers are watercourses shown on the statutory main river maps held by the Environment Agency and the Department for Environment, Flood and Rural Affairs (Defra). The Environment Agency has permissive powers to carry out works necessary for flood defence purposes on these rivers. The overall responsibility for maintenance however, lies with the riparian owner.

Figure 3-1 Anglian River Basin District Management Catchments (Anglian RBD FRMP, Environment Agency October 2014)

The Breckland study area falls across three different management catchments (shown in Figure 3-1) which are described in the Anglian River Basin District Flood Risk Management Plan as the Broadland Rivers catchment which drains towards Great Yarmouth in the west, and the Cam and Ely Ouse catchment and North West Norfolk catchment which both drain towards King's Lynn in the north east. A brief description of each main river is provided below.

- The **River Wensum** flows through the north eastern part of the district. The **Wendling Beck** joins the River Wensum near Billingford. The **Whitewater River** and **River Tud** are also tributaries which adjoin the River Wensum further downstream of the Breckland district. The River Wensum flows east to its confluence with River Yare in Norwich which subsequently drains to the sea at Great Yarmouth. The River Wensum and its tributaries are part of the Broadland Rivers catchment.

- The **River Yare** flows east from Shipdham out of the Breckland district towards Norwich, where it is joined by the River Wensum before flowing east to discharge to the sea at Great Yarmouth. The River Yare is part of the Broadland Rivers catchment.

- A short section (approximately 2.5km) of the **River Waveney** flows east along the south eastern boundary of the Breckland district towards Diss. The River Waveney is part of the Broadland Rivers catchment and drains to the sea at Lowestoft.

- The **River Nar** is located in the north west of the district. It flows west towards King's Lynn and discharges to the Tidal River Ouse. The River Nar is part of the North West Norfolk catchment.

- The **Little Ouse River** flows west from Hinderclay forming the southern boundary of the Breckland district round to Barnham. The Little Ouse then flows northwards through Thetford town centre before returning to the district boundary through Thetford Forest to Brandon. Upon leaving the district, the Little Ouse River flows west to discharge to Tidal River at Denver and reaches the Wash at King's Lynn. The Little Ouse River is part of the Cam and Ely Ouse catchment,

- The **River Thet** is a tributary of the Little Ouse River which flows from North End (to the south west of Attleborough) south west to join the Little Ouse River in Thetford.

- The **River Wissey** flows from Bradenham approximately south west and flows out of the district west of Foulden. This watercourse discharges to the Tidal River at Denver and ultimately the Wash at King's Lynn. The River Wissey is part of the Cam and Ely Ouse catchment

- The **Watton Brook** is a tributary of the River Wissey which flows west from Carbrooke to join the River Wissey at Hilborough. The Watton Brook is part of the Cam and Ely Ouse catchment.

3.4.2 Historic Records of River Flooding

The Environment Agency has provided an extract from the 'Recorded Flood Outlines' dataset for the study area[16] which details the following historic fluvial flood events in the district:

- Little Ouse, September 1968, March 1947.

- Black Bourn, September 1968, March 1947.

- River Wissey, March 1947.

- River Thet, March 1947, September 1968.

- River Nar, November 1993, breach of defence.

It should be noted that not all flood events may have been recorded and/or mapped. The extents associated with each of these flood events which have been recorded and mapped, are also included in the mapping of Flood Zone 2, shown in **Appendix A Figure 5** and the figures in **Appendix B**.

The Norfolk CC LFRMS identifies that Breckland DC is not generally at risk from significant and widespread fluvial flooding, but there are several smaller areas where residential and commercial buildings are at risk. In Thetford in particular the predominant flood risk is fluvial, where the Rivers Thet and Little Ouse meet within the town. It is noted that no formal fluvial flood defences have been constructed in Thetford.

Table 3-1 provides details of some historic flood events that have been recorded in Thetford, as set out in the Thetford Standard of Protection Study.

Table 3-1 Historic flood events recorded in Thetford (source: Thetford Standard of Protection Study)

Date	Location	Description
9 August 1843	Thetford	Many houses flooded to 2ft deep, especially affecting in Bridge Street.
20th Century	Thetford	The town centre suffered serious flooding on several occasions.
26 August 1912	Thetford	Parts of the town suffered flooding but little structural damage and no loss of life.
January 1915	Hockwold, 20km NW of Thetford	Little Ouse burst its banks.
1939	Thetford	Memorable flooding of Thetford's rivers.
1947	Thetford	Memorable flooding of Thetford's rivers.
19 March 1947	Hockwold, 20km NW of Thetford	Little Ouse burst its over 15m of its banks, flooding over 2500 ha of West Norfolk fenland.
September 1968	Thetford	High water levels, out of bank flow and flooding, especially in Bridge Street.

[16] The 'Recorded Flood Outlines' dataset identifies the flood extents associated with specific flood events. The 'Historic Flood Map' shows greatest extent of past flooding and does not identify individual flood events.

Around the Wendling Beck there is reported to be flooding associated with a combination of river and surface water sources.

3.4.3 NPPF Flood Zones

The risk of flooding is a function of the probability that a flood will occur and the consequence to the community or receptor as a direct result of flooding. The NPPF seeks to assess the probability of flooding from rivers by categorising areas within the fluvial floodplain into zones of low, medium and high probability, as defined in Table 3-2.

Table 3-2 Fluvial Flood Zones (extracted from the NPPG, 2014)

Flood Zone	Fluvial Flood Zone Definition	Probability of Flooding
Flood Zone 1	Land having a less than 1 in 1,000 (0.1%) annual exceedance probability (AEP) of river flooding. Shown as clear on the Flood Map – all land outside Flood Zones 2 and 3.	Low
Flood Zone 2	Land having between a 1 in 100 and 1 in 1,000 annual exceedance probability of river flooding (between 1% and 0.1% annual probability of flooding each year).	Medium
Flood Zone 3a	Land having a 1 in 100 or greater annual exceedance probability of river flooding (greater than 1% annual probability of flooding each year).	High
Flood Zone 3b	Land where water has to flow or be stored in times of flood. The identification of the functional floodplain takes into account local circumstances but for the purposes of this SFRA, land modelled to flood during a 5% AEP event or greater in any year has been mapped, in agreement with the Environment Agency and Breckland DC. Where the 5% AEP extent is not available for a particular watercourse, the Flood Zone 3a flood extent should be used as a surrogate.	Functional Floodplain

The 'Flood Map for Planning (Rivers and Sea)' is available on the Environment Agency website[17] and is the main reference for planning purposes as it contains Flood Zones 1, 2 and 3a which are referred to in the NPPF and presented in Table 3-2. The 'Flood Map for Planning (Rivers and the Sea)' provides information on the areas that would flood if there were no flood defences or buildings in the "natural" floodplain.

The 'Flood Map for Planning (Rivers and Sea)' was first developed in 2004 using national generalised modelling (JFLOW) and is now routinely updated and revised using the results from the Environment Agency's programme of catchment studies, entailing topographic surveys and hydrological and/or hydraulic modelling as well as previous flood events.

During the preparation of this version of the SFRA several modelling studies were completed for watercourses in the Breckland district, as set out in Table 3-3. AECOM has used the outputs of these modelling studies to update the Flood Zone mapping for the district[18] which is presented in **Appendix A Figure 5**, and within the mapping in Appendix B.

The large majority of the district is defined as Flood Zone 1, low probability of flooding from fluvial sources. However due to the lowland nature of the landscape, floodplains associated with principal watercourses are broad. There are large extents of Flood Zone 2 and 3 associated with the River Thet throughout the south of the district, extending from the area to the south west of Attleborough, through Snetterton, Harling, Brettenham and Thetford. The floodplain associated with the River Wensum is also broad, flowing through Guist, North Elmham, to the north of Swanton Morley and Lyng, and then out of the district towards Norwich. Further detail is provided in Appendix C.

Table 3-3 Hydraulic Modelling Studies in Breckland

Watercourse	Modelling Study
Middle Wissey	Eastern Rivers Modelling Study, JBA 2015
Little Ouse and Thet	Eastern Rivers Modelling Study, JBA 2015
River Thet	Eastern Rivers Modelling Study, JBA 2015
Upper Nar	Eastern Rivers Modelling Study, JBA 2015

[17] Environment Agency Flood Map for Planning (Rivers and Sea) http://apps.environment-agency.gov.uk/wiyby/37837.aspx
[18] Flood Zone 3a has been derived from the outputs for the 1% AEP modelled event. Flood Zone 2 has been derived from the outputs for the 0.1% AEP modelled event, as well as the extents of historic flood events as included on the Environment Agency Historic Flood Map.

Watercourse	Modelling Study
River Yare	CH2MHill, October 2014
River Wensum	Update JBA September 2014.

It should be noted that the scope of these modelling studies typically covers flooding associated with main rivers, and therefore ordinary watercourses that form tributaries to the main rivers may not always be included in the model. Modelling of ordinary watercourses available on the 'Flood Map for Planning (Rivers and Sea)' may be the result of the national generalised JFLOW modelling carried out by the Environment Agency and may need to be refined when determining the probability of flooding for an individual site and preparing a site-specific FRA. Further detail regarding the scope of site specific FRAs is provided in Section 7.

It is noted that a separate map is available on the Environment Agency website which is referred to as 'Risk of Flooding from Rivers and Sea'[19]. This map takes into account the presence of flood defences and so describes the actual chance of flooding, rather than the change if there were no defences present. While flood defences reduce the level of risk they don't completely remove it as they can be overtopped or fail in extreme weather conditions, or if they are in poor condition. As a result the maps may show areas behind defences which still have some risk of flooding. This mapping has been made available by the Environment Agency as the primary method of communicating flood risk to members of the public, however for planning purposes the 'Flood Map for Planning (Rivers and the Sea)' and associated Flood Zones remains the primary source of information.

Functional Floodplain Flood Zone 3b

The Functional Floodplain is defined in the NPPF as 'land where water has to flow or be stored in times of flood'. The Functional Floodplain (also referred to as Flood Zone 3b), is not separately distinguished from Flood Zone 3a on the Flood Map for Planning (Rivers and Sea). Rather the SFRA is the place where LPAs should identify areas of Functional Floodplain in discussion with the Environment Agency.

The PPG states that the identification of Functional Floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5% AEP) or greater in any year, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point for consideration. The guidance goes on to say that 'areas which would naturally flood with an annual probability of 1 in 20 or greater, but are prevented from doing so by existing infrastructure or solid buildings will not normally be defined as functional floodplain'.

Flood outlines for the 5% AEP event are available for the watercourses identified in Table 3-3 and these outlines have been used to map Functional Floodplain across the Breckland district, as shown in **Appendix A Figure 5**.

Where Functional Floodplain has not been modelled and mapped for a particular watercourse, the extent of Flood Zone 3a should be used as a surrogate for Flood Zone 3b. Should a site come forward for development adjacent to a watercourse, the scope of the site specific FRA will need to include the delineation of Flood Zone 3b Functional Floodplain to determine the suitability of the site for the proposed development.

Climate Change

A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change may increase peak rainfall intensity and river flow, which could result in more frequent and severe flood events. Climate change is perceived to represent an increasing risk to low lying areas of England, and it is anticipated that the frequency and severity of flooding will change measurably within our lifetime.

In February 2016 the Environment Agency published revised guidance on climate change allowances in an update to the document 'Adapting to Climate Change: Advice to Flood and Coastal Erosion Risk Management Authorities'[20]. This version of the document reflects an assessment completed by the Environment Agency between 2013 and 2015 using UKCP09 data, to produce more representative climate change allowances for river basin districts across England. The allowances for the Anglian river basin district are of relevance to Breckland and are set out in Table 3-4Table 3-4.

[19] Environment Agency 'Risk of Flooding from Rivers and Sea' http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=floodmap#x=237038&y=161974&scale=1

[20] Environment Agency, February 2016, Adapting to Climate Change: Advice to Flood and Coastal Erosion Risk Management Authorities. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/516116/LIT_5707.pdf

Table 3-4 Peak river flow allowances for Anglian river basin district (use 1961 to 1990 baseline)

River basin district	Allowance category	Total potential change anticipated for '2020s' (2015 to 2039)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Anglian	Upper end (90th)	25%	35%	65%
	Higher central (70th)	15%	20%	35%
	Central (50th)	10%	15%	25%

In order to determine which range of allowance should be assessed for a proposed development or plan, the Flood Zone and vulnerability classification should be considered, as set out below.

In Flood Zone 2

- essential infrastructure – use the higher central and upper end to assess a range of allowances
- highly vulnerable – use the higher central and upper end to assess a range of allowances
- more vulnerable – use the central and higher central to assess a range of allowances
- less vulnerable – use the central allowance
- water compatible – use none of the allowances

In Flood Zone 3a

- essential infrastructure – use the upper end allowance
- highly vulnerable – development should not be permitted
- more vulnerable – use the higher central and upper end to assess a range of allowances
- less vulnerable – use the central and higher central to assess a range of allowances
- water compatible – use the central allowance

In Flood Zone 3b

- essential infrastructure – use the upper end allowance
- highly vulnerable – development should not be permitted
- more vulnerable – development should not be permitted
- less vulnerable – development should not be permitted
- water compatible – use the central allowance

As part of the hydraulic modelling studies for the Rivers Wensum, Yare, and Eastern Rivers, simulations have been run for the 1% annual probability (1 in 100 year event) including a 20% increase in river flow to account for the implications of climate change based on previous climate change guidance. As a result, results assessing a full suite of allowances such as those presented in Table 3-4 are not currently available. The Environment Agency has confirmed that there is no intention to update existing modelling studies to include additional outputs. It is anticipated that future studies will take account of the new allowances, however in the interim period there will be greater emphasis on site specific FRAs to include for additional modelling scenarios to determine the future risk with respect to climate change.

The flood outline for the 1% AEP (1 in 100 year) event including allowance for climate change and the presence of defences has been mapped for the River Wensum, Yare and Eastern Rivers in **Appendix A Figure 5** and the figures in **Appendix B.** This data should be used with caution, as the extent of flooding including a greater allowance for climate change may be more significant.

3.4.4 Flood defences

Flood defences are structures which affect flow in times of flooding and therefore reduce the risk water from entering property. They generally fall into one of two categories; 'formal' or 'informal'.

A 'formal' flood defence is a structure which has been specifically built to control floodwater. It is maintained by its owner or statutory undertaker so that it remains in the necessary condition to function. In accordance with the Flood and Water Management Act, the Environment Agency has powers to construct and maintain defences to help against flooding.

An 'informal' defence is a structure that has not necessarily been built to control floodwater and is not maintained for this purpose. This includes road and rail embankments and other linear infrastructure (buildings and boundary walls) which may act as water retaining structures or create enclosures to form flood storage areas in addition to their primary function.

A study of informal flood defences has not been made as part of this assessment. Should any changes be planned in the vicinity of road or railway crossings over rivers in the study area it would be necessary to assess the potential impact on flood risk to ensure that flooding is not made worse either upstream or downstream. Smaller scale informal flood defences should be identified as part of site specific FRAs and the residual risk of their failure assessed.

In accordance with the scope of a Level 1 SFRA, a high level review of formal flood defences will be carried out using data from the Environment Agency Asset Information Management System (AIMS). This dataset contains details of flood defence assets associated with main rivers and provides a good starting point for identifying significant local defences and potential areas benefiting from defences, but the quantity and quality of information provided differs considerably between structures. The AIMS is intended to provide a reasonable indication of the condition of an asset and should not be considered to contain consistently detailed and accurate data (this would be undertaken as part of a Level 2 SFRA or site specific FRA where the need arises).

Upon receipt of the AIMS dataset from the Environment Agency, flood defences in the study area will be presented in **Appendix A Figure 5.**

3.4.5 Flood Warning Areas

The Environment Agency provides a free Flood Warning Service[21] for many areas at risk of flooding from rivers and the sea. In some parts of England the Environment Agency may be able to provide warnings when flooding from groundwater is possible. The Environment Agency has provided a GIS layer of Flood Warning Areas in the study area which are presented in **Appendix A Figure 8.** There are eight Environment Agency Flood Warning Areas in the district, as identified in Table 3-5.

Table 3-5 Flood Warning Areas in Breckland (Environment Agency 2015)

EA Area	Flood Warning Area	Watercourse
Central	River Thet & Little Ouse from Thetford to Brandon	Thet & Little Ouse
Eastern	River Waveney from, and including Diss to Bungay	Waveney
Eastern	River Tiffey, from Wymondham to Barford inclusive	Tiffey
Eastern	River Yare from, and including Barnham Broom to Cringleford	Yare
Eastern	River Tud from East Dereham to, and including New Costessey	Tud
Eastern	River Wensum, from Fakenham to Swanton Morley inclusive	Wensum
Eastern	Wendling Beck from Wendling to Worthing	Wendling Beck
Eastern	River Wensum from Swanton Morley to, and including New Costessey	Wensum

3.4.6 Emergency Rest Centres

Breckland DC's designated emergency rest centres are mapped in Appendix A Figure 5 **and summarised in**

[21] Environment Agency Flood Warning Service http://apps.environment-agency.gov.uk/wiyby/37835.aspx

Table 3-6.

Table 3-6 Emergency Rest Centres (Breckland Council 2015)

No.	Locations	Address	Postcode
1	Attleborough High School	Norwich Road, Attleborough	NR17 2AJ
2	Thetford Academy South	Stainforth Road, Thetford	IP24 3LH
3	Northgate High School	Cemetary RD, Dereham, Norfolk	NR19 2EU
4	Hamond's High School	Brandon Road, Swaffham	PE37 7DZ
5	Thetford Academy North	Croxton RD, Thetford	IP24 1LH
6	Wayland High School	Merton RD, Watton, Thetford	IP25 6BA
7	Watton Sports Centre	Dereham RD, Watton, Thetford	IP25 6EZ
8	Breckland Leisure Centre	Croxton Road Thetford	IP24 1JD
9	Wells Cole Community Centre	Bell Lane, Saham, Toney Thetford	IP25 7HD
10	Narborough Community Centre	Chalk Lane, Narborough, Norfolk	PE32 1SR
11	Mundford Village Centre	St Leonards St Munford, Thetford	IP26 5DW
12	Dereham Football Club	Aldiss Park, Norwich Road, Dereham	NR20 3PX
13	Dereham Leisure Centre		

3.5 Flooding from Surface Water

Overland flow and surface water flooding typically arise following periods of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding. In Breckland this chiefly consists of localised road flooding. The NPPG states that an SFRA should identify areas at risk from surface water flooding and drainage issues, taking account of the surface water flood risk published by the Environment Agency as well other available information.

In line with the previous SFRA, for practical purposes, flooding from drains and ditches has been considered in the same category as surface water flooding. Where ordinary watercourses are culverted, trash screens and culverts have the potential to become blocked by items such as plant debris and rubbish. Blockages can restrict the natural flow of water, increasing the chance of water flowing out of bank and causing local flooding due to the reduced conveyance potential of the associated watercourse.

3.5.1 Historic Records

Records of flooding from surface water, drains, ditches and ordinary watercourses have been provided from a number of sources. Reports and datasets included in the previous iterations of the SFRA report have been retained to provide a consistent record. Records of flooding which are georeferenced are presented in **Appendix B.**

Breckland Council Records

In 2005, Breckland District Council provided a report on flooding in the towns and villages of the district. This did not give any specific information as to dates of recent flood events. In 2007, the Breckland Council Planning Policy Officer and Amenity Services Manager were contacted to obtain any records of flooding since 2005. A list of eight events of flooding to properties was supplied, all of which were due to maintenance issues such as blocked drains or infilled ditches (Mott MacDonald 2007).

Table 3-7 Breckland Council Historic Flooding Records (Mott MacDonald 2007)

Date	Location	Type	Severity	Cause
Prior to 2005	Norwich Road, Attleborough		High - houses flooded to a depth of 3ft	Unknown
Prior to 2005	Toftwood, Dereham		Medium - localised flooding of numerous properties	Dereham Stream
Prior to 2005	Swanton Road, Dereham		Medium - localised flooding of numerous properties	Dereham Stream
Prior to 2005	Long Street, Great Ellingham	Surface water	Low	Insufficient capacity of drain running along Long Street
Prior to 2005	Swaffham		Unknown	Surface water drainage issues
After 2005	Toftwood, Dereham		Low	Blocked pipe
After 2005	Carbrooke		Low	Lack of ditch maintenance
After 2005	Great Ellingham	Surface water	Low	Highway runoff and lack of ditch maintenance
After 2005	Toftwood, Dereham		Low	Undersized pipes
After 2005	Norwich Road, Besthorpe		Low	Undersized culverts and blocked ditches
After 2005	Chantry Lane, Necton	Fluvial flooding	Medium - several properties	Undersized culvert
After 2005	Mill Lane, Attleborough		Medium - several properties	Blockage of trash screen on culvert

Further to this, a record of all sandbag deliveries made to properties in the district since 2005 was supplied (Mott MacDonald 2005), as detailed in

Table 3-8.

Table 3-8 Breckland Council Sandbag deliveries (Mott MacDonald 2007)

Date	Street	Area
31/08/2005	Northfield Road	Swaffham
02/11/2005	Longfields	Swaffham
03/11/2005	Heidi Close	Dereham
04/11/2005	Longfields	Swaffham
10/11/2005	Longfields	Swaffham
18/11/2005	Old Becclesgate	Dereham
19/06/2006	Old Becclesgate	Dereham
27/06/2006	Griston Road	Caston
24/08/2006	Byron Walk	Thetford
24/08/2006	Melville Road	Croxton
24/08/2006	Stanford Road	Thetford
24/08/2006	Elgin Way	Thetford
24/08/2006	St Johns Way	Thetford
24/08/2006	Earls Street	Thetford
24/08/2006	St Marys Crescent	Thetford
24/08/2006	St Marys Crescent	Thetford
10/10/2006	Norwich Road	Dereham
07/12/2006	Market Street	Shipdham
10/01/2007	The Street	Rocklands
10/01/2007	The Street	Rocklands
10/01/2007	Thorpe Farm Cottages	Shadwell
10/01/2007	Bunwell Road	Besthorpe
10/01/2007	Silver Street	Besthorpe
10/01/2007	-	Caston
10/01/2007	Long Street	Great Ellingham
10/01/2007	Kenninghall Road	Harling
10/01/2007	Cake Street	Old Buckenham
11/01/2007	Manor Close	Lyng
11/01/2007	Market Street	Shipdham
12/01/2007	Cake Street	Old Buckenham
17/01/2007	-	Cranworth
19/06/2007	Church Road	Worthing
21/06/2007	Fairfields	Thetford
22/06/2007	Old Becclesgate	Dereham
25/06/2007	Fakenham Road	Horningtoft
25/06/2007	Station Lane	Thuxton
25/06/2007	Brandon Road	Swaffham
25/06/2007	Post Office Lane	Reymerston
25/06/2007	New Road	Whissonsett
25/06/2007	-	Twyford
25/06/2007	Brackenwoods	Necton
26/06/2007	Saham Road	Ovington
26/06/2007	Saham Road	Ovington
26/06/2007	Saham Road	Ovington
26/06/2007	The Street	Caston
27/06/2007	Billingford Road	North Elmham
27/06/2007	Manor Close	Hockering
27/06/2007	Port Row	Lyng
27/06/2007	Port Row	Lyng
28/06/2007	Port Row	Lyng
28/06/2007	The Street	Bridgham
28/06/2007	Port Row	Lyng
28/06/2007	Shipdham Road	Dereham
28/06/2007	Hale Road	Necton
28/06/2007	Nelson Court	Watton
28/06/2007	Saham Road	Ovington
28/06/2007	Old Bridge	Gressenhall
28/06/2007	Dereham Road	Litcham
29/06/2007	Saham Road	Ovington
29/06/2007	School Plain	Scarning
29/06/2007	The Street	Foxley
02/07/2007	Ash Close	Swaffham
02/07/2007	Sporle Road	Swaffham
02/07/2007	The Paddocks	Swaffham
05/07/2007	Brackenwoods	Necton
05/07/2007	Market Street	Shipdham
05/07/2007	Market Street	Shipdham
05/07/2007	Beatrice Avenue	Dereham
19/07/2007	Blenheim Crescent	Tittleshall
26/07/2007	Charles Close	Dereham

Date	Street	Area
25/06/2007	Hammond Place	Lyng
25/06/2007	Fakenham Road	Horningtoft

Date	Street	Area
03/07/2007	Dodma Road	Weasenham St P

Breckland DC is aware of flooding problems associated with ordinary watercourses, as shown in Table 3-9.

Table 3-9 Watercourses prone to blockages in Breckland (SFRA Mott MacDonald 2007)

Watercourse	Location	Structure / Cause	History of flooding
Besthorpe Stream	Attleborough (South East of Railway)	Mill Lane culvert with trash screen	Few properties
Besthorpe Stream	Attleborough (South East of Railway)	Norwich Road culvert	Yes
Fowler's Lane Drain	Attleborough (Haverscroft Street)	Railway culvert	Unknown
OW3 ordinary watercourse	Dereham (Swanton Road)	Farm track culvert	Unknown
Neatherd Moor Drains	Dereham (Norwich Road)	Culvert downstream of Farm Rose	Blocked culvert at the time of site visit
Neatherd Moor Drains – larger drain	Dereham (Norwich Road)	Channel with irregular bed level	Blockage at time of the site visit
Toftwood Drain	Dereham (Toftwood)	Junction with River Tud	Blockage at time of the site visit
Channel 3 in Neaton	Watton Site (Neaton)	Channel with dense vegetation and sharp bends	Blockage at time of the site visit
Church Farm Stream	Banham	Series of culverts	Unknown
Mauley's Drain	East Harling	West Harling Road 1m culvert	Unknown
Forest Lodge Drain	East Harling	No outlet (connection to Maulay's drain has probably been removed)	Unknown
Moat Stream	Mattishall	Dereham Road bridge with limited opening	Unknown
Occupation Road Drain	Mattishall	0.3m diameter piped culverts to allow access to houses and fields	Water has recently spilled out of the drain, onto the road and into front gardens.
Butlers Drain	Narborough	0.5m culvert under Meadow Track in forested area	Channel blockage due to tree branches at the time of the study (2007 SFRA) with water backing up to the Meadow Lane culvert.
Allotment Drain	Narborough	Culvert under farm access track	Unknown
Town Beck	North Elmham	Footbridge 100m downstream of Hold Road. Assorted materials fixed by the farmer to the underside of the bridge to contain the animals.	Unknown
Town Beck	North Elmham	Two 0.25m diameter pipes under Old Hall Farm track	Unknown
Parkland Stream	Shipdham	0.8m diameter culvert in wooded area with old trash screen lying in the channel.	Unknown
Weeting watercourse	Weeting	Brandon Road culvert	Unknown
Necton Brook	Necton	Chantry Lane culvert	Frequent floods.

Internal Drainage Board Records

The East Harling IDB and the Water Level Management Alliance (WLMA) have been consulted as part of the Level 1 SFRA update, and asked to identify any areas that are susceptible to localised flooding.

The East Harling IDB has confirmed that they are not aware of any recent incidents in the IDB district that have resulted in the flooding of properties. There is a history of flooding upstream from the drainage culvert at Briar Gardens (off Norwich Road) in Attleborough, which is due to blockage of the debris screen at the head of the culvert and Breckland DC carry out regular clearance of this screen to mitigate flooding. There is also occasional flooding of agricultural land (water meadow) at Hall Farm to the north of the A11 Attleborough bypass.

The East Harling IDB undertakes regular inspections of the maintained watercourses to ensure no blockages. A maintenance programme is prepared based on local reports and inspections.

There are no flood defence assets in the IDB district. There is a fixed water level control structure at East Harling mill that maintains upstream water levels.

Consultation with the WLMA confirmed that they do not hold any information regarding flooding incidents. Critical watercourses that are maintained by the WLMA undergo annual weed cutting, less critical watercourses undergo maintenance work as required. There are no pumping stations or important water control structures within the IDB district.

Highways England Records

The Highways Agency records show that the A11 and/or the underpass at Stone Cross, near Roudham Heath, have been flooded several times since 2002 due to pumping failure. Blocked gullies have been the cause of surface water flooding on the A47 in July 2004 near Dereham, and July 2005 between Little Fransham and Scarning, and on the A11 to the north-east of Thetford in August 2006.

There are two trunk roads in the Breckland District under the Highways Agency (A11 and A47). Data of historic flood events on these roads since 2002 is presented in

Table 3-10.

No further records have been supplied by Highways England during the consultation as part of the SFRA update.

Table 3-10 Historic Flood Records on Highways England Roads

Date of Call	Location	Description
15/08/2002	A47 Between Honningham and Hockering	Floodign in residents' gardens
06/11/2002	A47 slip road to Swaffham	Flood on road
29/12/2002	A47 Dereham bypass	Serious flooding on road
14/03/2003	A47 Dereham, between Middlemitch and Moorgate roads	Flooding on underpass
30/07/2003	A47 Dereham just after B11110 Junction	Flooding across main carriageway, risk of aquaplaning
20/12/2003	A47 Wending junction near Beeston	Flood in carriageway
06/02/2004	A11 Attleborough bypass	Flood in lane 2
26/04/2004	A11 Snetterton	Flooding on underpass
28/04/2004	A11 Stone Cross, Roundham Heath	Flooding on underpass
04/05/2004	A11 Stone Cross	Area flooding due to pump not working
08/07/2004	A47 Hockering	Floodign reported as "torrent" across road eastbound
09/07/2004	A47 Dereham	Blocked gully near pond causing flood
12/08/2004	A47 at Necton	Flooding quite bad eastbound
23/08/2004	A11 Stone Cross	Bad flooding
27/08/2004	A11 Quidenham	Flood on road
14/10/2004	A11 Thetford Bypass	Flood on road
07/07/2005	A47 between Scarling and Little Fransham	Blocked gully causing possible flooding westbound
03/08/2006	A11 Stone Cross, Roundham Heath	Flooding road - pump needs assessing
24/08/2006	A11 Thetford, between A1075 R/Bt and Croxton interchange	Flooded central reservation and north side - gully heads need freeing up
24/08/2006	A11 Thetford, south of Sainsburys roundabout	Layby entrance flooded
20/09/2006	A11 S/B Snetterton, Stone cross	Flooding on underpass
01/10/2006	A11 Stone Cross, Roundham Heath	Flood warning signs requested
02/10/2006	A11 Stone Cross, Roundham Heath	High level flooding
10/01/2007	A11 Besthorpe	Flooding in both lanes
21/01/2007	A11 1st turn for Thetford	Flooding under roads, due to a fault with the pumping station
08/05/2007	A11 Thetford just south of BP garages	Flood on road
25/06/2007	A47 approx. 1 mile after Little Fransham	Reports of flood water approx 2ft deep and 100 yards in length
25/06/2007	A47 Mattishall turning	Localised flooding

Norfolk County Council Records

The Norfolk CC LFRMS notes that compared to the level of risk in other Norfolk districts some of the major urban areas in Breckland do face significant local flood risk. A SWMP has not yet been undertaken for any of the settlements in Breckland, and reliable information on surface water flooding is diffuse.

In the urban areas in the district there has historically been a reliance on sewers for drainage and many watercourses have been extensively culverted. This has led to a number of instances of flooding due to blockages, or inadequate capacity in the drainage network as detailed in Table 3-11.

Table 3-11 Norfolk CC Historic Flood Records

Date	Location	Type
06/03/2012	Caudle Springs, Carbrooke	Internal
23/07/2012	Yaxham Road, South Green	Internal

The Norfolk CC Highways Team has been consulted as part of the SFRA update. In order to help indicate areas where there may be ongoing issues with drainage, a list of drainage schemes in the Breckland area has been provided by the programme team, as shown in Table 3-12.

Table 3-12 Norfolk CC Highways Department Drainage Schemes in Breckland

2015 – 2016
PM5152 Deopham Low Road
PM5169 Shropham Watton Road
PM5180 Swanton Morley Manns Lane
PM5181 Great Dunham Palgrave Road
PM5200 Shropham Bradcar Road
2016 – 2017
PM5104 Dereham Hillcrest Avenue
PM5159 Caston The Street
2017 – 2018 (The following schemes are yet to be prioritised and may therefore be subject to change).
W30D B1111 STOW BEDON Watton Road B1111 Breckland
W47D C873 WEETING-WITH-BROOMHILL Brandon Rd / Fengate Drove Drainage Improvement Breckland
W31D 33368 WEETING-WITH-BROOMHILL ALL SAINTS, WEETING Breckland
S20D A1075 DEREHAM Shipdham Road Breckland DC lead authority South Breckland

3.5.2 Updated Flood Map for Surface Water

The Environment Agency has undertaken modelling of surface water flood risk at a national scale and produced mapping identifying those areas at risk of surface water flooding during three annual probability events: 1 in 30 year (3.33% annual probability), 1 in 100 year (1% annual probability and 1 in 1,000 year (0.1% annual probability). The latest version of the mapping is referred to as the 'updated Flood Map for Surface Water' (uFMfSW) and the extents have been made available for the Level 1 SFRA as GIS layers. This dataset is also available of the Environment Agency website, and is referred to as 'Risk of Flooding from Surface Water'.

The uFMfSW provides all relevant stakeholders, such as the Environment Agency, LPAs and the public access to information on surface water flood risk which is consistent across England and Wales[22]. The modelling helps the Environment Agency take a strategic overview of flooding, and assists LLFAs in their duties relating to management of surface water flood risk. For the purposes of this SFRA, the mapping allows an improved understanding of areas within the study area which may have a surface water flood risk.

The modelling represents a significant improvement on previous mapping, namely the FMfSW (2010) and the Areas Susceptible to Surface Water Flooding (AStSWF) (2009), for example:

- Increased model resolution to 2m grid,
- Representation of buildings and flow routes along roads and manual editing of the model for structural features such as flyovers,
- Use of a range of storm scenarios, and
- Incorporation of appropriate local mapping, knowledge and flood incident records.

However, it should be noted that this national mapping has the following limitations:

- Use of a single drainage rate for all urban areas,
- It does not show the susceptibility of individual properties to surface water flooding,
- The mapping has significant limitations for use in flat catchments,

[22] Environment Agency (2013) 'What is the updated Flood Map for Surface Water?'

- No explicit modelling of the interaction between the surface water network, the sewer systems and watercourses,
- In a number of areas, modelling has not been validated due to a lack of surface water flood records, and
- As with all models, the uFMfSW is affected by a lack of, or inaccuracies, in available data.

The uFMfSW for the study area is presented in **Appendix A Figure 6.**

Climate Change

The uFMfSW does not include a specific scenario to determine the impact of climate change on the risk of surface water flooding. However a range of three annual probability events have been undertaken, 3.3%, 1% and 0.1% and therefore it is considered appropriate to use the 0.1% AEP event as a substitute dataset to provide a worst case scenario and an indication of the implications of climate change.

3.6 Flooding from Groundwater

Groundwater flooding usually occurs in low lying areas underlain by permeable rock and aquifers that allow groundwater to rise to the surface through the permeable subsoil following long periods of wet weather. Low lying areas may be more susceptible to groundwater flooding because the water table is usually at a much shallower depth and groundwater paths tend to travel from high to low ground.

3.6.1 Historic Records of Groundwater Flooding

Owing to the underlying chalk aquifer in the district, groundwater flooding could potentially be an issue. Following significant rainfall in 2012 there have been some instances of flooding associated with high groundwater levels[23]. However at this time there is limited understanding of the risk of groundwater flooding in the district.

It should be noted that there has not been a statutory obligation to record incidences of groundwater flooding in the past and therefore it is likely that the groundwater flooding incidents recorded are not exhaustive.

3.6.2 Areas Susceptible to Groundwater Flooding

As part of the SFRA, an assessment of the risk of groundwater flooding needs to be considered; however, a quantified assessment of risk from groundwater flooding is difficult to undertake, especially on a strategic scale. This is due to lack of groundwater level records, the variability in geological conditions and the lack of predictive tools (such as modelling) that can be used to make assessments of groundwater flow and risk of groundwater flooding following rainfall events.

The Environment Agency Areas Susceptible to Groundwater Flooding (AStGWF) dataset is a strategic scale map showing groundwater flood areas on a 1km square grid. The Environment Agency has provided information with the data and guidance for using it, which is summarised below.

The AStGWF dataset has been prepared primarily as part of the PFRA process, to allow LLFAs across England and Wales such as Norfolk CC to obtain a broad feel for the wider areas which might be at risk from groundwater flooding.

The data has used the top two susceptibility bands of the BGS 1:50,000 Groundwater Flood Susceptibility Map and therefore covers consolidated aquifers and superficial deposits. It does not take account of the chance of flooding from groundwater rebound. It shows the proportion of each 1m square where geological and hydrogeological conditions show that groundwater might emerge. The susceptible areas are represented by one of four area categories showing the proportion of each 1km square that is susceptible to groundwater emergence. It does not show the likelihood of groundwater flooding occurring.

The dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The datasets has a number of limitations, as follows:

- The AStGWF dataset has not been formally assessed as appropriate for any other use than the PFRA;

[23] Norfolk County Council, March 2015, Local Flood Risk Management Strategy, Consultation Draft.

- The data should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding, but may be of use to LLFAs in identifying, where, for example, further studies may be useful;

- The AStGWF should not be used as the sole evidence for any specific flood risk management, land use planning or other decision at any scale. The data may however help to identify areas for assessment at a local scale where finer resolution datasets exist.

The AStGWF dataset has been mapped in **Appendix A Figure 7**. It highlights that the susceptibility to groundwater flooding correlates to the river corridors and the corresponding variations in geology. There are 1km squares with greater proportions of groundwater emergence along the river corridors.

3.7 Flooding from Sewers

Sewer flooding occurs when a sewer is full and overflows occur at manholes or drains in gardens (referred to as external flooding); or even inside of the building from toilets and drains (referred to as internal flooding). Basement conversions are particularly prone to sewer flooding, where they lie low relative to the depth of the public sewer.

During heavy rainfall, flooding from the sewer system may occur if:

(1) The rainfall event exceeds the capacity of the sewer system/drainage system:

Sewer systems are typically designed and constructed to accommodate rainfall events with a 3.3% AEP or less. Therefore, rainfall events with a return period of frequency greater than 3.3% AEP would be expected to result in surcharging of some of the sewer system. While Anglian Water Services (AWS), as the sewerage undertaker for the study area, recognise the impact that more extreme rainfall events may have, it is not cost beneficial to construct sewers that could accommodate every extreme rainfall event.

(2) The system becomes blocked by debris or sediment:

Over time there is potential that road gullies and drains become blocked from fallen leaves, build-up of sediment and debris (e.g. litter).

(3) The system surcharges due to high water levels in receiving watercourses:

Within the study area there is potential for surface water outlets to become submerged due to high river levels. When this happens, water is unable to discharge. Once storage capacity within the sewer system itself is exceeded, the water will overflow into streets and potentially into houses. Where the local area is served by 'combined' sewers i.e. containing both foul and storm water, if rainfall entering the sewer exceeds the capacity of the combined sewer and storm overflows are blocked by high water levels in receiving watercourses, surcharging and surface flooding may again occur but in this instance floodwaters will contain untreated sewage.

Historic Records of Sewer Flooding

Historic records of sewer flooding were provided by AWS during the preparation of the original SFRA in 2007. A request was made to AWS for a revised version of the DG5 Flood Register for the study area, however no data has been provided.

Details of historic records of sewer flooding are summarised below:

- The Lynn News reported that sewer flooding occurred in Necton, Chantry Lane, in June 2007 due to a manhole cover being lifted up. The Lynn News also reports regular sewer flooding in Sporle Road, New Sporle Road and West Acre Road, in Swaffham.

- Anglian Water reported several sewer flooding incidents in Breckland, mostly external, with frequencies between 2 every 10 years (2:10) and 1 every 20 years (1:20).

- Dereham is a "hotspot" for sewer flooding, which has occurred at the following locations:

- Norwich Road, South Green, Swanton Grove, Swanton Road, Wellington Road, Larner's Drift, Rash's Green, Hillcrest Avenue, and Boyd Avenue. Particularly noticeable are the internal flooding at Larner's Drift and the external flooding at Norwich Road which both occur at the high frequency of 2:10.

- According to the Environment Agency, sewer flooding in Larner's Drift and Lavender Grove occurred in a number of recent years due the unauthorised connection of surface water drainage facilities into the foul sewer.

- Sewer flooding is also quite significant in Watton in Brandon Road, Swaffham Road, Saham Road, and particularly in Norwich Road with 2:10 years frequency (internal and external).

- Internal and external sewer flooding occurred in Thetford town centre at Bridges Walk in August 2006 with 1:20 frequency and to the north of the town in Fairfields with 2:10 frequency.

- There is a sewer flooding issue in Bell Lane in Saham Toney, with a flooding frequency 1:10.

- Internal sewer flooding occurs in Chapel Street in Shipdham with 2:10 frequency.

- In addition sewer flooding has also been recorded in Bawdeswell and Whissonsett.

3.8 Reservoirs, Canals and Other Artificial Sources

The failure of a reservoir has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The NPPG encourages LPAs to identify any impounded reservoirs and evaluate how they might modify the existing flood risk in the event of a flood in the catchment it is located within, and / or whether emergency draw-down of the reservoir will add to the extent of flooding.

Reservoirs present in the study area are listed in Table 3-14Table 3-14. There is no record of reservoirs flooding in Breckland. However each reservoir is attributed a risk category which is based on the consequence of flooding, as shown in Table 3-13. In Breckland there is only one reservoir classified in the highest risk category "A", Dillington Carr, located in the north-west of Dereham. There is also one reservoir classified in the category "B", Hanger End, near Narborough. All the other reservoirs are classified in lowest risk category "D", or the risk has not been assessed.

Table 3-13 Consequence classification for impounding reservoirs

Risk Category Notes (Floods and Reservoir Safety; ICE 1996)
A At least 10 lives at risk and extensive property damage
B Fewer than 10 lives at risk but extensive property damage
C Negligible risk to human life but property damage
D No significant risk to life or property damage

Reservoirs in the UK have an extremely good safety record. The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers. It is assumed that these reservoirs are regularly inspected and essential safety work is carried out. These reservoirs therefore present a managed risk. Breckland DC is responsible for working with members of the Local Resilience Forum (LRF) to develop emergency plans for reservoir flooding and ensuring communities are well prepared.

Risk of Flooding from Reservoirs Mapping

The Environment Agency dataset 'Risk of Flooding from Reservoirs' available online identifies areas that could be flooded if a large[24] reservoir were to fail and release the water it holds. The mapping has been used to identify the risk across the study area and is referred to in the Area Assessments in Appendix C.

[24] A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools.

Table 3-14 Reservoirs in Breckland (Mott MacDonald 2007, revised 2015)

Reservoir	Location	Undertaker	NGR	Risk Category	Capacity (m^3)	EA Mapping*
Battles East	Near Swaffham	Queensquare Farming Limited	TF7390010400	Unknown	91,000	Y
Bridgeham Reservoir	Near Thetford	Paul Rackham Ltd	TL9560086500	Unknown	230,000	Y
Buckenham Tofts Upper	Near Thetford	Ministry of Defence	TL8400095000	D	30,000	Y
Caldecote Farm	Near Swaffham	Heygate Farm (Swaffham Ltd)	TF7610004000	Unknown	90,000	
Chalk Breck	Beachamwell	DH Sanderson and Son Ltd	TF550008300	Unknown	140,000	
Church Farm	Watton	Watton Produce Company Ltd	597649 292206	Unknown	Unknown	Y
Cley Breck North	Near Swaffham	Knights Farm Ltd	TF7700003800	Unknown	70,000	
Croxton Park Reservoir	Thetford	Croxton Park Ltd	TL8640086800	Unknown	320,000	Y
Dillington Carr	Near Dereham	Gorgate Ltd	TF9729416426	A	55,993	
Euston Reservoir	Thetford	Euston Estate	592421 276208	Unknown	Unknown	Y
Fourteen Acre Field	Near Swaffham	Heygate Farm (Swaffham) Ltd	TF8020007600	D	184,500	Y
Green Lane Reservoir	Near Swaffham	Heygate Farms Swaffham Ltd	581442, 303102	Unknown	Unknown	Y
Hadler's Hole, Croxton Hall Farm Res	Thetford	Goucher	TL8790086700	Unknown	140,000	Y
Hall Farm Reservoir Illington	Thetford	Richard Johnston Ltd	TL9450089300	Unknown	230,000	Y
Hamrow Farm	Near Whissonett	Stangroom Bros Ltd	TF9110023800	Unknown	29,000	
Hanger End (ID114)	Near Narborough	Narborough Farms Ltd	TF7490810333	B	27,523	
Highmore Drove	Northwold	JW Spencer Farms Ltd	TL7680098100	Unknown	Unknown	
Honey Potts (Field 6)	Near Swaffham	Knights Farm Ltd	TF7730000600	Unknown	31,000	
Hullgate Field	Near Swaffham	Sth Pickenham Estate Company Ltd	585824 303459	Unknown	Unknown	Y
Kirk Hall Farm	Attleborough	Kirk Hall Farms	TL9920095100	Unknown	81,000	Y
Larkshall Farm Reservoir	Near Thetford	Messrs RG Abrey Farms	TL9210089100	Unknown	25,000	Y
Narford Lake	Near Kings Lynn	Fountaine	TF7600014000	Unknown	400,000	Y
Piggeries Farm	Diddlington	J.W. Spencer Farms Ltd	580304, 296363	Unknown	Unknown	Y
RG Abrey Millienium Reservoir	Near Thetford	Abrey	TL9250089200	Unknown	460,000	Y
Sixty Million Gallon	Near Thetford	Abrey	592212, 289414	Unknown	Unknown	Y
Shadwell Park Lake	Near Thetford	Shadwell Estate Co.Td	591591 282950	Unknown	Unknown	Y
Soigne Reservoir	Narborough Gayton?	Heronhill Water LLP	577503 318089	Unknown	Unknown	Y
South Pickenham	Near Swaffham	Sth Pickenham Estate Company Ltd	TF8570003300	Unknown	312,500	Y
Stanford Water	Near Thetford	Ministry of Defence	TL8610095000	Unknown	85,000	Y
Swangey Farm Reservoir	Attleborough	PF Southgate Ltd	TM0150094300	Unknown	113,000	Y
Top Strong Land	Near Oxborough	Oxborough Farms Ltd	TF7580002900	D	92,000	
Warren Farm Beachamwell	Near Swaffham	Heygate Farm (Swaffham) Ltd	TF7770006300	D	92,000	
Warren Gun Breck	Near Swaffham	Knights Farm Ltd	TF7970002600	Unknown	332,000	

* Mapped on the Environment Agency 'Risk of Flooding from Reservoirs' mapping, available online.

4 Avoiding Flood Risk – Applying the Sequential Test

4.1 Sequential Approach

This Section guides the application of the Sequential Test and Exception Test in the Plan-making and planning application processes. Not all development will be required to undergo these tests, as described below, but may still be required to undertake a site specific FRA, guidance about which is included in Section 7.

The Sequential Test is a simple decision-making tool designed to ensure that sites at little or no risk of flooding are developed in preference to sites at higher risk. This will help avoid the development of sites that are inappropriate on flood risk grounds. The subsequent application of the Exception Test, where required, will ensure that new developments in areas of particular flood risk will only occur where flood risk is clearly outweighed by other sustainability drivers and where development can be made safe from flooding and not increase the risk of flooding elsewhere. All opportunities to locate new developments (except Water Compatible) in reasonably available areas of little or no flood risk should be explored, prior to any decision to locate them in areas of higher risk.

The sequential approach can be applied at all levels and scales of the planning process, both between and within Flood Zones. Details of applying the sequential approach within individual specific sites are included in Section 5.2.

4.2 Applying the Sequential Test – Plan-Making

As the LPA, Breckland DC must demonstrate that throughout the site allocation process a range of possible sites have been considered in conjunction with the flood risk and vulnerability information from the SFRA, and that the Sequential Test, and where necessary the Exception Test, has been applied. Figure 4-1 illustrates a potential approach for applying the Sequential Test that Breckland DC could adopt in the allocation of sites as part of the preparation of their Local Plan. In order to ensure that the Sequential Test takes account of flood risk from all sources, Table 4-1 provides a suggested flood risk classification based on available datasets.

The Sequential Test should be undertaken by Breckland DC and accurately documented to ensure decision processes are consistent and transparent.

Table 4-1 Flood Risk Classifications for Sequential Test

Risk	Source of Flooding				
	Fluvial	Surface Water	Groundwater	Sewer	Reservoir
Low	Flood Zone 1	uFMfSW Very Low	AStGWF (<25%)	Anglian Water to assess the sewer network for each site	Use EA Flooding from Reservoirs map
Medium	Flood Zone 2	uFMfSW Low to Medium	AStGWF (25-50%) AStGWF (50-75%) AStGWF (>75%)		N/A
High	Flood Zone 3a	uFMfSW High	Historic records of groundwater flooding		N/A
Very High	Flood Zone 3b	N/A	N/A		N/A

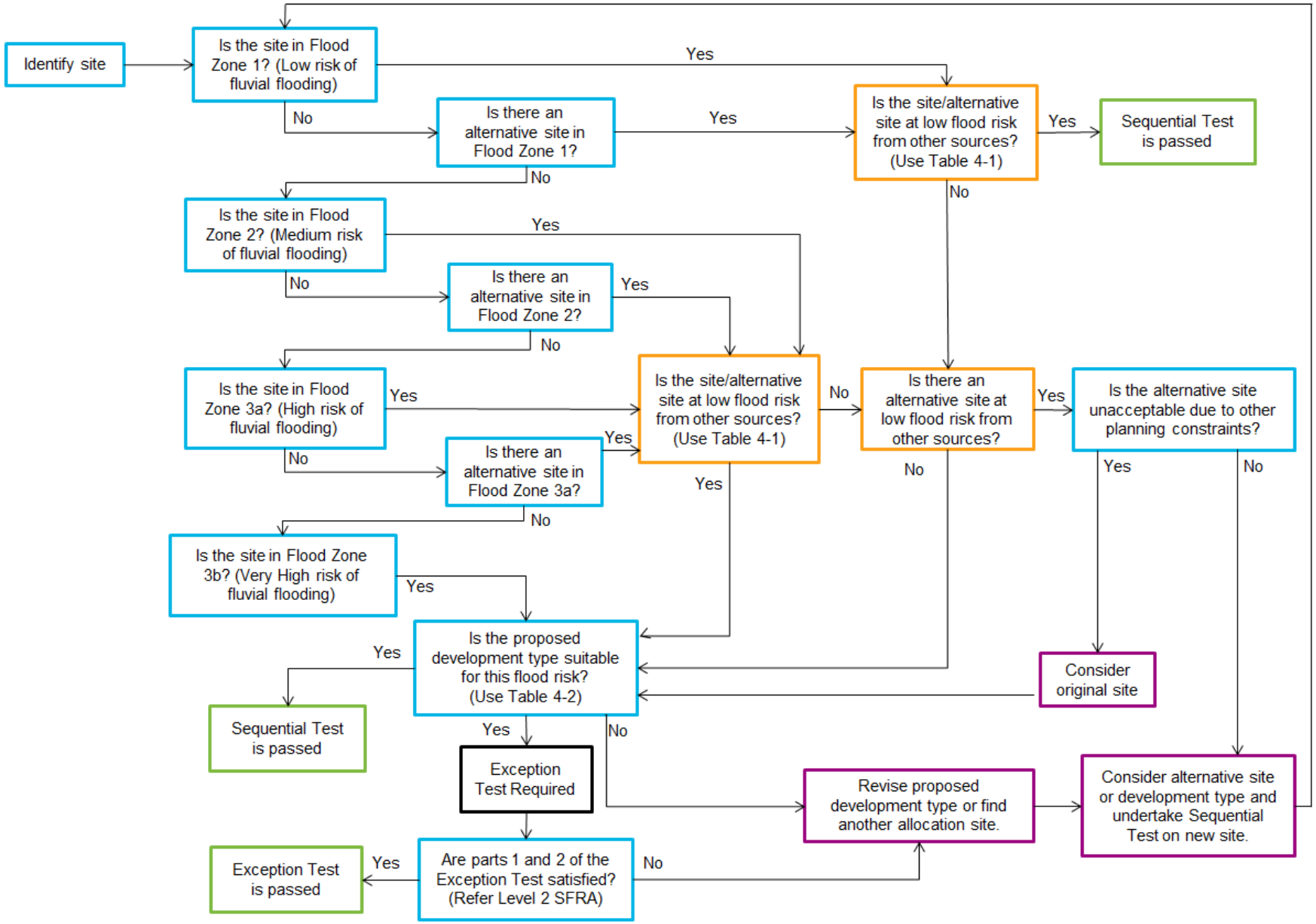


Figure 4-1 Application of Sequential Test for Plan-Making

The Sequential Test requires an understanding of the Flood Zones in the study area, the risk from other sources of flooding, and the vulnerability classification of the proposed developments. Flood Zone definitions are provided in Table 3-2 and mapped in the figures in Appendix B (and the Flood Map for Planning (Rivers and Sea) on the Environment Agency website). Flood risk vulnerability classifications, as defined in the NPPG are presented in Table 4-2.

Table 4-2 Flood Risk Vulnerability Classification (PPG, 2014)

Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines.
Highly Vulnerable	• 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. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as "essential infrastructure").
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding. • 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 assembly 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 works which do not need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).
Water Compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • 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 conservation 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.

The NPPF acknowledges that some areas will (also) be at risk of flooding from sources other than fluvial. All sources must be considered when planning for new development including: flooding from land or surface water runoff; groundwater; sewers; and artificial sources.

If a location is recorded as having experienced repeated flooding from the same source this should be acknowledged within the Sequential Test.

The recommended steps in undertaking the Sequential Test are detailed below. This is based on the Flood Zone and Flood Risk Vulnerability. Table 4-3 indicates the compatibility of different development types with the Flood Zones.

Table 4-3 Flood Risk Vulnerability and Flood Zone 'Compatibility' (PPG, 2014)

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	1	✓	✓	✓	✓	✓
	2	✓	✓	Exception Test Required	✓	✓
	3a	Exception Test Required	✓	×	Exception Test Required	✓
	3b	Exception Test Required	✓	×	×	×

✓ - Development is appropriate × - Development should not be permitted

4.2.1 Recommended stages for LPA application of the Sequential Test in Plan-Making

The information required to address many of these steps is provided in the accompanying GIS layers and maps presented in Appendix A.

a. Assign potential developments with a vulnerability classification (Table 4-2). Where development is mixed, the development should be assigned the highest vulnerability class of the developments proposed.

b. The location and identification of potential development should be recorded.

c. The Flood Zone classification of potential development sites should be determined based on a review of the Flood Map for Planning (Rivers and Sea). Where these span more than one flood zone, all zones should be noted.

d. The risk of flooding from other sources should also be identified, based on readily available datasets and local information.

e. Identify existing flood defences serving the potential development sites. (However, it should be noted that for the purposes of the Sequential Test, flood zones ignoring defences should be used).

f. The design life of the development should be considered with respect to climate change:

- 100 years – up to 2116 for residential developments; and
- Design life for commercial / industrial developments will be variable, however a 75 year design life may be assumed for such development, unless demonstrated otherwise.

g. Highly Vulnerable developments to be accommodated within the LPA area should be located in those sites identified as being within Flood Zone 1 and at low risk of flooding from other sources. If these cannot be located in area of low flood risk, because the identified sites are unsuitable or there are insufficient sites in areas of low flood risk, sites in Flood Zone 2 can then be considered. Highly Vulnerable developments in Flood Zone 2 will require application of the Exception Test. If sites in Flood Zone 2 are inadequate then the LPA may have to identify additional sites in Flood Zones 1 or 2 to accommodate development or seek opportunities to locate the development outside their administrative area. Within each flood zone Highly Vulnerable development should be directed, where possible, to the areas at lowest risk from all sources of flooding. It should be noted that Highly Vulnerable development is not appropriate in Flood Zones 3a and 3b.

h. Once all Highly Vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as More Vulnerable. In the first instance More Vulnerable development should be located in any unallocated sites in Flood Zone 1 and at low risk of flooding from other sources. Where these sites are unsuitable or there are insufficient sites remaining, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate More Vulnerable development, sites in Flood Zone 3a can

be considered. More Vulnerable developments in Flood Zone 3a will require application of the Exception Test[25]. As with Highly Vulnerable development, within each flood zone More Vulnerable development should be directed to areas at lowest risk from all sources of flooding. It should be noted that More Vulnerable development is not appropriate in Flood Zone 3b.

i. Once all More Vulnerable developments have been allocated to a development site, the LPA can consider those development types defined as Less Vulnerable. In the first instance Less Vulnerable development should be located in any remaining unallocated sites in Flood Zone 1 and at low risk of flooding from other sources, continuing sequentially with Flood Zone 2, then Flood Zone 3a. Less Vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.

j. Essential Infrastructure should be preferentially located in the lowest flood risk zones, however this type of development may be located in Flood Zones 3a and 3b, provided the Exception Test is satisfied.

k. Water Compatible development has the least constraints with respect to flood risk and it is considered appropriate to allocate these sites last. The sequential approach should still be followed in the selection of sites; however it is appreciated that Water Compatible development by nature often relies on access and proximity to water bodies.

l. Where the development type is Highly Vulnerable, More Vulnerable, Less Vulnerable or Essential Infrastructure and a site is found to be impacted by a recurrent flood source (other than fluvial), the site and flood sources should be investigated further regardless of any requirement for the Exception Test.

4.2.2 Windfall Sites

Windfall sites are those which have not been specifically identified as available in the Local Plan process. They comprise previously-developed sites that have unexpectedly become available. In cases where development cannot be fully met through the provision of site allocations, LPAs are expected to make a realistic allowance for windfall development, based on past trends and expected future trends. It is recommended that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

4.3 Applying the Sequential – Individual Applications

If development is proposed in Flood Zone 2 or 3, and the Sequential Test has not already been carried out for the site for the same development type at the Local Plan level, then it is necessary to undertake a Sequential Test for the site. The Environment Agency publication 'Demonstrating the Flood Risk Sequential Test for Planning Applications'[26] sets out the procedure as follows:

- Identify the geographical area of search over which the test is to be applied; this could be the District area, or a specific catchment if this is appropriate and justification is provided (e.g. school catchment area or the need for affordable housing within a specific area identified for regeneration in Local Plan policies).
- Identify the source of 'reasonably available' alternative sites; usually drawn from evidence base / background documents produced to inform the Local Plan.
- State the method used for comparing flood risk between sites; for example the Environment Agency Flood Map for Planning, the SFRA mapping, site-specific FRAs if appropriate, other mapping of flood sources.
- Apply the Sequential Test; systematically consider each of the available sites, indicate whether the flood risk is higher or lower than the application site, state whether the alternative option being considered is allocated in the Local Plan, identify the capacity of each alternative site, and detail any constraints to the delivery of the alternative site(s).
- Conclude whether there are any reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
- Where necessary, as indicated by Table 4-3, apply the Exception Test.
- Apply the Sequential approach to locating development within the site (as described in Section 5).

It should be noted that it is for LPAs, taking advice from the Environment Agency as appropriate, to consider the extent to which Sequential Test considerations have been satisfied, taking into account the particular circumstances in any given case. The developer should justify with evidence to the LPA what area of search has been used when making the application. Ultimately Breckland DC needs to be satisfied in all cases that the proposed development would be safe and not lead to increased flood risk elsewhere.

[25] And thereby trigger the need for an increased scope Level 2 Strategic Flood Risk Assessment.
[26] Environment Agency, April 2012, 'Demonstrating the flood risk Sequential Test for Planning Applications', Version 3.1

4.3.1 Sequential Test Exemptions

It should be noted that the Sequential Test does not need to be applied in the following circumstances:

- Individual developments proposed on sites which have been allocated in development plans through the Sequential Test.
- Minor development, which is defined in the NPPF as:
    - minor non-residential extensions: industrial / commercial / leisure etc. extensions with a footprint <250m^2;
    - alterations: development that does not increase the size of buildings e.g. alterations to external appearance;
    - householder development: for example; sheds, garages, games rooms etc. within the curtilage of the existing dwelling , in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats;
- Change of Use applications, unless it is for a change of use of land to a caravan, camping or chalet site, or to a mobile home site or park home site;
- Development proposals in Flood Zone 1 (land with a low probability of flooding from rivers or the sea) and at low risk of flooding from other sources, unless the SFRA, or other more recent information, indicates there may be flooding issues now or in the future (for example, through the impact of climate change);
- Redevelopment of existing properties (e.g. replacement dwellings), provided they do not increase the number of dwellings in an area of flood risk (i.e. replacing a single dwelling with an apartment block).

4.4 Exception Test

The purpose of the Exception Test is to ensure that where it may be necessary to locate development in areas at risk of flooding, new development is only permitted in Flood Zone 2 and Flood Zone 3 where the flood risk is clearly outweighed by other sustainability factors and where the development will be safe during its lifetime, considering climate change.

Applying the Exception Test should only be considered once it has been demonstrated that the Sequential Test has been satisfied; i.e. it has been adequately demonstrated, to the satisfaction of Breckland DC as the LPA, that there are no alternative sites at lower risk of flooding where the proposed development could be located.

The NPPF states that for the Exception Test to be passed:

– *Part 1 - "It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by the SFRA where one has been prepared; and*

– *Part 2 - A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall."*

Both elements of the test will have to be passed for development to be allocated or permitted.

In order to determine Part 1) of the Exception Test, applicants should assess their scheme against the objectives set out in the Sustainability Appraisal as set out in the Breckland DC Core Strategy and Development Control Policies Submission Sustainability Appraisal Report and reproduced in Table 4-4Table 4-4.

In order to demonstrate satisfaction of Part 2) of the Exception Test, relevant measures, such as those presented within Section 5, should be applied and demonstrated within a site-specific FRA as detailed in Section 7.

Table 4-4 Breckland DC Sustainability Appraisal Objectives[27]

SEA/SA Topic	Sustainability Appraisal Objective	Decision making (Appraisal) questions
Land, water and Soil Resources	1. Minimise the irreversible loss of undeveloped land and productive agricultural holdings and encourage the recycling/reuse of onsite resources to minimise the impacts on the environment and safeguard resources for the future generations.	Will it use land that has been previously developed?
		Will it use land efficiently?
		Will it protect and enhance the best and most versatile agricultural land?
		Will it use brownfield land?
		Will it recycle on site resources?
	2. Limit water consumption to the capacity of natural processes and storage systems and maintain and enhance water quality.	Will it reduce water consumption?
		Will it conserve groundwater resources?
		Will it maintain or enhance water quality?
	3. Ensure the sustainable reuse of water to accommodate additional growth and development with minimal impacts on water quality.	Will it reduce water consumption?
		Will it conserve groundwater resources?
		Will it maintain or enhance water quality?
Climate change and air pollution	4: Minimise the production of waste and support the recycling of waste.	Will it reduce waste?
		Will it re-use waste?
		Will it enable composting of waste?
		Will it enable recycling of waste?
		Will waste be recovered in other ways for other uses?
		Will it increase waste going to landfill?
		Will it encourage the re-use and recycling of aggregates?
		Will it lead to an increased proportion of energy needs being met from renewable sources?
	5. Reduce contributions to climate change and localised air pollution.	Will it reduce the emissions of greenhouse gases by reducing energy consumption?
		Will it improve air quality?
		Will it reduce traffic volumes?
		Will it support travel by means other than single occupancy car?
	6. To adapt to climate change and avoid, reduce and manage flood risk.	Will it increase the risk of flooding?
		Will it contribute to a higher risk elsewhere?
		Will it attenuate the flow and run off of water?
Biodiversity	7. Protect, conserve, enhance and expand biodiversity and promote and conserve geodiversity.	Will it protect, maintain and enhance sites designated for their nature conservation interest?
		Will it conserve and enhance species, diversity and green infrastructure and avoid harm to protected species?
		Will it promote and conserve geodiversity?
	8. Protect, enhance and increase Green Infrastructure in the District.	Will it protect the district's infrastructure?
		Will it enhance the district's infrastructure?
		Will it facilitate the creation of new Green Infrastructure which will improve links and corridors between open space?
Cultural heritage and landscape	9. Maintain, enhance and preserve the distinctiveness, diversity and quality of landscape and townscape character.	Will it maintain and enhance the distinctiveness of landscape and townscape character?
		Will it maintain and enhance the character of settlements?
		Will it protect and enhance open spaces of amenity and recreational value?
	10. Conserve and where appropriate enhance the historic environment.	Will it protect or enhance (designated) heritage assets?
		Will it protect or enhance the significance and setting of (designated) heritage assets?
Population and human health	11. Improve the health and wellbeing of the population.	Will it reduce early death rates?
		Will it increase life expectancy?
		Will it improve access to essential services such as health facilities?

[27] Core Strategy and Development Control Policies Submission Sustainability Appraisal Report https://www.breckland.gov.uk/sites/default/files/Uploads/Submission%20Sustainability%20Appraisal.pdf

SEA/SA Topic	Sustainability Appraisal Objective	Decision making (Appraisal) questions
		Will it encourage healthy lifestyles, including travel and food choices? Will it help the population to move more, eat well and live longer?
	12. Reduce and prevent crime	Will it reduce levels of crime?
	13. Improve the quality and quantity of publicly accessible open space.	Will it improve accessibility to open space?
		Will it improve the quality, quantity and multi functionality of accessible open space?
Inclusive communities	14. Improve the quality, range and accessibility of essential services and facilities.	Will it improve accessibility to key local services and facilities, including [illegible]?
		Will it improve accessibility to shopping facilities?
	15. Redress inequalities related to age, gender, disability, race, faith, location and income.	Will it address the Indices of Multiple Deprivation and the underlying indicators?
		Will it improve accessibility to essential services and facilities?
		Will it improve relations between people from different backgrounds and social groups?
	16. Ensure all groups have access to affordable, decent and appropriate housing that meets their needs.	Will it support the range of housing types and sizes, including affordable to meet the needs of all sectors in the community?
		Will it reduce the number of unfit homes?
		Will it reduce housing need?
		Will it meet the needs of the travelling community?
Economic Activity	17. Increase the vitality and viability of existing town centres.	Will it increase vitality of existing town centres?
		Will it increase viability of existing town centres?
		Will it provide for the needs of the local community?
	18. Help people gain access to satisfying work appropriate to their skills, potential and place of residence.	Will it support and improve education?
		Will it encourage employment and reduce employment overall?
		Will it improve access to employment?
		Will it improve access to employment by means other than single occupancy car?
	19. Improve the efficiency, competitiveness and adaptability of the local economy.	Will it improve business development and enhance competitiveness?
		Will it make land and property available for business development?
		Will it support sustainable tourism?

5 Managing and Mitigating Flood Risk

5.1 Overview

The NPPF appreciates that it may not always be possible to avoid locating development in areas at risk of flooding. This Section provides guidance on the range of measures that could be considered in order to manage and mitigate flood risk. Subject to the Sequential Test being passed for a particular site, these measures should be considered when preparing a site-specific FRA, as described in Section 7.

As noted in Section 3, it is essential that the development control process influencing the design of future development within the District carefully mitigates the potential impact that climate change may have upon the risk of flooding. As a result mitigation measures should be designed with an allowance for climate change over the lifetime of the proposed development as follows:

- 100 years (up to 2115) for residential developments; and
- 75 years (up to 2090) for commercial / industrial developments, or other time horizon specific to the non-residential use proposed.

5.2 Development Layout and Sequential Approach

A sequential approach to site planning should be applied within new development sites.

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Most large development proposals include a variety of land uses of varying vulnerability to flooding. The sequential approach should be applied within development sites to locate the most vulnerable elements of a development in the lowest risk areas (considering all sources of flooding) e.g. residential elements should be restricted to areas at lower probability of flooding whereas parking, open space or proposed landscaped areas can be placed on lower ground with a higher probability of flooding.

5.3 Riverside Development

Retain at least an 8 metre wide undeveloped buffer strip alongside main rivers and explore opportunities for riverside restoration. Retain an 8 metre wide buffer strip alongside ordinary watercourses. New development within 8m of a watercourse will require an environmental permit from the Environment Agency if it is a main river, or consent from Norfolk County Council (as LLFA) or the relevant Internal Drainage Board if it is an ordinary watercourse.

The Environment Agency is likely to seek at least an 8 metre wide undeveloped buffer strip alongside fluvial main rivers for maintenance purposes, and would also ask developers to explore opportunities for riverside restoration as part of any development. Norfolk CC and IDBs will seek a similar undeveloped buffer strip to be retained alongside ordinary watercourses.

As of 6th April 2016, the Water Resources Act 1991 and associated land drainage byelaws have been amended and flood defence consents will now fall under the Environmental Permitting (England and Wales) Regulations 2010. Any works within 8m of a Main River will be subject to the Environmental Permitting Regulations (EPR). Further details and guidance are available on the GOV.UK website[28]. The Environment Agency can be consulted regarding permission to do work on or near a river, floor or sea defence by contacting enquiries@environment-agency.gov.uk.

As of 6th April 2012 responsibility for the consenting of works by third parties on ordinary watercourses under Section 23 of the Land Drainage Act 1991 (as amended by the Flood and Water Management Act 2010) has transferred from the Environment Agency to the LLFA, Norfolk CC. Norfolk CC is now responsible for the consenting of works to ordinary watercourses outside of IDB districts, and has powers to enforce un-consented and non-compliant works. This includes any works (including temporary) within 8 metres that affect flow within the channel (such as in channel

[28] https://www.gov.uk/guidance/flood-risk-activities-environmental-permits.

structures or diversion of watercourses). Enquiries and applications for ordinary watercourse consent should be emailed to water.management@norfolk.gov.uk with 'Ordinary Watercourse Consent Application' as the subject title, or sent to Norfolk County Council, Flood & Water Management, County Hall, Martineau Lane, Norwich, Norfolk NR1 2SG.

An application form for Ordinary Watercourse Consent can be found on the Norfolk CC website http://www.norfolk.gov.uk/view/NCC103717

Norfolk CC, as the LLFA will be minded to reject applications for culverting in areas identified as being in Flood Zone 2 or 3a/3b and/or in an area of surface water flooding identified within the Environment Agency Flood Maps for Surface Water, due to the potential of proposed works increasing flood risk. Exceptions to this policy will only be considered if the applicant is able to demonstrate that, on the balance of probabilities, the proposed development would not increase flood risk. Where Norfolk CC is made aware of breaches to other legislation then it will make the appropriate organisation aware of this.

5.4 Floodplain Compensation Storage

All new development within the 1% AEP flood extent including an allowance for climate change (for the lifetime of the development) must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water, and should seek opportunities to provide betterment with respect to floodplain storage. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced.

As depicted in Figure 5-1, floodplain compensation must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it be in the immediate vicinity, in the applicant's ownership and linked to the site[29]. Floodplain compensation must be considered in the context of the 1% annual probability (1 in 100 year) flood level including an allowance for climate change. When designing a scheme flood water must be able to flow in and out and must not pond. An FRA must demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624[30].

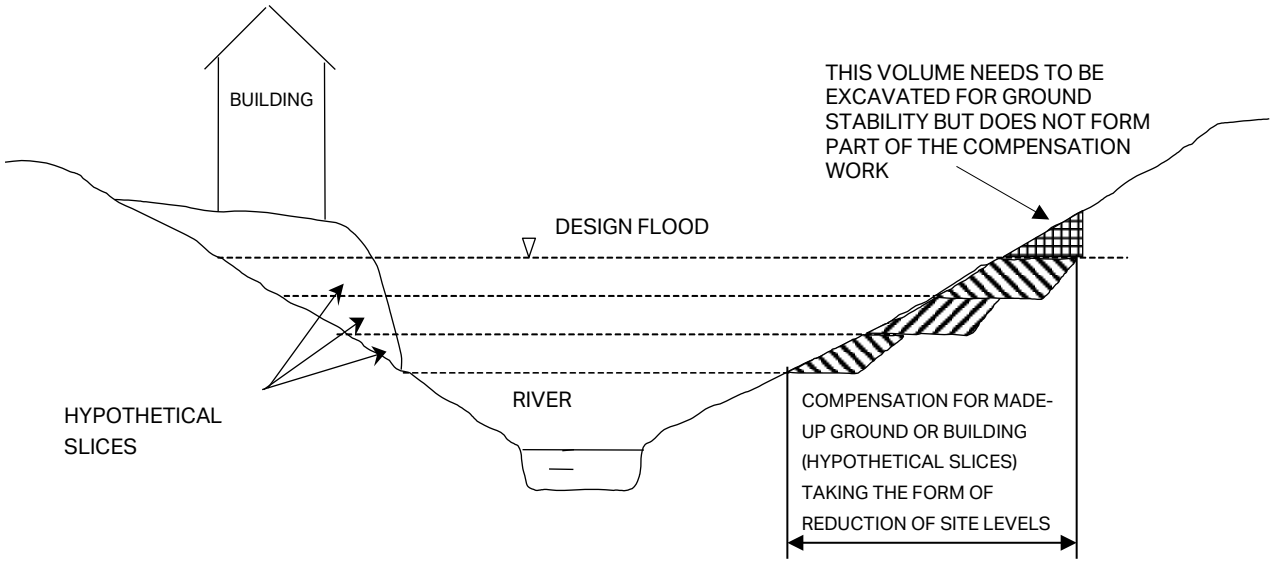


Figure 5-1 Example of Floodplain Compensation Storage (Environment Agency 2009)

The requirement for no loss of floodplain storage means that it is not possible to modify ground levels on sites which lie completely within the floodplain (when viewed in isolation), as there is no land available for lowering to bring it into the floodplain. It is possible to provide off-site compensation within the local area e.g. on a neighbouring or adjacent site,

[29] In hydrological connectivity.
[30] CIRIA January 2004, CIRIA Report 624: Development and Flood Risk - Guidance for the Construction Industry

or indirect compensation, by lowering land already within the floodplain, however, this would be subject to detailed investigations and agreement with the Environment Agency to demonstrate (using an appropriate flood model where necessary) that the proposals would improve and not worsen the existing flooding situation or could be used in combination with other measures to limit the impact on floodplain storage.

5.5 Finished Floor Levels

All More Vulnerable and Highly Vulnerable development within Flood Zones 2 and 3 should set Finished Floor Levels 300mm above the known or modelled 1 in 100 annual probability (1% AEP) flood level including an allowance for climate change.

Where developing in Flood Zone 2 and 3 is unavoidable, the recommended method of mitigating flood risk to people, particularly with More Vulnerable (residential) and Highly Vulnerable land uses, is to ensure internal floor levels are raised a freeboard level above the design flood level. Finished floor levels should be set at least 300mm above the flood level or above ground level, whichever is more precautionary. It should be noted that land raising to achieve raised FFL should only be permitted if it can be provided in such a way that does not increase flood risk to surrounding areas.

In certain situations (e.g. for proposed extensions to buildings with a lower floor level or conversion of existing historical structures with limited existing ceiling levels), it could prove impractical to raise the internal ground floor levels to sufficiently meet the general requirements. In these cases, the Environment Agency and/or Breckland DC should be approached to discuss options for a reduction in the minimum internal ground floor levels provided flood resistance measures be implemented up to an agreed level. There are also circumstances where flood resilience measures should be considered first. These are described further below. For both Less and More Vulnerable developments where internal access to higher floors is required, the associated plans showing the access routes and floor levels should be included within any site-specific FRA.

5.6 Flood Resistance 'Water Exclusion Strategy'

There are a range of flood resistance and resilience construction techniques that can be implemented in new developments to mitigate potential flood damage. The Department for Communities and Local Government (CLG) have published a document 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'[31], the aim of which is to provide guidance to developers and designers on how to improve the resistance and resilience of new properties to flooding through the use of suitable materials and construction details. Figure 5-2 provides a summary of the Water Exclusion Strategy (flood resistance measures) and Water Entry Strategy (flood resilience measures) which can be adopted depending on the depth of floodwater that could be experienced.

[31] CLG (2007) *Improving the Flood Performance of New Buildings, Flood Resilient Construction*

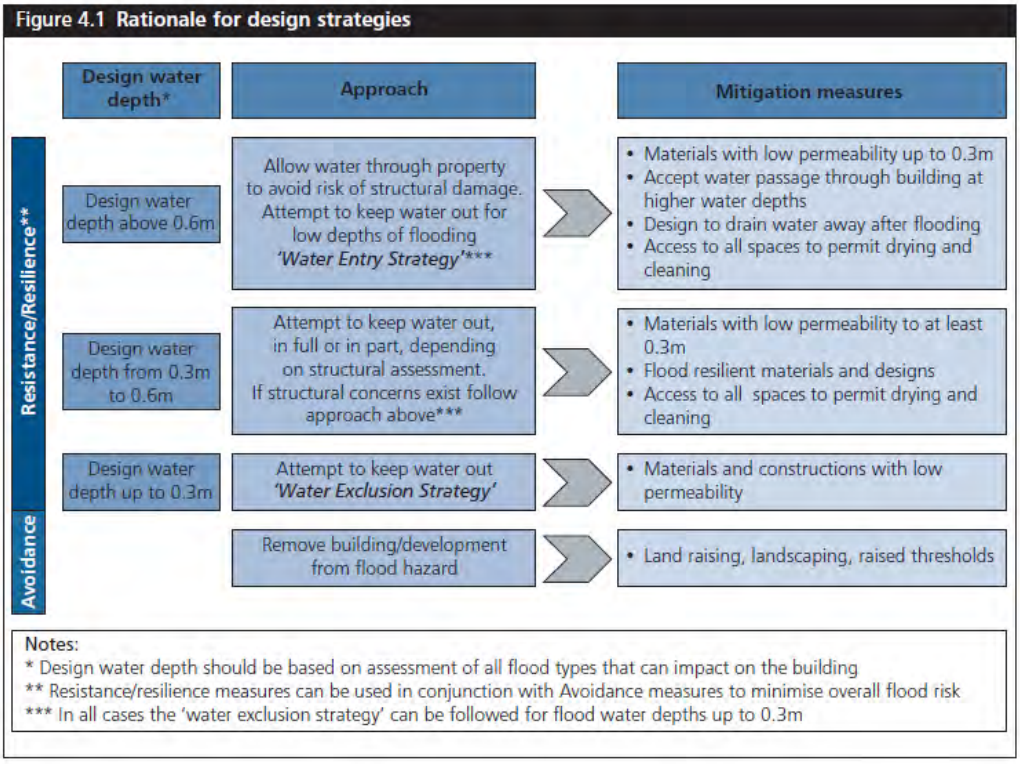


Figure 5-2 Flood Resistant / Resilient Design Strategies, Improving Flood Performance, CLG 2007

Resistance measures are aimed at preventing water ingress into a building (Water Exclusion Strategy); they are designed to minimise the impact of floodwaters directly affecting buildings and to give occupants more time to relocate ground floor contents. These measures will probably only be effective for short duration, low depth flooding, i.e. less than 0.3m, although these measures should be adopted where depths are between 0.3m and 0.6m and there are no structural concerns.

In areas at risk of flooding of low depths (<0.3m), the following flood resistance measures could be considered:

- Using materials and construction with low permeability.
- Land raising.
- Landscaping e.g. creation of low earth bunds (subject to this not increasing flood risk to neighbouring properties).
- Raising thresholds and finished floor levels e.g. porches with higher thresholds than main entrance.
- Flood gates with waterproof seals.

Property flood protection devices are available on the market, designed specifically to resist the passage of floodwater (Figure 5-3 and Figure 5-4). These include removable flood barriers and gates designed to fit openings, vent covers and stoppers designed to fit WCs. These measures can be appropriate for preventing water entry associated with fluvial flooding as well as surface water and sewer flooding. The efficacy of such devices relies on their being deployed before a flood event occurs. It should also be borne in mind that devises such as air vent covers, if left in place by occupants as a precautionary measure, may compromise safe ventilation of the building in accordance with Building Regulations.

Figure 5-3 Examples of flood barriers, air bricks and non-return valves

Figure 5-4 Example of flood gates

5.7 Flood Resilience 'Water Entry Strategy'

For flood depths greater than 0.6m, it is likely that structural damage could occur in traditional masonry construction due to excessive water pressures. In these circumstances, the strategy should be to allow water into the building, but to implement careful design in order to minimise damage and allow rapid re-occupancy. This is referred to as the Water Entry Strategy. These measures are appropriate for uses where temporary disruption is acceptable and suitable flood warning is received. It should be noted that these measures are used to minimise rather than prevent flooding, and the length of time spent out of the building during the 'clear-up' period may still be lengthy.

Materials should be used which allow the passage of water whilst retaining their structural integrity and they should also have good drying and cleaning properties. Alternatively sacrificial materials can be included for internal and external finishes; for example the use of gypsum plasterboard which can be removed and replaced following a flood event. Flood resilient fittings should be used to at least 0.1m above the design flood level. Resilience measures are either an integral part of the building fabric or are features inside a building that will limit the damage caused by floodwaters.

In areas at risk of frequent or prolonged flooding, the following flood resilience measures could be implemented:

- Use materials with either, good drying and cleaning properties, or, sacrificial materials that can easily be replaced post-flood.
- Design for water to drain away after flooding.
- Design access to all spaces to permit drying and cleaning.
- Raise the level of electrical wiring, appliances and utility metres.
- Coat walls with internal cement based renders; apply tanking on the inside of all internal walls.
- Ground supported floors with concrete slabs coated with impermeable membrane.
- Tank basements, cellars or ground floors with water resistant membranes.
- Use plastic water resistant internal doors.

Further specific advice regarding suitable materials and construction techniques for floors, walls, doors and windows and fittings can be found in 'Improving the Flood Performance of New Buildings, Flood Resilient Construction'32.

5.8 Structures

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 and designed in such a way as to prevent entrainment of debris which in turn could increase flood risk and/or breakaway posing a danger to life during high flows. Care should also be taken that these structures do not block flow paths and/or cause an increased risk to adjacent areas.

5.9 Safe Access and Egress

Safe access and egress is required to enable the evacuation of people from the development, provide the emergency services with access to the development during times of flood and enable flood defence authorities to carry out any necessary duties during periods of flood.

Within areas at risk of fluvial flooding, a safe access/egress route should allow occupants to safely enter and exit the buildings and be able to reach land outside the flooded area (e.g. within Flood Zone 1) using public rights of way without the intervention of emergency services or others during design flood conditions, including climate change allowances. This is of particular importance when contemplating development on sites located on dry islands.

Guidance prepared by the Environment Agency[33] uses a calculation of flood hazard to determine safety in relation to flood risk. Flood hazard is a function of the flood depth and flow velocity at a particular point in the floodplain along with a suitable debris factor to account for the hazard posed by any material entrained by the floodwater. The derivation of flood hazard is based on the methodology in Flood Risks to People FD2320, the use of which for the purpose of planning and development control is clarified in the abovementioned publication.

Table 5-1 Hazard to People Rating (HR=d x (v +0.5) + DF) (Table 13.1 FD2320/TR2)

Flood Hazard	Hazard Rating	Description
Low	Less than 0.75	Very low hazard – Caution
Moderate	0.75 to 1.25	Dangerous for some – includes children, the elderly and the infirm
Significant	1.25 to 2.0	Dangerous for most – includes the general public
Extreme	More than 2.0	Dangerous for all – includes the emergency services

For developments located in areas at risk of fluvial flooding, safe access / egress must be provided for new development as follows in order of preference:

- Safe dry route for people and vehicles.
- Safe dry route for people.
- If a dry route for people is not possible, a route for people where the flood hazard (in terms of depth and velocity of flooding) is low and should not cause risk to people.
- If a dry route for vehicles is not possible, a route for vehicles where the flood hazard (in terms of depth and velocity of flooding) is low to permit access for emergency vehicles. However the public should not drive vehicles in floodwater.
- In all these cases, a 'dry' access/egress is a route located above the 1% annual probability flood level (1 in 100 year) including an allowance for climate change.

[32] CLG, 2007, Improving the Flood Performance of New Buildings, Flood Resilient Construction. http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf?bcsi_scan_E956BCBE8ADBC89F=0&bcsi_scan_filename=flood_performance.pdf
[33] Environment Agency, HR Wallingford, May 2008, Supplementary note on Flood hazard ratings and thresholds for development planning and control purpose. Clarification of Table 13.1 FD2320/TR2 and Figure 3.2 FD2321/TR1. http://evidence.environment-agency.gov.uk/FCERM/Libraries/FCERM_Project_Documents/FD2321_7400_PR_pdf.sflb.ashx

With respect to other sources of flooding, consideration should be made of likely surface water ponding. As recommended in the CIRIA 635 Designing for Exceedance in Urban Drainage – Good Practice (Table 12.3), provision should be made to ensure that flood depths do not exceed 100mm to keep water within a kerb height and to reduce the likelihood of bow waves from vehicles driving through water affecting others, for example housing to the side of a car park.

5.10 Safe Refuge

In exceptional circumstances, dry access above the 1% annual probability (1 in 100 year) flood level including climate change may not be achievable. In these circumstances the Environment Agency and Breckland DC should be consulted to ensure that the safety of the site occupants can be satisfactorily managed. This will be informed by the type of development, the number of occupants and their vulnerability and the flood hazard along the proposed egress route. A suggested definition of a safe place of refuge is a dry, habitable space, internally accessible and accessible at all times. For example, this may entail the designation of a safe place of refuge on an upper floor of a building, from which the occupants can await the flood levels to subside or be rescued by emergency services. It should be noted that sole reliance on a safe place of refuge is a last resort, and all other possible means to evacuate the site should be considered first. Provision of a safe place of refuge will not guarantee that an application will be granted.

5.11 Car Parks

Where car parks are specified as areas for the temporary storage of surface water and fluvial floodwaters, flood depths should not exceed 300mm given that vehicles may be moved by water of greater depths. Where greater depths are expected, car parks should be designed to prevent the vehicles from floating out of the car park. Signs should be in place to notify drivers of the susceptibility of flooding and flood warning should be available to provide sufficient time for car owners to move their vehicles if necessary.

5.12 Flood Routing

All new development, whether in Flood Zones 2 and 3 at risk of fluvial flooding, at risk of surface water flooding or at risk of groundwater flooding at the surface, should not adversely affect flood routing and thereby increase flood risk elsewhere. Opportunities should be sought within the site design to make space for water, such as:

- Removing boundary walls or replacing with other boundary treatments such as hedges, fences (with gaps).
- Considering alternatives to solid wooden gates, or ensuring that there is a gap beneath the gates to allow the passage of floodwater.
- On uneven or sloping sites, consider lowering ground levels to extend the floodplain without creating ponds. The area of lowered ground must remain connected to the floodplain to allow water to flow back to river when levels recede.
- Create under-croft car parks or consider reducing ground floor footprint and creating an open area under the building to allow flood water storage.
- Where proposals entail floodable garages or outbuildings, consider designing a proportion of the external walls to be committed to free flow of floodwater.

In order to demonstrate that 'flood risk is not increased elsewhere', development in the floodplain will need to prove that flood routing is not adversely affected by the development, for example giving rise to backwater affects or diverting floodwaters onto other properties.

Potential overland flow paths should be determined and appropriate solutions proposed to minimise the impact of the development, for example by configuring road and building layouts to preserve existing flow paths and improve flood routing, whilst ensuring that flows are not diverted towards other properties elsewhere. Flow paths in greenfield areas should be maintained. Where this is not the case, developers should assess the increased risk of flooding through the change in flow path, i.e. through the consideration of change in surface roughness resulting in increased velocity of floodwater and increase in the hazard rating associated with the potential flooded area.

Careful consideration should be given to the use of fences and landscaping walls so as to prevent causing obstruction to flow routes and increasing the risk of flooding to the site or neighbouring areas.

It will also be necessary to consider how these areas or features will be maintained over the lifetime of the development, which may require the removal of permitted development rights in certain locations.

5.13 Flood Warning and Evacuation Plans

Evacuation is where flood alerts and warnings, such as those provided by the Environment Agency associated with fluvial flooding, enable timely actions by residents or occupants to allow evacuation to take place unaided, i.e. without the deployment of trained personnel to help people from their homes, businesses and other premises. Rescue by the emergency services is likely to be required where flooding has occurred and prior evacuation has not been possible.

For all developments (excluding minor developments and change of use) proposed in Flood Zone 2 or 3, a Flood Warning and Evacuation Plan should be prepared to demonstrate what actions site users will take before, during and after a flood event to ensure their safety, and to demonstrate their development will not impact on the ability of the local authority and the emergency services to safeguard the current population.

The Environment Agency has a tool on their website to create a Personal Flood Plan[34]. The Plan comprises a checklist of things to do before, during and after a flood and a place to record important contact details. Where proposed development comprises non-residential extension <250m^2 and householder development (minor development), it is recommended that the use of this tool to create a Personal Flood Plan will be appropriate.

Flood Evacuation Plans should also be prepared for sites located next to surface water flow, or where there is another source of flood risk affecting the site.

Flood Warning and Evacuation Plans should include:

How flood warning is to be provided, such as:

- availability of existing flood warning systems (refer Table 3-5);
- where available, rate of onset of flooding and available flood warning time; and
- how flood warning is given.

What will be done to protect the development and contents, such as:

- How easily damaged items (including parked cars) or valuable items (important documents) will be relocated;
- How services can be switched off (gas, electricity, water supplies);
- The use of flood protection products (e.g. flood boards, airbrick covers);
- The availability of staff/occupants/users to respond to a flood warning, including preparing for evacuation, deploying flood barriers across doors etc.; and
- The time taken to respond to a flood warning.

Ensuring safe occupancy and access to and from the development, such as:

- Occupant awareness of the likely frequency and duration of flood events, and the potential need to evacuate;
- Safe access route to and from the development;
- If necessary, the ability to maintain key services during an event;
- Vulnerability of occupants, and whether rescue by emergency services will be necessary and feasible; and
- Expected time taken to re-establish normal use following a flood event (clean-up times, time to re-establish services etc.)

There is no statutory requirement for the Environment Agency or the emergency services to approve evacuation plans. Breckland DC is accountable via planning condition or agreement to ensure that plans are suitable. This should be done in consultation with emergency planning staff.

[34] Environment Agency Tool 'Make a Flood Plan'. https://www.gov.uk/government/publications/personal-flood-plan

6 Guidance for the Application of Sustainable Drainage Systems

6.1 What are Sustainable Drainage Systems?

Suitable surface water management measures should be incorporated into new development designs in order to reduce and manage surface water flood risk to, and posed by the proposed development. This should be achieved by incorporating Sustainable Drainage Systems (SuDS).

Sustainable Drainage Systems (SuDS) are surface water drainage solutions designed to manage surface water runoff and mitigate the adverse effects of urban storm water runoff by reducing flood risk and controlling pollution[35]. SuDS techniques allow surface water runoff from development to be controlled in ways that imitate natural drainage by controlling the rate of discharge to a receiving watercourse. SuDS may also provide valuable habitat and amenity value when carefully planned for in development.

The SuDS Manual[36] identifies four processes that can be used to manage and control runoff from developed areas. Each option can provide opportunities for storm water control, flood risk management, water conservation and groundwater recharge:

A. **Infiltration:** the soaking of water into the ground. This is the most desirable solution as it mimics the natural hydrological process. The rate of infiltration will vary with soil type and condition, the antecedent conditions and with time. The process can be used to recharge groundwater sources and feed baseflows of local watercourses, but where groundwater sources are vulnerable or there is risk of contamination, infiltration techniques are not suitable.

   The use of traditional infiltration techniques that infiltrate to the ground is dependent on the underlying ground conditions. However, it is also possible to use shallow infiltration techniques in combination with storage techniques on sites which have impermeable geology, and therefore these techniques should not be overlooked. Guidance on Norfolk CC's position on the use of deep infiltration systems is provided in Section 6.2.

B. **Detention/Attenuation:** the slowing down of surface flows before their transfer downstream, usually achieved by creating a storage volume and a constrained outlet. In general, though the storage will enable a reduction in the peak rate of runoff, the total volume will remain the same, just occurring over a longer duration.

   Detention measures are not constrained by geology, though in areas of permeable geology, there will also be a degree of infiltration of runoff taking place.

C. **Conveyance:** the transfer of surface runoff from one place to another, e.g. through open channels, pipes and trenches.

D. **Water Harvesting:** the direct capture and use of runoff on site, e.g. for domestic use (flushing toilets) or irrigation of urban landscapes. The ability of these systems to perform a flood risk management function will be dependent on their scale, and whether there will be a suitable amount of storage always available in the event of a flood.

As part of any SuDS scheme, consideration should be given to the long-term maintenance of the SuDS to ensure that it remains functional for the lifetime of the development. Table 6-1 has been reproduced from the SuDS Manual, CIRIA C697 and outlines typical SuDS techniques.

[35] Defra, Environment Agency (March 2015) Cost Estimation for SuDS – Summary of Evidence

[36] CIRIA C697 SuDS Manual. http://www.ciria.org/Resources/Free_publications/the_suds_manual.aspx It should be noted that since the preparation of this Level 1 SFRA CIRIA have published C753, the updated SuDS Manual (November 2015). This industry standard contains the design principals to deliver Sustainable Drainage Systems (SuDS). It updates and significantly revises the C697 (2007) manual. CIRIA state that the updated manual incorporates the latest technical advice and adaptable processes to assist in the planning, design, construction, management and maintenance of good SuDS. It also considers the recent changes to policy and the newly issued DEFRA SuDS Technical Standards.

Table 6-1 Typical SuDS Components (Y; primary process. * some opportunities, subject to design)

Technique	Description	Conveyanc	Detention	Infiltration	Harvesting
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.		Y	Y	*
Filter Drains	Linear drains/trenches filled with a permeable material, often with perforated pipe in the base of the trench. Surface water from the edge of paved areas flows into the trenches, is filtered and conveyed to other parts of the site.	Y	Y		
Filter Strips	Vegetated strips of gently sloping ground designed to drain water evenly from impermeable areas and filter out silt and particulates.	*	*	*	
Swales	Shallow vegetated channels that conduct and/or retain water, and can permit infiltration when unlined.	Y	Y	*	
Ponds	Depressions used for storing and treating water.		Y	*	Y
Wetlands	As ponds, but the runoff flows slowly but continuously through aquatic vegetation that attenuates and filters the flow. Shallower than ponds. Based on geology these measures can also incorporate some degree of infiltration.	*	Y	*	Y
Detention Basin	Dry depressions designed to store water for a specified retention time.		Y		
Soakaways	Sub-surface structures that store and dispose of water via infiltration.			Y	
Infiltration Trenches	As filter drains, but allowing infiltration through trench base and sides.	*	Y	Y	
Infiltration Basins	Depressions that store and dispose of water via infiltration.		Y	Y	
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation. It is noted that the use of brown/green roofs should be for betterment purposes and not to be counted towards the provision of on-site storage for surface water. This is because the hydraulic performance during extreme events is similar to a standard roof (CIRIA C697).		Y		
Rainwater Harvesting	Storage and use of rainwater for non-potable uses within a building, e.g. toilet flushing. It is noted that storage in these types of systems is not usually considered to count towards the provision of on-site storage for surface water balancing because, given the sporadic nature of the use of harvested water, it cannot be guaranteed that the tanks are available to provide sufficient attenuation for the storm event.	*	*	*	Y

The application of SuDS is not limited to a single technique per site. Often a successful SuDS solution will utilise a combination of techniques, providing flood risk, pollution and landscape/wildlife benefits. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS. It should be noted, each development site must offset its own increase in runoff and attenuation cannot be "traded" between developments.

Other measures may also be required in relation to water and sewerage infrastructure that might include pipes and below ground storage required as part of a wider strategic scheme, to deal with surface water flood risk. Options may include:

- Increasing capacity in drainage systems;
- Separation of foul and surface water sewers;
- Improved drainage maintenance regimes; and,
- Managing overland flows.

It is noted that whilst piped systems and attenuation tanks can be used to mitigate flood risk, they don't address issues of water quality, amenity or biodiversity benefit, and therefore these measures should only be incorporated as *part* of a solution rather than the only option for a particular development site.

6.2 Management Train

The concept used in the development of drainage systems is the surface water 'management train'[37] whereby different techniques can be used in series to change the flow and quality characteristics of runoff in stages that attempt to mimic natural drainage. The hierarchy of techniques that should be considered in developing the management train are[49]:

1. **Prevention –** the use of good site design and site housekeeping measures to prevent runoff and pollution (e.g. sweeping to remove surface dust and detritus from car parks), and rain water reuse/harvesting. Prevention policies should generally be included within the site management plan.
2. **Source controls –** control of runoff at or very near its source (e.g. soakaways, other infiltration methods, green roods, pervious pavements).
3. **Site controls –** management of water in a local area or site (e.g. routing water from building roofs and car parks to a large soakaway, infiltration or detention basin.)
4. **Regional controls –** management of runoff from a site or several sites, typically in a balancing pond or wetland.

Generally the aim should be to discharge surface water run-off as high up the following hierarchy of drainage options as reasonably practicable:

- Into the ground (shallow infiltration)
- To a surface water body
- To a surface water sewer, highway drain, or another drainage system
- To a combined sewer

Where possible, stormwater should be managed in small, cost-effective landscape features located within small sub-catchments rather than being conveyed to and managed in large systems at the bottom of drainage areas. The techniques that are higher in the hierarchy are preferred to those further down so that prevention and control of water at the source should always be considered before site or regional controls. However, where upstream control opportunities are restricted, a number of lower hierarchy options should be used in series. Water should only be conveyed elsewhere if it cannot be dealt with at the site[49].

The passage of water between stages of the management train should be considered through the use of natural conveyance systems (e.g. swales and filter trenches) wherever possible. Pipework and sub-surface proprietary produce may still be required, especially where space is limited. Pre-treatment (i.e. the removal of silt and sediment loads) and maintenance is vital to ensure the long-term effectiveness of SuDS. Overland flow routes will also be required to convey and control floodwaters safely and effectively during extreme flood events. Generally, the greater the number of techniques used in a series the better the performance is likely to be and the lower the risk of overall system failure.

SuDS can be applied in all development situations, although individual site constraints may limit the potential of some sites achieving full benefits for all functions. The variety of SuDS available allows planners and designers to make full potential of the local land and consider the needs of local people when implementing the drainage design. The wishes of all the relevant stakeholders needs to be balanced in additional to the risk associated with each design option.

Norfolk CC Position on Deep Infiltration Systems

It should be noted that Norfolk CC does not consider deep infiltration or borehole soakaways as infiltration systems to meet the requirements as SuDS. Whilst soakaways can provide important groundwater recharge via infiltration at depth, it does not mimic the natural drainage system as would shallow infiltration. Norfolk CC state in their Interim Position Statement (http://www.norfolk.gov.uk/view/NCC168839) that they would only expect it to be used as a final option for the location of discharge of surface water on a par with a sewer.

Norfolk CC state that they would expect any planning application to clearly demonstrate with supporting information, as to why other SuDS discharge options are not appropriate prior to a proposal of a deep infiltration soakaway, i.e. the SuDS hierarchy of shallow infiltration, outfall to a surface watercourse or surface water sewer has been considered and there are valid reasons to discount them.

It is noted that the Environment Agency would comment on issues with regard to potential groundwater pollution. They have clear guidance in their published Groundwater Protection Policy GP3 (in particular G1 and G9 or regarding SuDS

[37] ttp://www.ciria.org.uk/suds/suds_management_train.htm

G10, G11, G12 and G13). They state that the use of deep infiltration systems may be appropriate in some cases if it is clear that there are no other feasible surface water disposal options. The Environment Agency would consider the pollution potential following their risk assessment process.

6.3 SuDS Costs

6.3.1 Whole Life Costs

Identifying whole life costs associated with SuDS is a complex process, and involves consideration of the following: Procurement and design costs; Capital construction costs; Operation and maintenance costs; Monitoring costs; and Replacement or decommissioning costs. If the incorporation of SuDS is considered early in the design, as part of the wider landscaping and site planning phase, there is greater potential to manage the costs of SuDS effectively.

Information on typical capital costs and maintenance costs are provided below. For further detail, and information on the other associated costs noted above, reference can be made to industry guidance such as the Defra and Environment Agency publication 'Cost Estimation for SuDS- Summary of Evidence' (Defra Environment Agency, March 2015).

6.3.2 Capital Costs

Defra and the Environment Agency have prepared a document containing unit costs for particular SUDS components based on a number of industry references. These have been compiled in Table 6-2. It is noted that these costs are based on actual costs from a number of projects from within the UK and from a wider literature review. If used for cost estimating purposes these costs should be costs should be increased to allow for inflation to present day values.

It should be noted that these costs are provided as an indicative cost for each type of SuDS. Whilst they provide a range of costs for each type and a relative assessment between SuDS features, the costs associated with any specific site will depend on a number of factors as follows:

- Scale and size of development;
- Hydraulic design criteria (design event, volume of storage required and impermeable catchment area);
- Inlet/outlet infrastructure design (volume and velocity of anticipated flows and the capacity of drainage system beyond site boundary);
- Water quality design criteria;
- Soil types (permeability and depth of water table), porosity and load bearing capacity;
- Materials availability;
- Density of planting;
- Specific Utilities requirements;
- Proximity to receiving watercourse;
- Amenity / public education / safety requirements

Table 6-2 Indicative costs for SUDS options (Defra, Environment Agency 2015)

Option	Unit cost	Source
Green roofs	£90/m^2 - covered roof with sedum mat £80/m^2 - biodiverse roof (varied covering of plants, growing medium and aggregates) Variable costs for Sedum blanket , turf and growing medium roof options	Bamfield, 2005. Bamfield, 2005. Rawlinson, 2006
Simple rainwater harvesting (water butts)	£100 - £243 per property (includes installation and connection pipe)	Stovin & Swan 2007
Advanced rainwater harvesting	£2,100 - £2,400 per residential property £2,500 - £6,000 per residential property £2,600 - £3,700 per residential property £6,300 - £21,000 per commercial / industrial property £45 per m^2 for residential properties £9 per m^2 for non-residential properties	Woking BC EA, 2007 RainCycle, 2005 RainCycle, 2005 EA, 2007 EA, 2007
Greywater re-use	£1,900 - £3,500 per residential property £3,000 per property	Woking BC EA, 2007

Option	Unit cost	Source
Permeable paving	£30-£40 per m^2 of permeable surface £27 per m^2 of replacement surface £54 per m^2	CIRIA, 2007 Stovin & Swan 2007 EA, 2007
Filter drain / perforated pipes	£100 - £140 per m^3 stored volume £61 per m £120 per m^2	CIRIA, 2007 Stovin & Swan 2007 EA, 2007
Swales	£10-£15 per m^2 swale area £18-£20 per m length using an excavator £12.5 per m^2	CIRIA, 2007 Stovin & Swan 2007 EA, 2007
Infiltration basin	£10-£15 per m^3 stored volume	CIRIA, 2007
Soakaways	>£100 per m^3 stored volume £454 -£552 per soakaway	CIRIA, 2007 Stovin & Swan 2007
Infiltration trench	£55-£65 per m^3 stored volume £74-£99 per m length £60 per m^2	CIRIA, 2007 Stovin & Swan 2007 EA, 2007
Filter strip	£2-£4 per m^2 filter strip area	CIRIA, 2007
Constructed wetland	£25-£30 per m^3 treated volume	CIRIA, 2007
Retention (wet) pond	£15-£25 per m^3 treated volume £80,000 per 5000m^3 pond (£16 per m3)	CIRIA, 2007 SNIFFER, 2007
Detention basin	£15-£20 per m^3 detention volume £35-£55 per m^3 stored volume £18 per m^3	CIRIA, 2007 Stovin & Swan 2007 SNIFFER, 2007
Onsite attenuation and storage	£449-£518 per m^3 for reinforced concrete storage tank. No data available for oversized pipes	Stovin & Swan 2007

6.3.3 Operation and Maintenance Costs

As with any other flood risk management structure, SuDS require ongoing maintenance to ensure the system remains in good working order and the design life of the system is extended as long as possible. Operation and maintenance activities will include the following:

- Monitoring and post-construction inspection;
- Regular, planned maintenance (annual or more frequent); and,
- Intermittent, refurbishment, repair/remedial maintenance;

Additional costs may include the allocation of resources and materials as a result of maintenance activities.

The long-term maintenance costs associated with SuDS are relatively unknown as they are usually absorbed by operators responsible for maintaining the infrastructure as part of their wider asset base.

Whilst the construction of SuDS (e.g. storage ponds) and wetlands are relatively straightforward to calculate, however, maintenance costs are slightly more difficult to estimate due to the lack of information regarding whom is responsible for this ongoing maintenance. The key factors that will influence maintenance costs include:

- Type and frequency of maintenance required (e.g. sediment removal, inlet/outlet maintenance, landscaping, and litter removal).
- The costs of maintenance (materials, labour and equipment costs);
- The availability and source of materials and disposal costs; and,
- The responsibility for maintenance (e.g. LA, highways agency, residents, developer).

Table 6-3 outlines some generic SuDS costs based on review of literature and some UK case studies undertaken by HR Wallingford (2004).

Table 6-3 Indicative annual maintenance costs for key SuDS options[38]

Option	Annual Maintenance costs	
Green roofs	£2,500/yr for first 2 years for covered rood with sedum mat, £600/yr after. £1,250/yr for first 2 years for covered rood with biodiverse roof, £150/yr after.	Bamfield (2005) Bamfield (2005)
Simple rainwater harvesting (water butts)	Negligible	
Advanced rainwater harvesting	£250 per year per property for external maintenance contract	RainCycle
Permeable paving	£0.5 - £1/m^3 storage volume	HR Wallingford, 2004
Filter drain/perforated pipes	£0.2 - £0.1/m^2 of filter surface area	HR Wallingford, 2004
Swales	£0.1/m^2 of swale surface area £350/yr	HR Wallingford, 2004 Ellis, 2003
Infiltration basin	£0.1 - £0.3/m^2 of detention basin area £0.25 - £1/m^3 of detention volume	HR Wallingford, 2004
Soakaways	£0.1/m^2 of treated area	HR Wallingford, 2004
Infiltration trench	£0.2 - £1/m^2 of filter surface area	HR Wallingford, 2004
Filter strip	£0.1/m^2 of filter surface area	HR Wallingford, 2004
Constructed wetland	£0.1/m^2 of wetland surface area. Annual maintenance of £200-250/yr for first 5 years (declining to £80 - £100/yr after 3 year)	HR Wallingford, 2004 Ellis, 2003
Retention (wet) pond	£0.5 - £1.5/m^2 of retention pond surface area £0.1 - £2/m^3 of pond volume	HR Wallingford, 2004 HR Wallingford, 2004 Ellis, 2003
Detention basin	£0.1 - £0.3/m^2 of detention basin area £0.25 - £1/m^3 of detention volume £250-£1000 per basin	HR Wallingford, 2004 HR Wallingford, 2004 Ellis, 2003

6.4 What is the role of the Norfolk County Council?

As part of their role as LLFA, Norfolk County Council is a statutory consultee for surface water drainage and have a role to identify local flood risk (i.e. flood risk associated with surface water, groundwater and ordinary watercourses). From 6th April 2015, all major development[39] should include provision for SuDS and a Sustainable Drainage Strategy will need to be completed and signed by a competent drainage engineer to verify that the proposals conform to the Government's 'Sustainable Drainage Systems: Non-Statutory Technical Standards[40]. Where the site is at risk of flooding from local sources, a Flood Risk Assessment will also be required.

The following sections provide an overview of the Technical Standards and items which applicants should include when preparing a Sustainable Drainage Strategy for submission to Norfolk CC. Further information and guidance is available on the Norfolk CC website https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers

6.4.1 What are the Technical Standards?

A set of non-statutory Technical Standards have been published which set the requirements for the design, construction, maintenance and operation of sustainable drainage systems (SuDS). The Technical Standards that are of chief concern in relation to the consideration of flood risk to and from development relating to peak flow control and volume control are presented below.

LASOO is the Local Authority SuDS Officer Organisation which is a professional association of local authority officers that have involvement in sustainable drainage systems. LASOO are the owners and writers of a Practice Guidance document which sits alongside the Non-Statutory Technical Standards for SuDS. The Practice Guidance is a living document that is regularly updated and is available on the LASOO website http://www.lasoo.org.uk/non-statutory-technical-standards-for-sustainable-drainage.

[38] Defra, Environment Agency (March 2015) Cost Estimation for SuDS – Summary of Evidence.
[39] Developments of 10 dwellings or more; or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010).
[40] Sustainable drainage systems: non-statutory technical standards - https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

Peak flow control

S2 For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

Volume control

S4 Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event.

S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

Flood risk within the development

S7 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.

S8 The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.

S9 The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

All major[41] developments and other development should not result in an increase in surface water runoff, and where possible, should demonstrate betterment in terms of rate and volumes of surface water runoff.

Sustainable Drainage Systems (SuDS) should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible in accordance with the requirements of the Technical Standards and supporting guidance published by DCLG and Department for the Environment, Food and Rural Affairs (Defra)[42].

6.4.2 What should a Sustainable Drainage Strategy include?

There will be some variation between LLFAs regarding specific requirements for preparing a Sustainable Drainage Strategy, and at the time of writing, requirements are still being developed. The following provides an indication of the type of information that would be required as part of a Sustainable Drainage Strategy:

- A plan of the existing site.
- A topographical level survey of the area to metres Above Ordnance Datum (mAOD).
- Demonstration of a clear understanding of how surface water flows across the site and surrounding area. This could use the topographic survey and the information presented on the 'Flood Map for Surface Water' on the Environment Agency website.
- Plans and drawings of the proposed site layout identifying the footprint of the area being drained (including all buildings, access roads and car parks).
- Calculations of:

[41] Major development – 10 or more dwellings and 1000 sqm floorspace

[42] Sustainable drainage systems: non-statutory technical standards - https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards; PPG Flood Risk and Coastal Change - http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/reducing-the-causes-and-impacts-of-flooding/why-are-sustainable-drainage-systems-important/

  - Changes in permeable and impermeable coverage across the site.
  - The existing and proposed controlled discharge rate for a 1 in 1 year event, 1 in 30 year and a 1 in 100 year event (with an allowance for climate change), which should be based on the estimated greenfield runoff rate.
  - Proposed storage volume (attenuation) including the water storage capacity of the proposed drainage features, with demonstration that they meet the requirements of the Technical Standards.
- Plans, drawings and specification of proposed SuDS measures. This should include detail of hard construction, soft landscaping and planting. A drainage design can incorporate a range of SuDS techniques.
- A design statement describing how the proposed measures manage surface water as close to its source as possible and follow the drainage hierarchy described in Section 6.2.
- Geological information including borehole logs, depth to water table and/or infiltration test results in accordance with BRE365.
- Details of overland flow routes for exceedance events.
- Details of any offsite works required, together with necessary consents (where relevant).
- A management plan for future maintenance and adoption of drainage system for the lifetime of the development.

Applicants are encouraged to discuss their proposals with Norfolk CC at the pre-application stage and in due course the Flood and Water Management Team at Norfolk CC will offer pre-application advice to developers on a chargeable basis. Once resources and charging schedules are in place to support this element of the services service stakeholders will be informed. Further updates on the charging schedule will be placed on the website in due course http://www.norfolk.gov.uk/environment/flood_and_water_management/developers/index.htm

7 Guidance for preparing site-specific FRAs

7.1 What is a Flood Risk Assessment?

A site-specific FRA is a report suitable for submission with a planning application which provides an assessment of flood risk to and from a proposed development, and demonstrates how the proposed development will be made safe, will not increase flood risk elsewhere and where possible will reduce flood risk overall in accordance with paragraph 100 of the NPPF and PPG. An FRA should consider all sources of flooding, as set out in the NPPF. It must be prepared by a suitably qualified and experienced person and must contain all the information needed to allow Breckland DC to satisfy itself that the requirements have been met.

7.2 When is a Flood Risk Assessment required?

The NPPF states that a site-specific FRA is required in the following circumstances:

- Proposals for new development (including minor development[43] and change of use) in Flood Zones 2 and 3.
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency)[44].
- Proposals of 1 hectare or greater in Flood Zone 1.
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

For proposals less than 1 hectare within Flood Zone 1, a Flood Risk Assessment may still be required, to assess the risk of flooding from local sources, i.e. surface water, groundwater and ordinary watercourses. For example, a FRA for a small site may identify surface water flow paths that will need to be carefully managed throughout the proposed development to ensure that the development will be made safe, will note increase flood risk elsewhere, and where possible will reduce flood risk overall.

7.3 How detailed should a FRA be?

The PPG states that site-specific FRAs should be proportionate to the degree of flood risk, the scale and nature of the development, its vulnerability classification (Table 4-2) and the status of the site in relation to the Sequential and Exception Tests. Site-specific FRAs should also make optimum use of readily available information, for example the mapping presented within this SFRA and available on the Environment Agency website, although in some cases additional modelling or detailed calculations will need to be undertaken. For example, where the development is an extension to an existing house (for which planning permission is required) which would not significantly increase the number of people present in an area at risk of flooding, Breckland DC would generally need a less detailed assessment to be able to reach an informed decision on the planning application. For a new development comprising a greater number of houses in a similar location, or one where the flood risk is greater Breckland DC may require a more detailed assessment, for example, the preparation of site-specific hydraulic modelling to determine the flood risk to and from the site pre and post-development, and the effectiveness of any management and mitigation measures incorporated within the design.

As a result, the scope of each site-specific FRA will vary considerably. Table 7-1 presents the different levels of site-specific FRA as defined in the CIRIA publication C624[45] and identifies typical sources of information that can be used.

[43] According to the PPG, minor development means:
minor non-residential extensions: industrial / commercial / leisure etc. extensions with a footprint <250m^2.
alterations: development that does not increase the size of buildings e.g. alterations to external appearance.
householder development: for example; sheds, garages, games rooms etc. within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

[44] Consultation has confirmed that there are no areas with critical drainage problems identified by the Environment Agency.

Sufficient information must be included to enable the Council and where appropriate, consultees, to determine that the proposal will be safe for its lifetime, not increase flood risk elsewhere and where possible, reduce flood risk overall. Failure to provide sufficient information will result in applications being refused.

[45] CIRIA, 2004, Development and flood risk – guidance for the construction industry C624.

Table 7-1 Levels of Site-Specific Flood Risk Assessment

Description
Level 1 Screening study to identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information. The screening study will ascertain whether a FRA Level 2 or 3 is required. Typical sources of information include: • Strategic Flood Risk Assessment (SFRA) • Flood Map for Planning (Rivers and Sea) • Flood Risk from Surface Water mapping (available on Environment Agency website) • Environment Agency Standing Advice • NPPF Tables 1, 2 and 3
Level 2 Scoping study to be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding, or the site may increase flood risk due to increased run-off. This study should confirm the sources of flooding which may affect the site. The study should include: • An appraisal of the availability and adequacy of existing information; • A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere; and • An appraisal of the scope of possible measures to reduce flood risk to acceptable levels. • The scoping study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development. Typical sources of information include those listed above, plus: • Local policy statements or guidance. • Catchment Flood Management Plan. • Norfolk County Council PFRA and LFRMS. • Data request from the EA to obtain result of existing hydraulic modelling studies relevant to the site and outputs such as maximum flood level, depth and velocity. • Consultation with Environment Agency/Norfolk CC/sewerage undertakers and other flood risk consultees to gain information and to identify in broad terms, what issues related to flood risk need to be considered including other sources of flooding. • Historic maps. • Interviews with local people and community groups. • Walkover survey to assess potential sources of flooding, likely routes for floodwaters, the key features on the site including flood defences, their condition. • Site survey to determine general ground levels across the site, levels of any formal or informal flood defences.
Level 3 Detailed study to be undertaken if a Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The study should include: • Quantitative appraisal of the potential flood risk to the development; • Quantitative appraisal of the potential impact of the development site on flood risk elsewhere; and • Quantitative demonstration of the effectiveness of any proposed mitigations measures. Typical sources of information include those listed above, plus: • Detailed topographical survey. • Detailed hydrographic survey. • Site-specific hydrological and hydraulic modelling studies which should include the effects of the proposed development. • Monitoring to assist with model calibration/verification. • Continued consultation with the LPA, Environment Agency and other flood risk consultees.

7.3.1 Environment Agency Data Requests

The Environment Agency offers a series of 'products' for obtaining flood risk information suitable for informing the preparation of site-specific FRAs as described on their website https://www.gov.uk/planning-applications-assessing-flood-risk.

- Products 1 – 4 relate to mapped deliverables including flood level and flood depth information and the presence of flood defences local to the proposed development site;
- Product 5 contains the reports for hydraulic modelling of the Main Rivers;
- Product 6 contains the model output data so the applicant can interrogate the data to inform the FRA.
- Product 7 comprises the hydraulic model itself.

Products 1 – 6 can be used to inform a Level 2 FRA. In some cases, it may be appropriate to obtain Product 7 and to use as the basis for developing a site-specific model for a proposed development as part of a Level 3 FRA. This can be requested from their National Customer Contact Centre via enquiries@environment-agency.gov.uk or the relevant area Customer and Engagement Teams as follows:

- Anglian Central Customer and Engagement Team ANC.Enquiries@environment-agency,gov.uk
- Essex, Norfolk and Suffolk Customer and Engagement Team ENSenquiries@environment-agency.gov.uk

7.3.2 Modelling of Ordinary Watercourses

It should be noted that the Flood Map for Planning only covers watercourses with catchment greater than 3km^2. As a result, for smaller catchments, flood zones won't be present but there may be some risk of flooding. Where a proposed development site is in close proximity to an Ordinary Watercourse and either no modelling exists, or the available modelling is considered to provide very conservative estimates of flood extents (due to the use of national generalised JFLOW modelling), applicants may need to prepare a simple hydraulic model to enable more accurate assessment of the probability of flooding associated with the watercourse and to inform the site-specific FRA. This should be carried out in line with industry standards and in agreement with the Environment Agency and Norfolk County Council (as the LLFA).

7.4 What needs to be addressed in a Flood Risk Assessment?

The PPG states that the objectives of a site-specific flood risk assessment are to establish:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- the evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
- whether the development will be safe and pass the Exception Test, if applicable.

7.5 Flood Risk Assessment Checklist

Appendix D provides a checklist for site-specific FRAs including the likely information that will need to be provided along with references to sources of relevant information. As described in Section 7.3, the exact level of detail required under each heading will vary according to the scale of development and the nature of the flood risk.

7.6 Pre-application Advice

At all stages, Breckland DC, and where necessary the Environment Agency, Norfolk CC and/or the Statutory Water Undertaker may need to be consulted to ensure the FRA provides the necessary information to fulfil the requirements for planning applications.

The Environment Agency, Norfolk CC and Breckland DC each offer pre-application advice services which should be used to discuss particular requirements for specific applications.

- **Breckland DC** offer free pre-application advice. Enquiries can be submitted by completing the Preliminary Enquiries Form available online at http://www.breckland.gov.uk/content/pre-application-advice

- **Environment Agency** http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/research/planning/33580.aspx The following government guidance sets out when LPAs should consult with the Environment Agency on planning applications https://www.gov.uk/flood-risk-assessment-local-planning-authorities.

- In due course the Flood and Water Management Team at **Norfolk CC** will offer pre-application advice to developers on a chargeable basis. Further updates on the service will be placed on the website in due course http://www.norfolk.gov.uk/environment/flood_and_water_management/developers/index.htm

8 Flood Risk Management Policy Considerations

8.1 Overview

In order to encourage a holistic approach to flood risk management and ensure that flooding is taken into account at all stages of the planning process, this Section builds on the findings of the SFRA to set out key recommendations for consideration by Breckland BC in relation to flood risk planning policy and with respect to development management decisions on a day-to-day basis.

8.2 Policy Considerations

It is recommended that the following flood risk objectives are taken into account by Breckland DC during the policy making process. Guidance on how these objectives can be met throughout the development control process for individual development sites is included within Section 5.

8.2.1 Seeking Flood Risk Reduction through Spatial Planning and Site Design

- Use the Sequential Test to locate new development in areas of lowest risk, giving highest priority to areas within Flood Zone 1 and at low risk of flooding from other sources. Locating new development away from the most vulnerable flood risk areas would minimise the cost of installing and maintaining new flood defences and land drainage measures.
- Use the Sequential Test within development sites to inform site layout by locating the most vulnerable elements of a development in the lowest risk areas. For example, the use of low-lying ground in waterside areas for recreation, amenity and environmental purposes can provide an effective means of flood risk management as well as providing connected green spaces with consequent social and environmental benefits.
- Avoid development immediately downstream of flood storage reservoirs which will be at high hazard areas in the event of failure.
- Seek opportunities for new development to achieve reductions to wider flood risk issues where possible, e.g. larger developments may be able to make provisions for flow balancing within new attenuation SuDS features.
- Identify long-term opportunities to remove development from the floodplain through land swapping, whereby existing development is removed from the floodplain and the site returned to provide its original flood storage function.
- Build resilience into a site's design (e.g. flood resistant or resilient design, raised floor levels).
- Ensure development is 'safe'. For residential developments to be classed as 'safe', dry pedestrian egress out of the floodplain and emergency vehicular access should be possible. Dry pedestrian access/egress should be possible for the 1 in 100 year return period event including an allowance for climate change associated with fluvial flooding.

8.2.2 Reducing Surface Water Runoff from New Developments

- All sites require the following:
    - Use of SuDS (where possible use of strategic SuDS should be made).
    - Discharge rates should be restricted to Greenfield runoff rates.
    - 1 in 100 year attenuation of surface water, taking including an allowance for climate change.
- Space should be specifically set aside for SuDS and used to inform the overall layout of development sites.
- Surface water drainage proposals should have a clear plan for the long term maintenance and adoption of the systems, prior to approval of any planning permission in line with national planning policy.
- Large potential development areas with a number of new allocation sites will be required to develop a strategy for providing a joint SuDS scheme. This will need to be on an integrated and strategic scale and where necessary will require the collaboration of all developers involved in implementing a specific expansion area or site.

- Careful assessment of the potential impact of surface water drainage from new developments will be necessary in areas with constrained drainage networks, particularly those networks that are dependent upon sewers and culverted watercourses with limited capacity.
- Further work is necessary to understand the full extent of risk from surface water flooding in Breckland, including the preparation of Surface Water Management Plans.
- Reducing the potential impacts of sewer flooding may require the installation of Sustainable Drainage Systems in both new and existing developments. The risk of foul sewer flooding that result from the misconnection of surface water drainage to the foul sewer network could be addressed if opportunities to disconnect surface water from foul sewers are taken.
- Consideration may need to be given to further use of rural Sustainable Drainage Systems to reduce both the risk of flooding and the risk of rivers drying out (smoothing out the peaks and troughs of local rainfall).

8.2.3 Enhancing and Restoring the River Corridor

- An assessment of the condition of existing assets (e.g. bridges, culverts, river walls) should be made. Refurbishment and/or renewal of the asset should ensure that the design life is commensurate with the design life of the development. Developer contributions should be sought for this purpose.
- Those proposing development should look for opportunities to undertake river restoration and enhancement as part of a development to make space for water. Enhancement opportunities should be sought when renewing assets (e.g. de-culverting, the use of bio-engineered river walls, raising bridge soffits to take into account climate change).
- Avoid further culverting and building over culverts. Where practical, all new developments with culverts running through their site should seek to de-culvert rivers for flood risk management and conservation benefit. Any culverting or works affecting the flow of a watercourse requires the prior written consent of either the Environment Agency (for main rivers), or Norfolk CC or the relevant IDB (for ordinary watercourses) under the terms of the Environmental Permitting Regulations 2010, the Flood and Water Management Act 2010 and the Land Drainage Act 1991. These regulatory bodies seek to avoid culverting, and their consent for such works will not normally be granted except as a means of access.
- Set development back from rivers, seeking an 8 metre wide undeveloped buffer strip for development by all watercourses including those where the Flood Zone does not exist. Under the Environmental Permitting Regulations, the prior written consent of the Environment Agency is required for any proposed works or structures in, under, over or within 8m of a main river. Similarly, consent is required from the relevant IDB for works within 9m of an IDB ordinary watercourse asset or structure. This is to allow easy maintenance of the watercourses, and includes consent for fencing, planting and temporary structures. Consent is required from NCC in relation to any structures affecting flow within an ordinary watercourse, in line with the FWMA.

8.2.4 Protecting and Promoting Areas for Future Flood Alleviation Schemes

- Protect Greenfield functional floodplain from future development (our greatest flood risk management asset) and reinstate areas of functional floodplain which have been developed (e.g. reduce building footprints or relocate to lower flood risk zones).
- Identify sites where developer contributions could be used to fund future flood risk management schemes or can reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

8.2.5 Improving Flood Resilience and Emergency Planning

Relative to other Norfolk Districts Breckland has lower levels of fluvial flood risk, affecting fewer properties. Where flooding affects only a limited number of properties, it is unlikely that measures to improve flood defences will attract priority funding. Instead it may be necessary to place greater reliance on making properties that are at risk more resilient to flooding. Similarly, steps should be made to improve the resilience of properties and infrastructure that is at risk of surface water flooding, through:

- Seeking to improve the emergency planning process using the outputs from the SFRA.
- For areas at risk of fluvial flooding, encouraging all those within existing Flood Zone 3a and 3b (residential and commercial occupiers) to sign up to Flood Warning Service operated by the Environment Agency.
- Ensuring robust emergency (evacuation) plans are implemented for new developments.

- Considering locations where flood resistant and resilient measures, such as those presented in Sections 5.6 and 5.7 can be retrofitted to properties at risk of surface water or fluvial flooding.

8.3 Development Management Considerations

8.3.1 Flood Zone 3b Functional Floodplain

The Functional Floodplain has been defined within this SFRA using the 5% AEP flood extent. These areas should be safeguarded from development, with exemptions where development could reduce flood risk overall or improve floodplain storage. Should modelling be undertaken for other watercourses in the study area, the same definition should be used to delineate the extent of the functional floodplain along the watercourse.

Only Water Compatible developments are permitted in Flood Zone 3b, and Essential Infrastructure developments require the Exception Test (refer to Table 4-3). Where Water Compatible or Essential Infrastructure development cannot be located elsewhere, it must:

- Remain operational and safe for users in times of flood;
- Result in no net loss of flood storage;
- Not impede water flows; and
- Not increase flood risk elsewhere.

Proposals for the change of use or conversion to a use with a higher vulnerability classification should not be permitted. Basements, basements extensions, conversions of basements to a high vulnerability classification or self-contained units should not be permitted.

Where minor development is proposed, schemes should not affect floodplain storage or flow routes through the incorporation of the following mitigation measures in line with CIRIA guidance on SuDS:

- Raised finished floor levels;
- Voids and where possible;
- Direct or indirect floodplain compensation;
- Flood resilience measures;
- The removal of other non-floodable structures;
- Replacement of impermeable surfaces with permeable;
- Improved surface water drainage through the implementation of SuDS features such as water butts/rainwater harvesting;
- Living roofs;
- Infiltration trenches/soakaways; and
- Below ground attenuation tanks.

Drainage attenuation ponds and other SuDS storage features are not considered to be Water Compatible and should therefore not be located within Flood Zone 3b.

8.3.2 Flood Zone 3a High Probability

Flood Zone 3a High Probability comprises land having a 1% (1 in 100 year) annual probability or greater. Water Compatible and Less Vulnerable developments are permitted in Flood Zone 3a; Essential Infrastructure and More Vulnerable developments require the Exception Test and Highly Vulnerable development is not permitted in this flood zone (refer to Table 4-3). Where development is proposed opportunities should be sought to:

- Relocate existing development to land in zones with a lower probability of flooding;
- Reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques;
- Ensure it remains safe for users in times of flood; and
- Create space for flooding to occur by restoring natural floodplain and flood flow paths and by identifying, allocating and safeguarding open space for flood storage.

8.3.3 Flood Zone 2 Medium Probability

Flood Zone 2 Medium Probability comprises land having between a 1% (1 in 100 year) and 0.1% (1 in 1000) annual probability of flooding from fluvial watercourses. Water Compatible, Essential Infrastructure, Less Vulnerable and More Vulnerable developments are permitted in the Flood Zone 2, and Highly Vulnerable development requires the Exception Test (refer to Table 4-3). Where development is proposed in areas of Flood Zone 2, the planning policy approach is similar to Flood Zone 3a. Opportunities should be sought to:

- Relocate existing development to land in zones with a lower probability of flooding;
- Reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques;
- Ensure it remains safe for users in times of flood; and
- Create space for flooding to occur by restoring natural floodplain and flood flow paths and by identifying, allocating and safeguarding open space for flood storage.

8.3.4 Flood Zone 1 Low Probability

Flood Zone 1 Low Probability comprises land having a less than 0.1% (1 in 1000 year) annual probability of flooding from fluvial watercourses including ordinary watercourses. All development vulnerability classifications are permitted in Flood Zone 1 (refer to Table 4-3). Where development over 1ha is proposed or there is evidence of flooding from another localised source in areas of Flood Zone 1, opportunities should be sought to:

- Identify any surface water flow paths present on the site to inform appropriate site use and layout design;
- Apply the sequential approach within the development site;
- Ensure that the management of surface water runoff from the site is considered early in the site planning and design process;
- Ensure that proposals achieve an overall reduction in the level of flood risk to the surrounding area, through the appropriate application of sustainable drainage techniques.

8.3.5 Changes of Use

Where a development undergoes a change of use and the vulnerability classification of the development changes, there may be an increase in flood risk. For example, changing from industrial use to residential use will increase the vulnerability classification from Less to More Vulnerable (Table 4-2Table 4-2).

For change of use applications in Flood Zone 2 and 3, applicants must submit a FRA with their application. This should demonstrate how the flood risks to the development will be managed so that it remains safe through its lifetime including provision of safe access and egress and preparation of Flood Warning and Evacuation Plans where necessary. Further guidance will be provided within the Level 2 SFRA Report.

As changes of use are not subject to the Sequential or Exception Tests, Breckland DC could consider when formulating policy what changes of use will be acceptable, having regard to paragraph 157 (6th bullet) of the NPPF and taking into account the findings of this SFRA. This is likely to depend on whether developments can be designed to be safe and that there is safe access and egress.

8.4 Next Steps

8.4.1 Sequential Test

Using the strategic flood risk information presented within this Level 1 SFRA, Breckland DC should undertake the Sequential Test for their potential development sites to document the process whereby future development is steered towards areas of lowest flood risk.

8.4.2 Level 2 SFRA

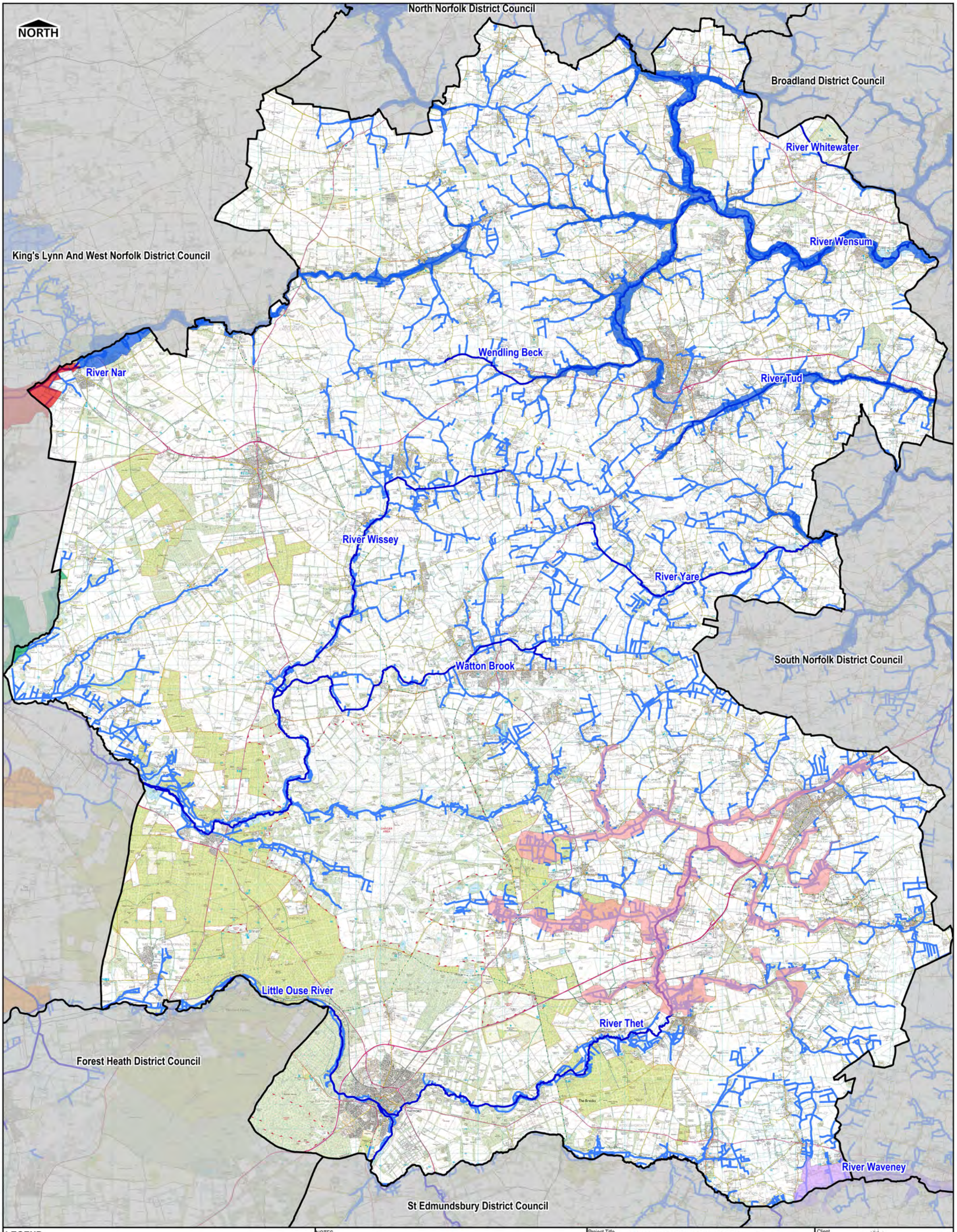
Where it is not possible to accommodate all the necessary development outside those areas identified to be at risk of flooding, a Level 2 SFRA may be required to provide information to support the application of the Exception Test for future development sites. The scope of the Level 2 SFRA would be to consider the detailed nature of the flood characteristics within a flood zone including; flood depth, velocity, rate of onset and duration of flooding.

The Level 2 SFRA would provide a more detailed assessment of the flood risk for specific development sites which may require the application of the Exception Test.

8.4.3 Future Updates to the SFRA

This SFRA has been updated building heavily upon existing knowledge and newly available datasets with respect to flood risk within the district, made available by the Environment Agency. In the future, new modelling studies or new information may influence future development management decisions within the district. Therefore it is important that the SFRA is adopted as a 'living' document and is reviewed regularly in light of emerging policy directives, flood risk datasets and an improving understanding of flood risk within the district.

Appendix A. District Wide Figures



LEGEND

- Administrative Boundaries
- Main River
- Ordinary Watercourse

Water Management Alliance

- Norfolk Rivers IDB
- Kings Lynn IDB

East Harling IDB

- East Harling IBD

Downham Market Group of IDBs

- East of Ouse Polver & Nar
- Northwold
- Southery & District
- Stoke Ferry
- Stringside

Waveney Lower Yare and Lothingland IDB

- Waveney Valley

NOTES

Main Rivers are designated by Defra on a 'Main River Map'. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only. However overall responsibility for maintenance lies with the riparian owner.

An Ordinary Watercourse is a watercourse that does not form part of a Main River. This includes all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows according to the Land Drainage Act 1991.

Drainage Boards have powers under the Land Drainage Act 1991 (as amended by the 1994 Act) to undertake works on any watercourse within their district other than Main River. A Board's District is defined on a sealed map prepared by the Environment Agency and approved by the relevant Ministry. In addition Boards can undertake works on watercourses outside their drainage district in order to benefit the district. Within the Drainage Districts, Boards have designated arterial watercourses to which they will normally apply their statutory powers.

Project Title: BRECKLAND DISTRICT COUNCIL LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT UPDATE

Drawing Title: STUDY AREA

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NORTH

North Norfolk District Council

Broadland District Council

King's Lynn And West Norfolk District Council

South Norfolk District Council

Forest Heath District Council

St Edmundsbury District Council

LEGEND

- Administrative Boundaries
- Carstone Formation
- Gault Formation
- Holywell Nodular Chalk Formation
- Lewes Nodular Chalk Formation, Seaford Chalk Formation
- West Melbury Marly Chalk Formation and Zig
- Wroxham Crag Formation

NOTES The 1:50,000 scale digital map data is generalised and the geological interpretation should be used only as a guide to the geology at a local level, not as a site-specific geological plan based on detailed site investigations.

Project Title
BRECKLAND DISTRICT COUNCIL LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT UPDATE

Drawing Title
BEDROCK GEOLOGY

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Drawing Number
FIGURE 2

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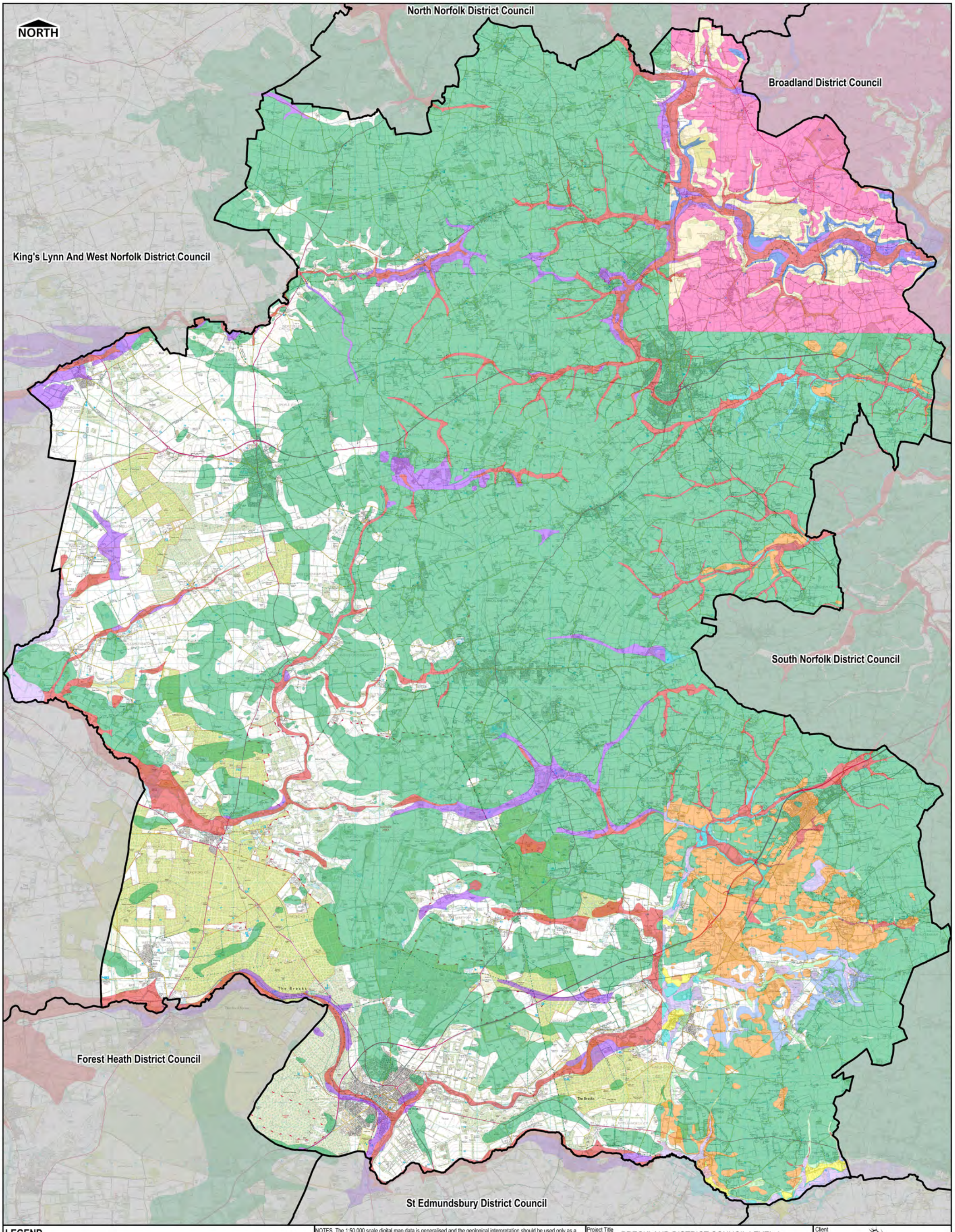

LEGEND

- Administrative Boundaries
- Alluvial Fan Deposits
- Alluvium
- Banham Member
- Brickearth
- Glaciofluvial Deposits, Mid Pleistocene
- Happisburgh Glacigenic Formation and Lowestoft Formation
- Head
- Lowestoft Formation
- Peat
- River Terrace Deposits (Undifferentiated)
- River Terrace Deposits 1
- River Terrace Deposits 2
- River Terrace Deposits 3
- Till, Mid Pleistocene

NOTES The 1:50,000 scale digital map data is generalised and the geological interpretation should be used only as a guide to the geology at a local level, not as a site-specific geological plan based on detailed site investigations.

Project Title
BRECKLAND DISTRICT COUNCIL LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT UPDATE

Drawing Title
SUPERFICIAL GEOLOGY

Drawn	SL	Version	1
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North Norfolk District Council

NORTH

Broadland District Council

King's Lynn And West Norfolk District Council

South Norfolk District Council

Forest Heath District Council

St Edmundsbury District Council

LEGEND

Administrative Boundaries

Superficial Deposits - Aquifer Designation

- Secondary (undifferentiated)
- Secondary A
- Secondary B
- Unproductive

NOTES The 1:50,000 scale digital map data is generalised and the geological interpretation should be used only as a guide to the geology at a local level, not as a site-specific geological plan based on detailed site investigations.

Project Title: BRECKLAND DISTRICT COUNCIL LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT UPDATE

Drawing Title: SUPERFICIAL GEOLOGY - AQUIFER DESIGNATION

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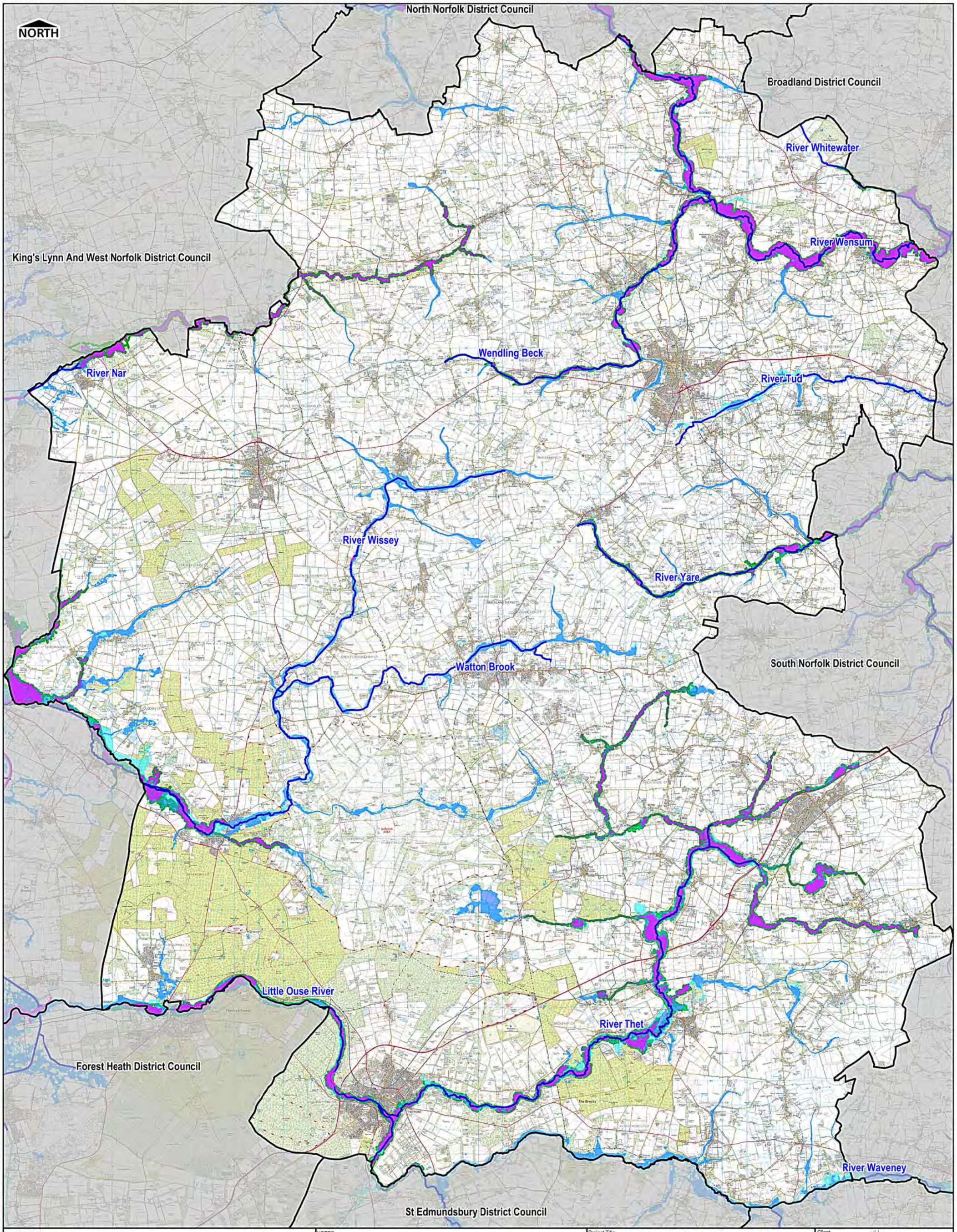

LEGEND

- Administrative Boundaries
- Main River
- Flood Defences

Probability of Flooding from Rivers

- Flood Zone 1 Low Probability
- Flood Zone 2 Medium Probability
- Flood Zone 3a High Probability
- Flood Zone 3b Functional Floodplain, where available
- Defended 1% AEP incl. climate change where available
- Areas Benefitting from Flood Defences

NOTES

Main Rivers are designated by Defra on a 'Main River Map'. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only. However overall responsibility for maintenance lies with the riparian owner.

The Environment Agency Flood Map for Planning (Rivers and Sea) is available on the Environment Agency website (www.gov.uk/environment-agency) and displays the risk of flooding based on probability.
Flood Zone 1: Land assessed, ignoring the presence of flood defences, as having a less than 0.1% annual probability of fluvial or tidal flooding in any year. Flood Zone 2: Land assessed, ignoring the presence of flood defences, as having between a 1% nd 0.1% annual probability of fluvial flooding in any year. Flood Zone 3: Land assessed, ignoring the presence of flood defences, as having a 1% or greater annual probability of fluvial flooding in any year.
The Flood Map displays the location of linear raised flood defences such as embankments and walls. Flood storage areas, land designated and operated to store flood water are displayed in a separate polygon layer. Land that may benefit from the presence of flood defences during a 1% fluvial or 0.5% tidal flood event. These are areas that would flood if the defence were not present, but may not flood because the defence is present. Areas benefitting from flood storage areas may be remote from the flood defence structure.
This map is intended to provide a strategic overview of fluvial flood risk and should not be used to assess flood risk for individual properties.

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Drawing Title: FLOOD ZONES

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Drawing Number: FIGURE 5

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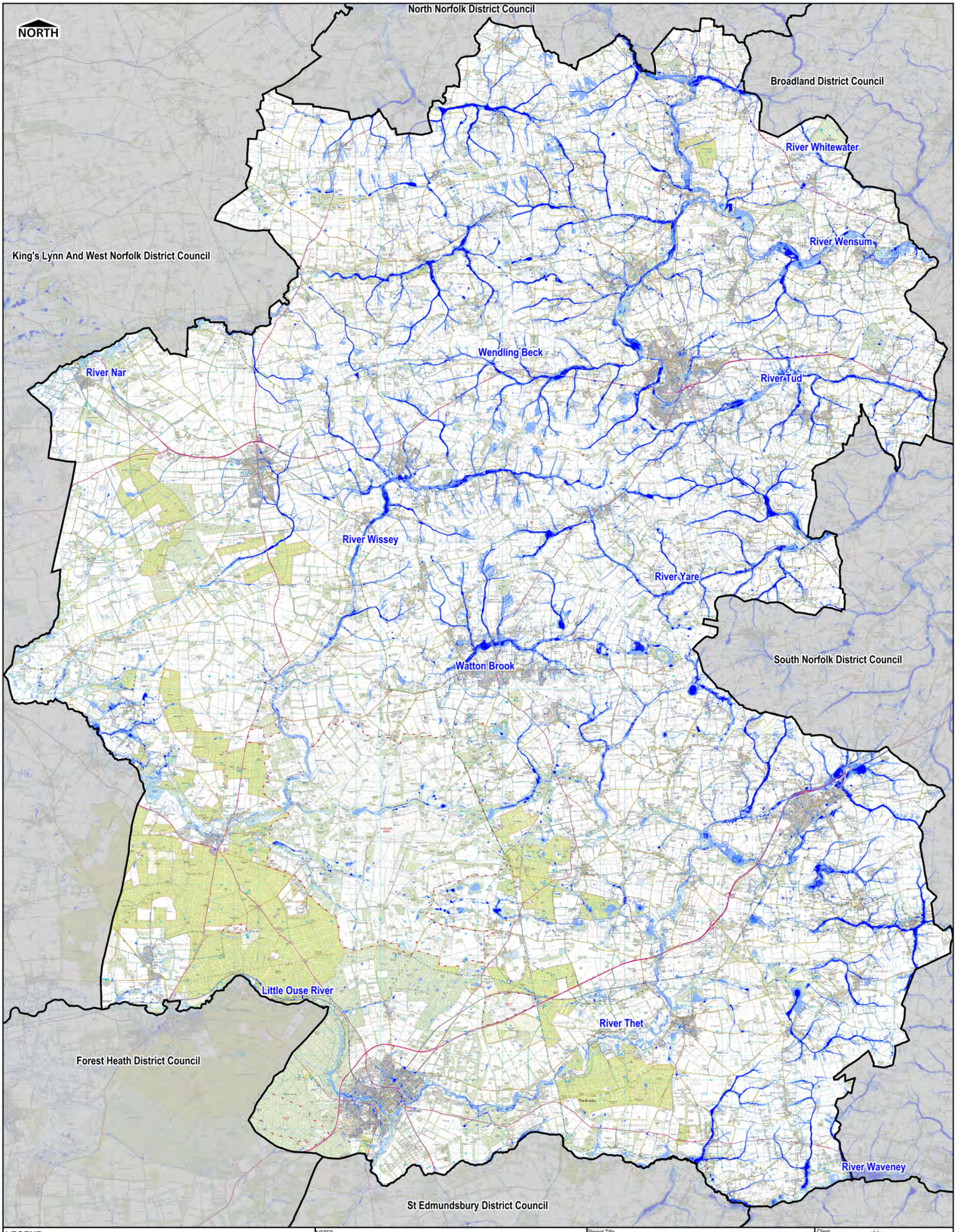

LEGEND

- Administrative Boundaries
- Main River
- Ordinary Watercourse

Probability of Flooding from Surface Water

- High (>3.3% AEP)
- Medium (1% - 3.3% AEP)
- Low (0.1% - 1% AEP)
- Very Low (<0.1% AEP)

NOTES

This map shows the predicted likelihood of surface water flooding based on the Environment Agency's updated Flood Map for Surface Water (uFMfSW) data, which may be subject to further analysis in the future. More information is provided on the Environment Agency website (www.gov.uk/environment-agency).
The risk from surface water flooding is divided into categories:
High: each year, the chance of flooding is greater than 1 in 30 (3.3%).
Medium: each year, the chance of flooding is between 1 in 100 (1%) and 1 in 30 (3.3%).
Low: each year, the chance of flooding is between 1 in 1000 (0.1%) and 1 in 100 (1%).
Very Low: each year, the chance of flooding is less than 1 in 1000 (0.1%).

Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies or flows over the ground instead. This type of flooding can be difficult to predict as it is hard to forecast exactly where or how much rain will fall in any storm.
The potential impact of surface water flooding can vary according to the depth of the water and its velocity (speed and direction in which it is flowing).

This map is intended to provide a strategic overview of surface water flood risk and should not be used to assess flood risk for individual properties.

Project Title
BRECKLAND DISTRICT COUNCIL LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT UPDATE

Drawing Title
UPDATED FLOOD MAP FOR SURFACE WATER

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FIGURE 6

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NORTH

North Norfolk District Council

Broadland District Council

King's Lynn And West Norfolk District Council

South Norfolk District Council

Forest Heath District Council

St Edmundsbury District Council

LEGEND

Administrative Boundaries

Areas Susceptible to Groundwater Flooding

Area classification (proportion of each 1km square that is susceptible to groundwater flood emergence). Absence of values for any grid squares means that no part of that square is identified as being susceptible to groundwater emergence. See notes for further guidance.

- < 25 %
- >= 25% < 50%
- >= 50% < 75%
- >= 75 %

NOTES Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. It was developed specifically by the Environment Agency for use by Lead Local Flood Authorities (LLFAs) for use in Preliminary Flood Risk Assessment (PFRA) as required under the Flood Risk Regulations. The data was produced to annotate indicative Flood Risk Areas for PFRA with information to allow LLFAs to determine whether there may be a risk of flooding from groundwater.

This data has used the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map and thus covers consolidated aquifers (chalk, sandstone etc., termed 'clearwater' in the data attributes) and superficial deposits. It does not take account of the chance of flooding from groundwater rebound. It shows the proportion of each 1km grid square where geological and hydrogeological conditions show that ground-water might emerge. The susceptible areas are represented by one of four area categories (listed above) showing the proportion of each 1km square that is susceptible to groundwater emergence. It does not show the likelihood of groundwater flooding occurring.

In common with the majority of datasets showing areas which may experience groundwater emergence, this dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

Project Title: BRECKLAND DISTRICT COUNCIL LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT UPDATE

Drawing Title: AREAS SUSCEPTIBLE TO GROUNDWATER FLOODING

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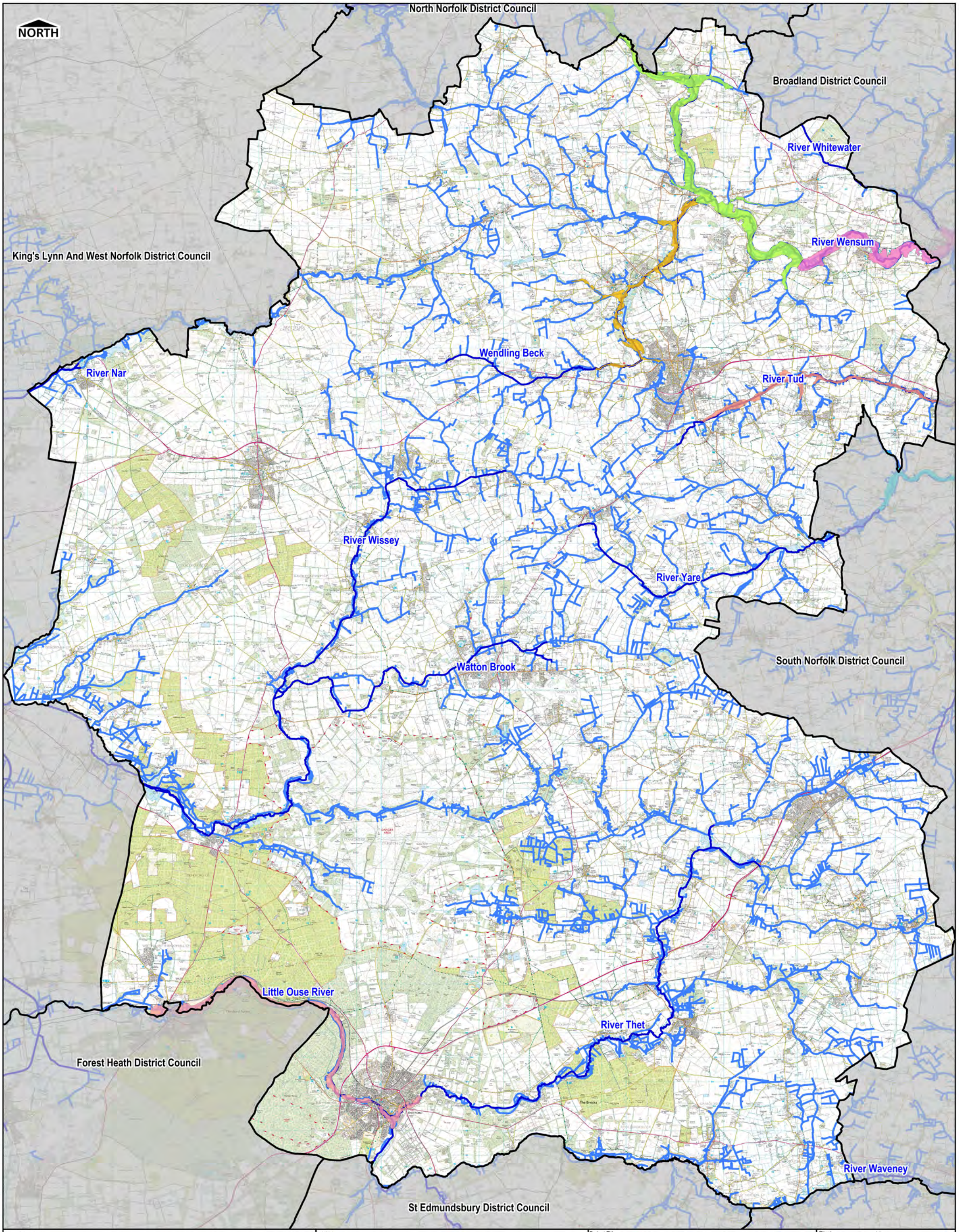

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LEGEND

- Administrative Boundaries
- Main River
- Ordinary Watercourse

Environment Agency Flood Warning Areas

- River Thet & Little Ouse from Thetford to Brandon
- River Tiffey, from Wymondham to Barford
- River Tud from East Dereham to New Costessey
- River Waveney from Diss to Bungay
- River Wensum from Swanton Morley to New Costessey
- River Wensum from Fakenham to Swanton Morley
- River Yare from Barnham Broom to Cringleford
- Wendling Beck from Wendling to Worthing

NOTES

Main Rivers are designated by Defra on a 'Main River Map'. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only. However overall responsibility for maintenance lies with the riparian owner.

An Ordinary Watercourse is a watercourse that does not form part of a Main River. This includes all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices (other than public sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows according to the Land Drainage Act 1991.

The Environment Agency provide a free flood warning service for many areas at risk of flooding from rivers and the sea. The Environment Agency issue flood warnings to homes and businesses when flooding is expected. Upon receipt of a flood warning, occupants should take immediate action.

Project Title

BRECKLAND DISTRICT COUNCIL LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT UPDATE

Drawing Title

ENVIRONMENT AGENCY FLOOD WARNING AREAS

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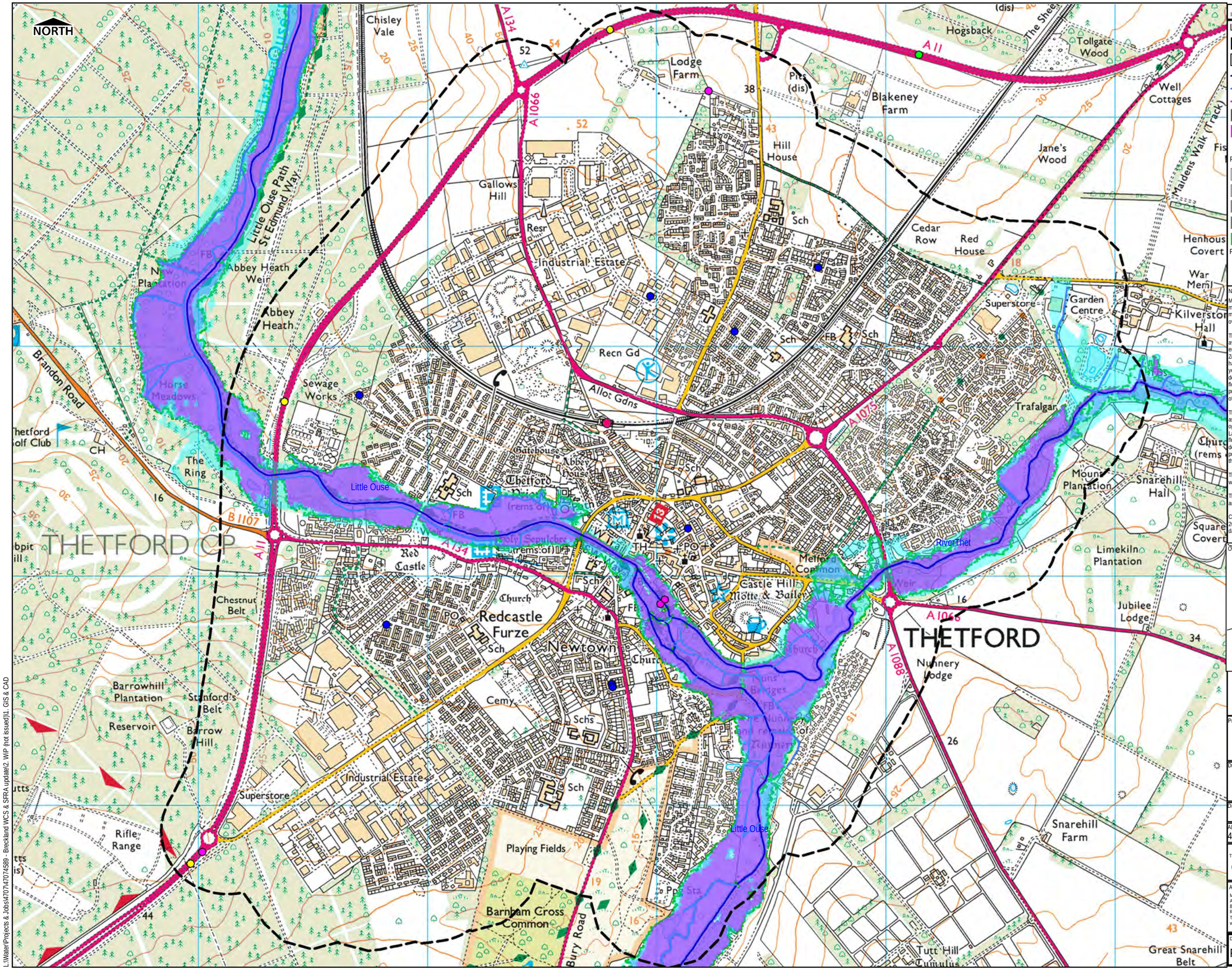
Appendix B. Area Assessment Mapping

1	Attleborough
2	Thetford
3	Dereham
4	Swaffham
5	Watton
6	Great Ellingham
7	Sporle, Necton
8	Old Buckenham, Banham
9	North Elmham, Bawdeswell
10	Mattishall, Hockering
11	Swanton Morley
12	Garboldisham
13	East Harling, Kenninghall
14	Narborough, Litcham
15	Shipdham, Yaxham
16	Weeting
17	Ashill



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LEGEND

- Settlements, Market Towns, Local Service Centres
- Internal Drainage Board Administrative Area
- Main River
- Ordinary Watercourse
- Flood Defences
- Areas Benefitting from Flood Defences
- Flood Storage Areas
- Emergency Rest Centres

Probability of Flooding from Rivers

- Flood Zone 1 Low Probability
- Flood Zone 2 Medium Probability
- Flood Zone 3a High Probability
- Flood Zone 3b Functional Floodplain, where available
- Defended 1% AEP incl. climate change, where available

Flood Records

- Fluvial
- Surface Water
- Sewer
- Infrastructure Failure
- Sandbag Delivery

Notes

Main Rivers are designated by Defra on a 'Main River Map'. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only. However overall responsibility for maintenance lies with the riparian owner.

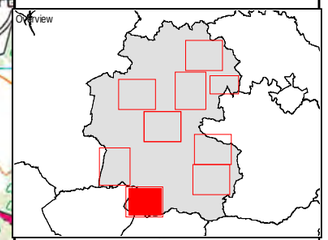
The Environment Agency Flood Map for Planning (Rivers and Sea) is available on the Environment Agency website (www.gov.uk/environment-agency) and displays the risk of flooding based on probability. Flood Zone 1: Land assessed, ignoring the presence of flood defences, as having a less than 0.1% annual probability of fluvial or tidal flooding in any year. Flood Zone 2: Land assessed, ignoring the presence of flood defences, as having between a 1% nd 0.1% annual probability of fluvial flooding in any year. Flood Zone 3: Land assessed, ignoring the presence of flood defences, as having a 1% or greater annual probability of fluvial flooding in any year.

The Flood Map displays the location of linear raised flood defences such as embankments and walls. Flood storage areas, land designated and operated to store flood water are displayed in a separate polygon layer. Land that may benefit from the presence of flood defences during a 1% fluvial or 0.5% tidal flood event. These are areas that would flood if the defence were not present, but may not flood because the defence is present. Areas benefitting from flood storage areas may be remote from the flood defence structure.

This map should be used with reference to the Level 1 SFRA Report which provides further details regarding the datasets used.

This map is intended to provide a strategic overview of fluvial flood risk and should not be used to assess flood risk for individual properties.

Overview



Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Key Settlement: Thetford

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
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LEGEND

- Settlements, Market Towns, Local Service Centres
- Internal Drainage Board Administrative Area
- Main River
- Ordinary Watercourse
- Flood Defences
- Areas Benefitting from Flood Defences
- Flood Storage Areas
- Emergency Rest Centres

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Flood Records

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- Surface Water
- Sewer
- Infrastructure Failure
- Sandbag Delivery

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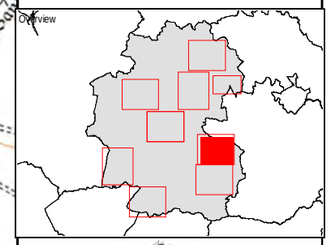
Overview



Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Key Settlement: Attleborough

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
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FIGURE 1	FINAL

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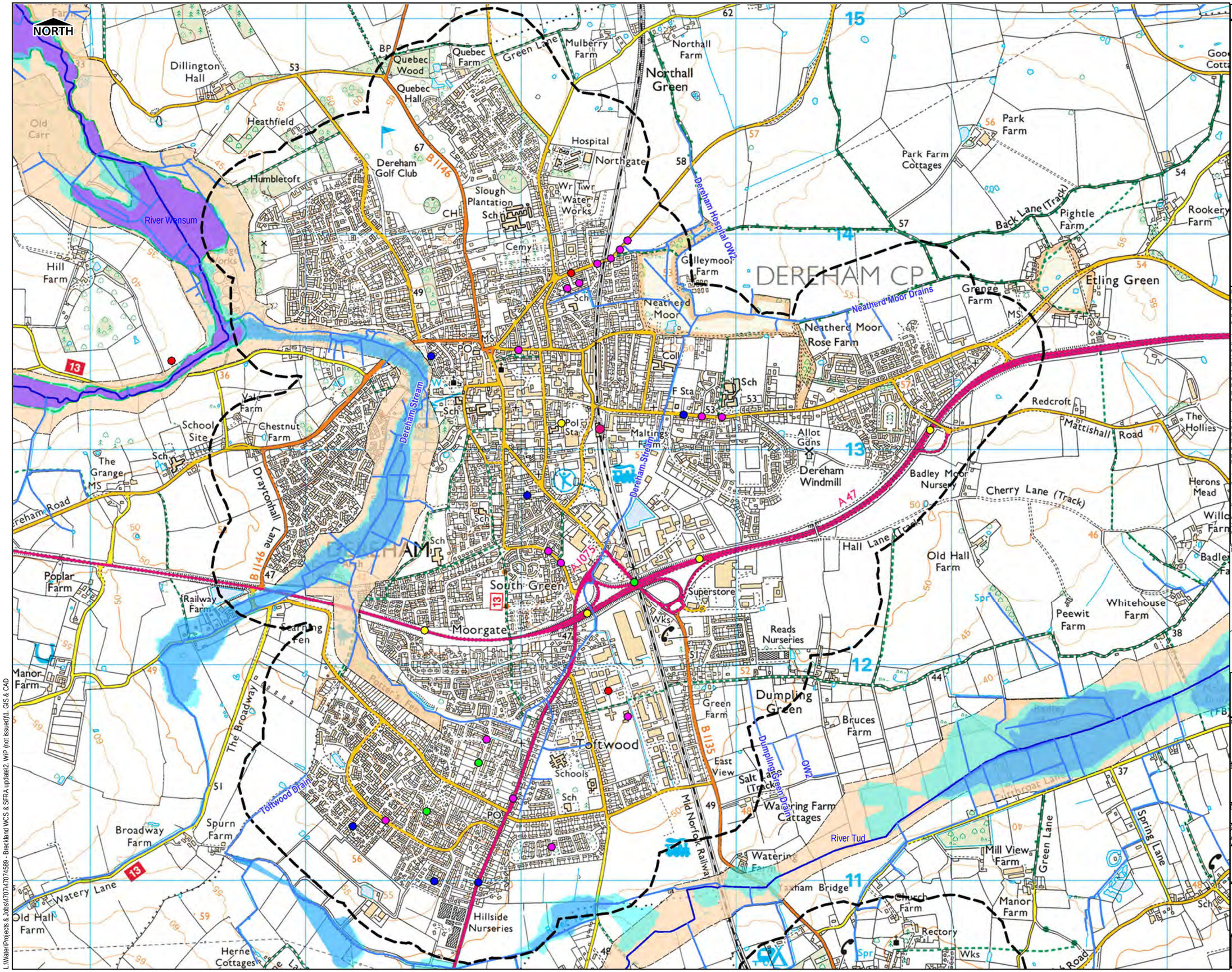

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LEGEND

- Settlements, Market Towns, Local Service Centres
- Internal Drainage Board Administrative Area
- Main River
- Ordinary Watercourse
- Flood Defences
- Areas Benefitting from Flood Defences
- Flood Storage Areas
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- Defended 1% AEP incl. climate change, where available

Flood Records

- Fluvial
- Surface Water
- Sewer
- Infrastructure Failure
- Sandbag Delivery

Notes

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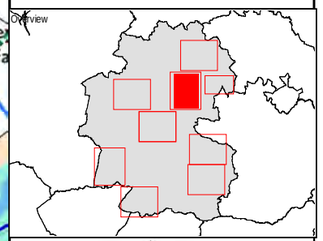
This map is intended to provide a strategic overview of fluvial flood risk and should not be used to assess flood risk for individual properties.

Overview



Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Market Town: Dereham

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:16,000

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Drawing Number	Rev
FIGURE 3	FINAL

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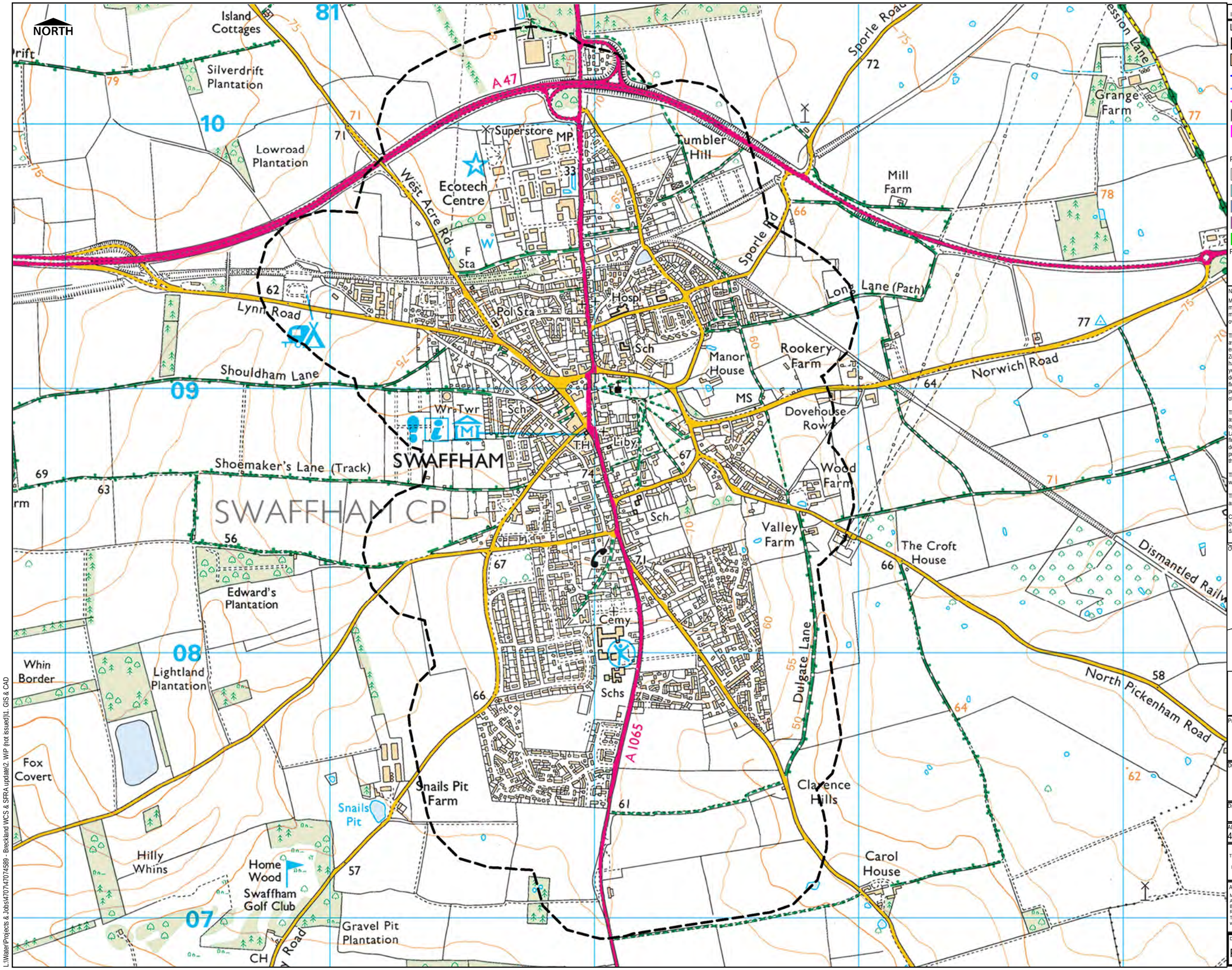

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

LEGEND

- Settlements, Market Towns, Local Service Centres
- Internal Drainage Board Administrative Area
- Main River
- Ordinary Watercourse
- Flood Defences
- Areas Benefitting from Flood Defences
- Flood Storage Areas
- Emergency Rest Centres

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- Flood Zone 1 Low Probability
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- Flood Zone 3b Functional Floodplain, where available
- Defended 1% AEP incl. climate change, where available

Flood Records

- Fluvial
- Surface Water
- Sewer
- Infrastructure Failure
- Sandbag Delivery

Notes

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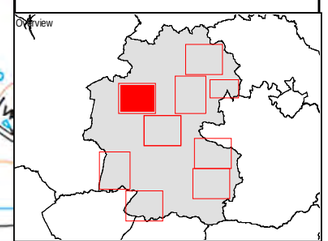

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Market Town: Swaffham

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:13,000

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Drawing Number	Rev
FIGURE 4	FINAL

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LEGEND

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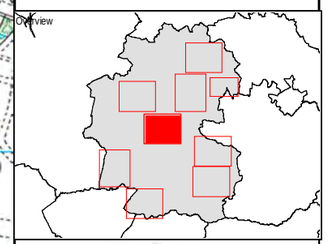

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Market Town: Watton

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:16,000

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Drawing Number	Rev
FIGURE 5	FINAL

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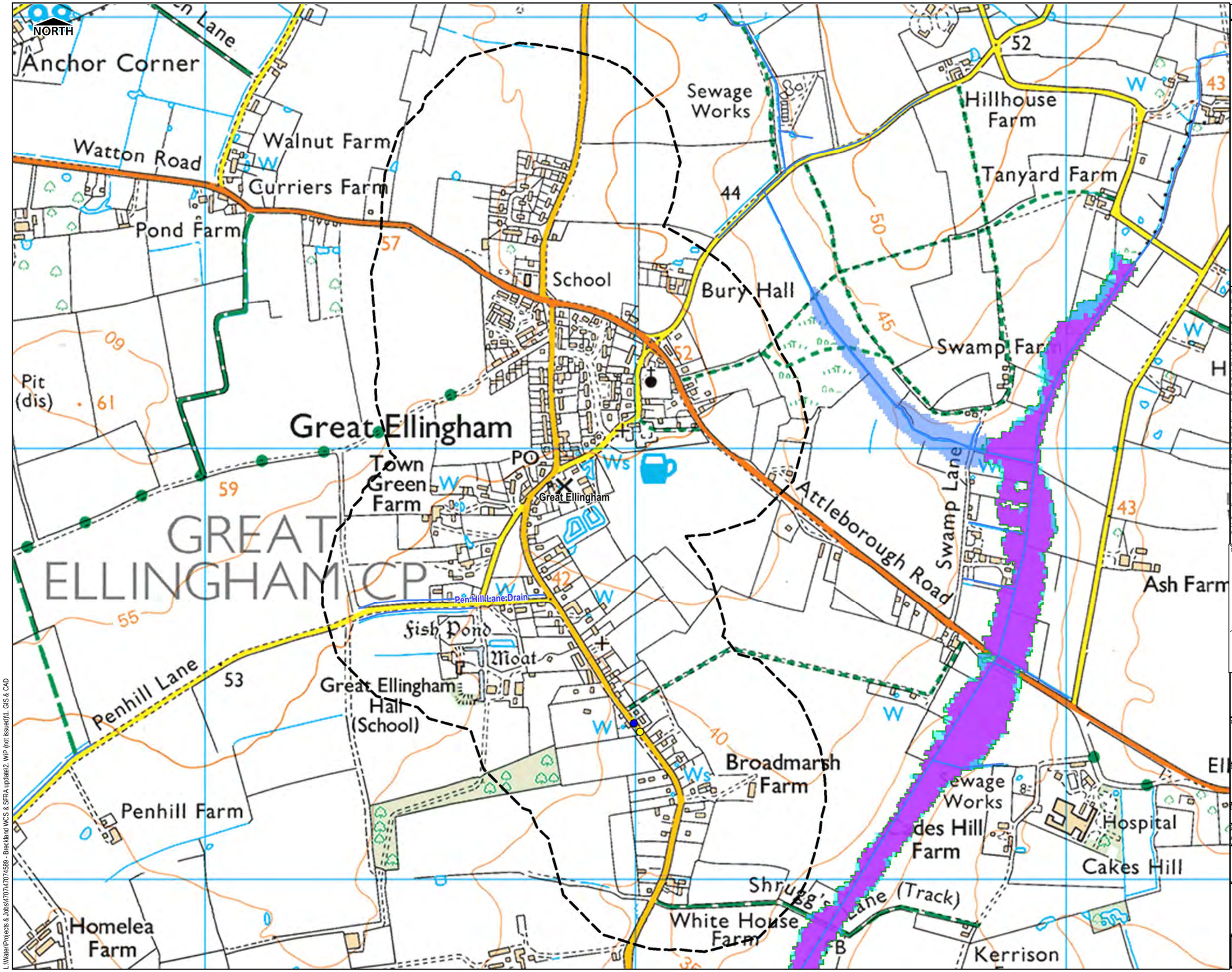

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LEGEND

- Settlements, Market Towns, Local Service Centres
- Internal Drainage Board Administrative Area
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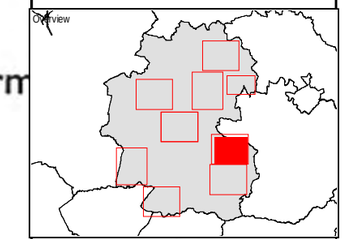

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centre: Great Ellingham

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:8,000

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Drawing Number	Rev
FIGURE 6	FINAL

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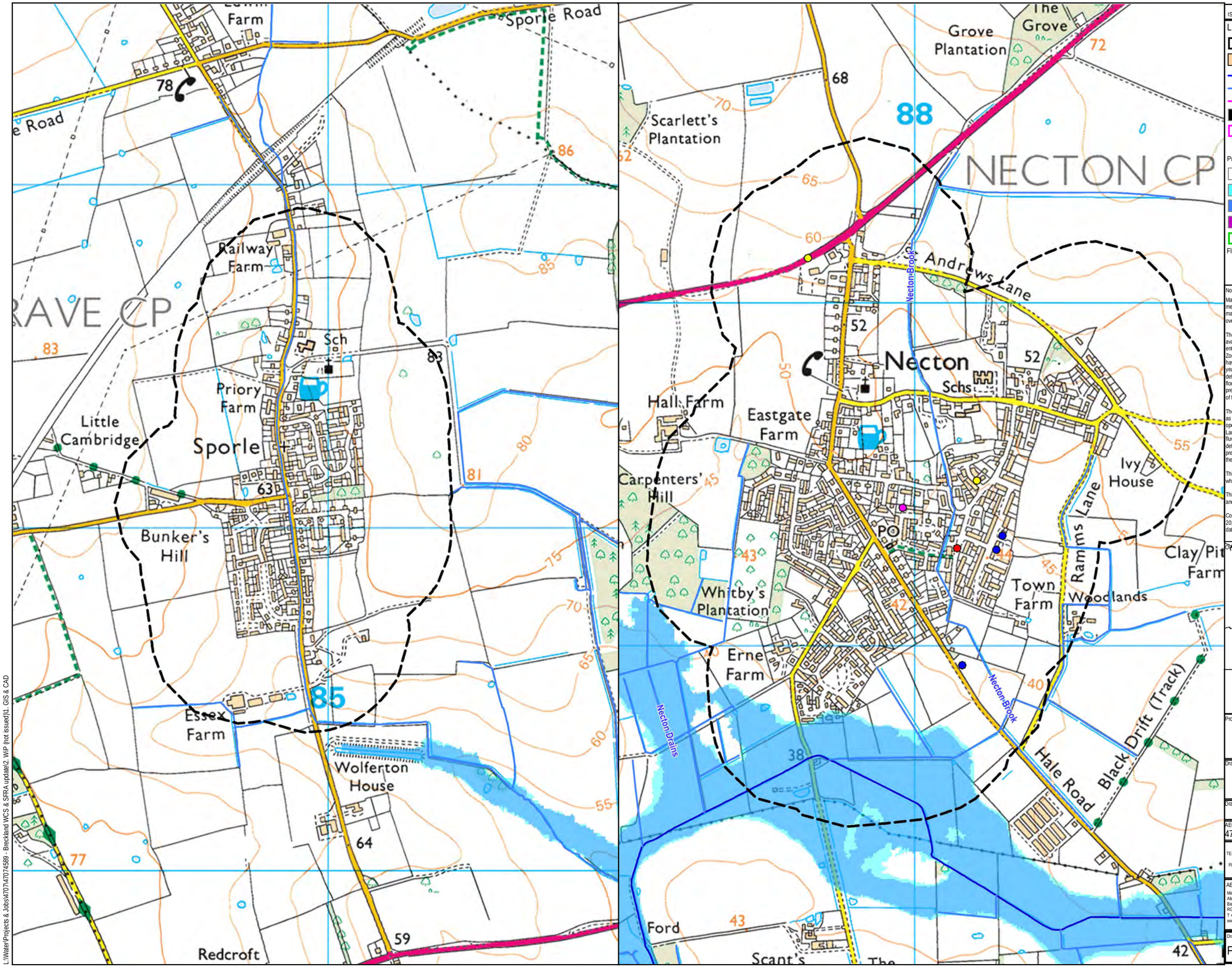

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LEGEND

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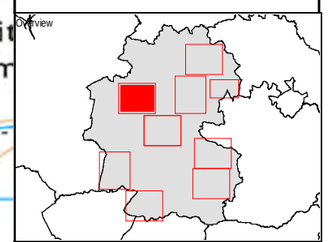

Breckland

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
Sporle and Necton

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:10,000

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Drawing Number	Rev
FIGURE 7	FINAL

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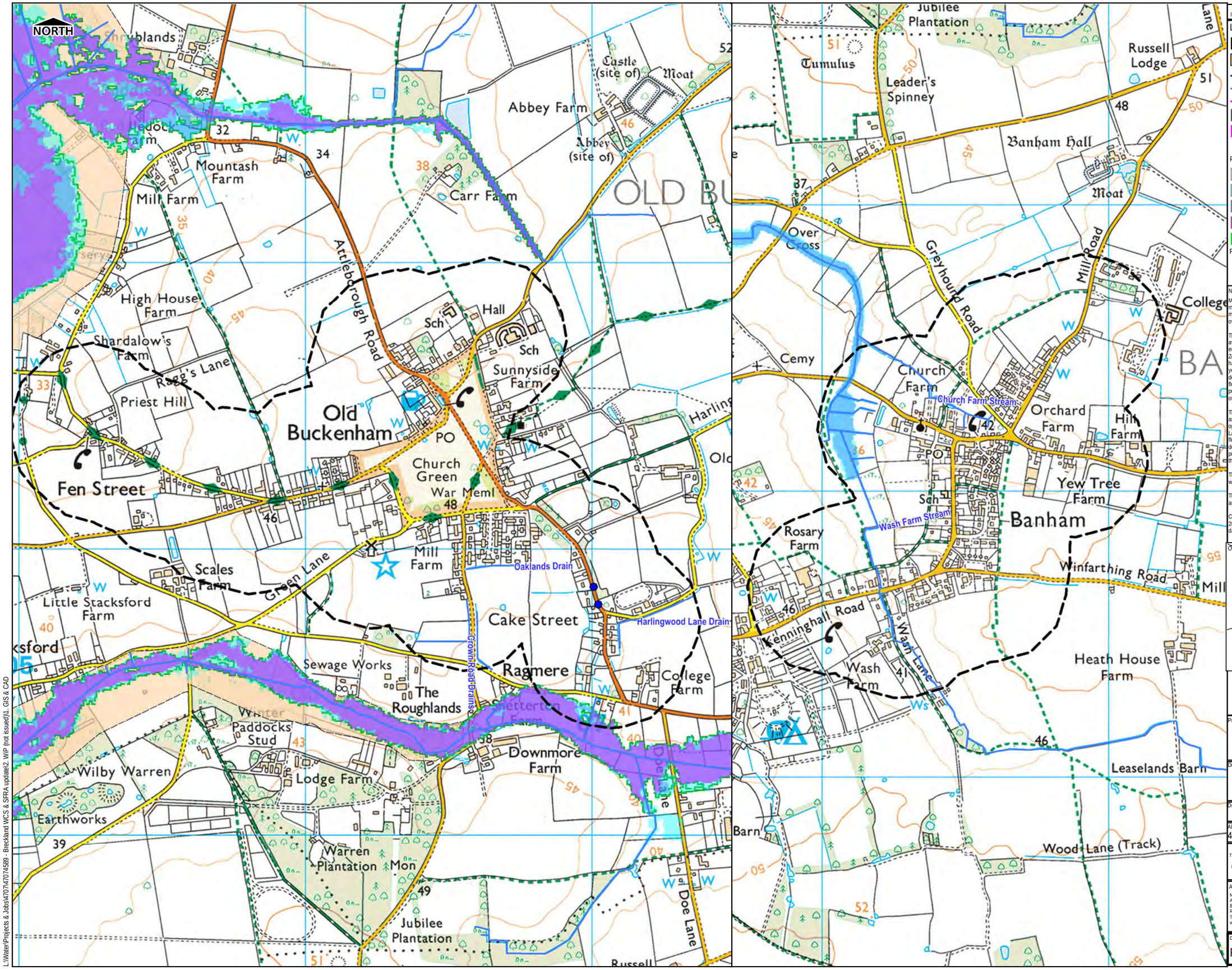

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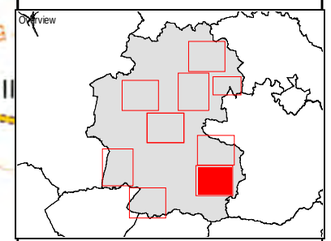

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
Old Buckenham, Banham

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:12,000

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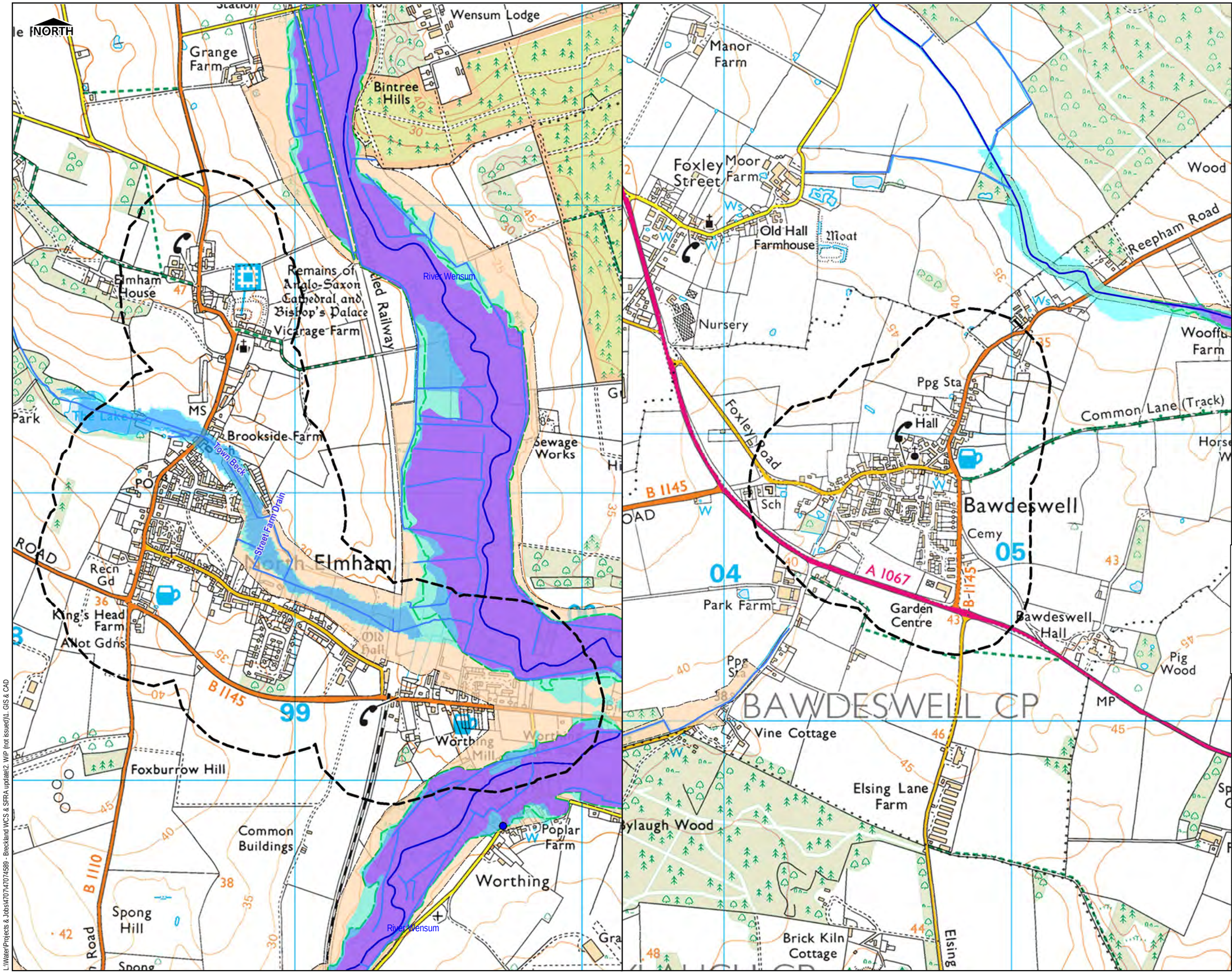
Drawing Number	Rev
FIGURE 8	FINAL



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LEGEND

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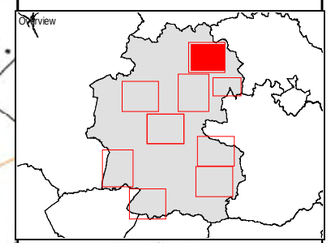

Breckland

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
North Elmham, Bawdeswell

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:12,000

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Drawing Number	Rev
FIGURE 9	FINAL

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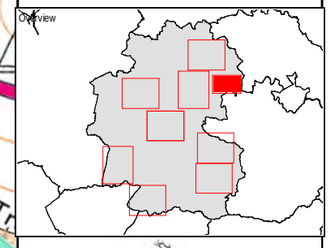

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
Mattishall, Hockering

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:12,000

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Drawing Number	Rev
FIGURE 10	FINAL

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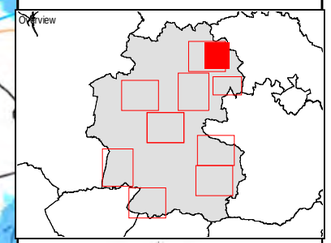

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
Swanton Morley

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:11,000

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Drawing Number	Rev
FIGURE 11	FINAL

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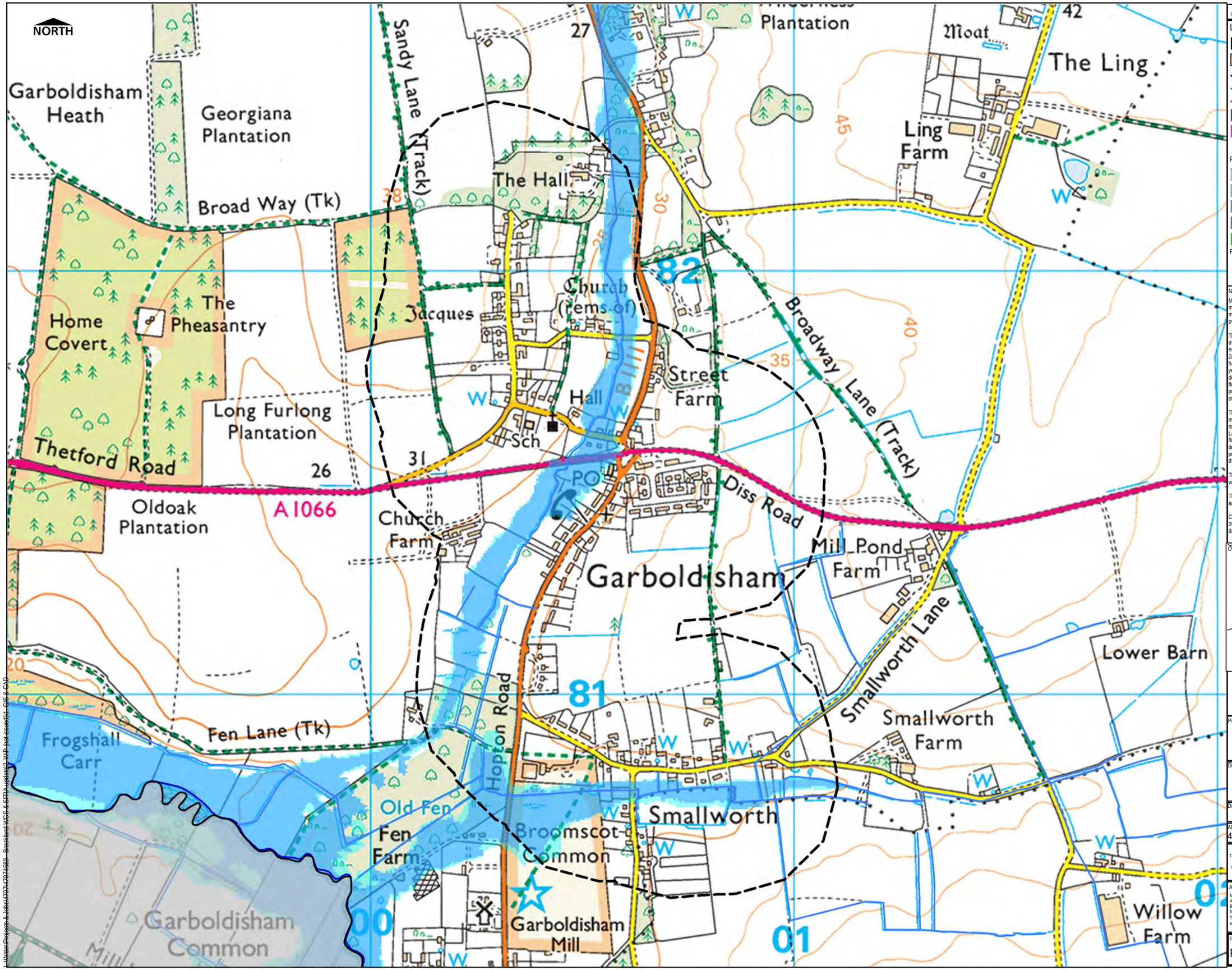

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LEGEND

- Settlements, Market Towns, Local Service Centres
- Internal Drainage Board Administrative Area
- Main River
- Ordinary Watercourse
- Flood Defences
- Areas Benefitting from Flood Defences
- Flood Storage Areas
- Emergency Rest Centres

Probability of Flooding from Rivers

- Flood Zone 1 Low Probability
- Flood Zone 2 Medium Probability
- Flood Zone 3a High Probability
- Flood Zone 3b Functional Floodplain, where available
- Defended 1% AEP incl. climate change, where available

Flood Records

- Fluvial
- Surface Water
- Sewer
- Infrastructure Failure
- Sandbag Delivery

Notes

Main Rivers are designated by Defra on a 'Main River Map'. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only. However overall responsibility for maintenance lies with the riparian owner.

The Environment Agency Flood Map for Planning (Rivers and Sea) is available on the Environment Agency website (www.gov.uk/environment-agency) and displays the risk of flooding based on probability. Flood Zone 1: Land assessed, ignoring the presence of flood defences, as having a less than 0.1% annual probability of fluvial or tidal flooding in any year. Flood Zone 2: Land assessed, ignoring the presence of flood defences, as having between a 1% nd 0.1% annual probability of fluvial flooding in any year. Flood Zone 3: Land assessed, ignoring the presence of flood defences, as having a 1% or greater annual probability of fluvial flooding in any year.

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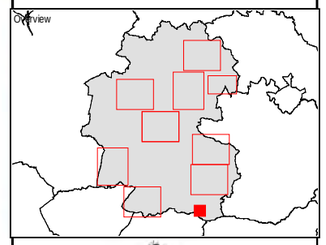
This map should be used with reference to the Level 1 SFRA Report which provides further details regarding the datasets used.

This map is intended to provide a strategic overview of fluvial flood risk and should not be used to assess flood risk for individual properties.

Overview



Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
Garboldisham

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:10,000

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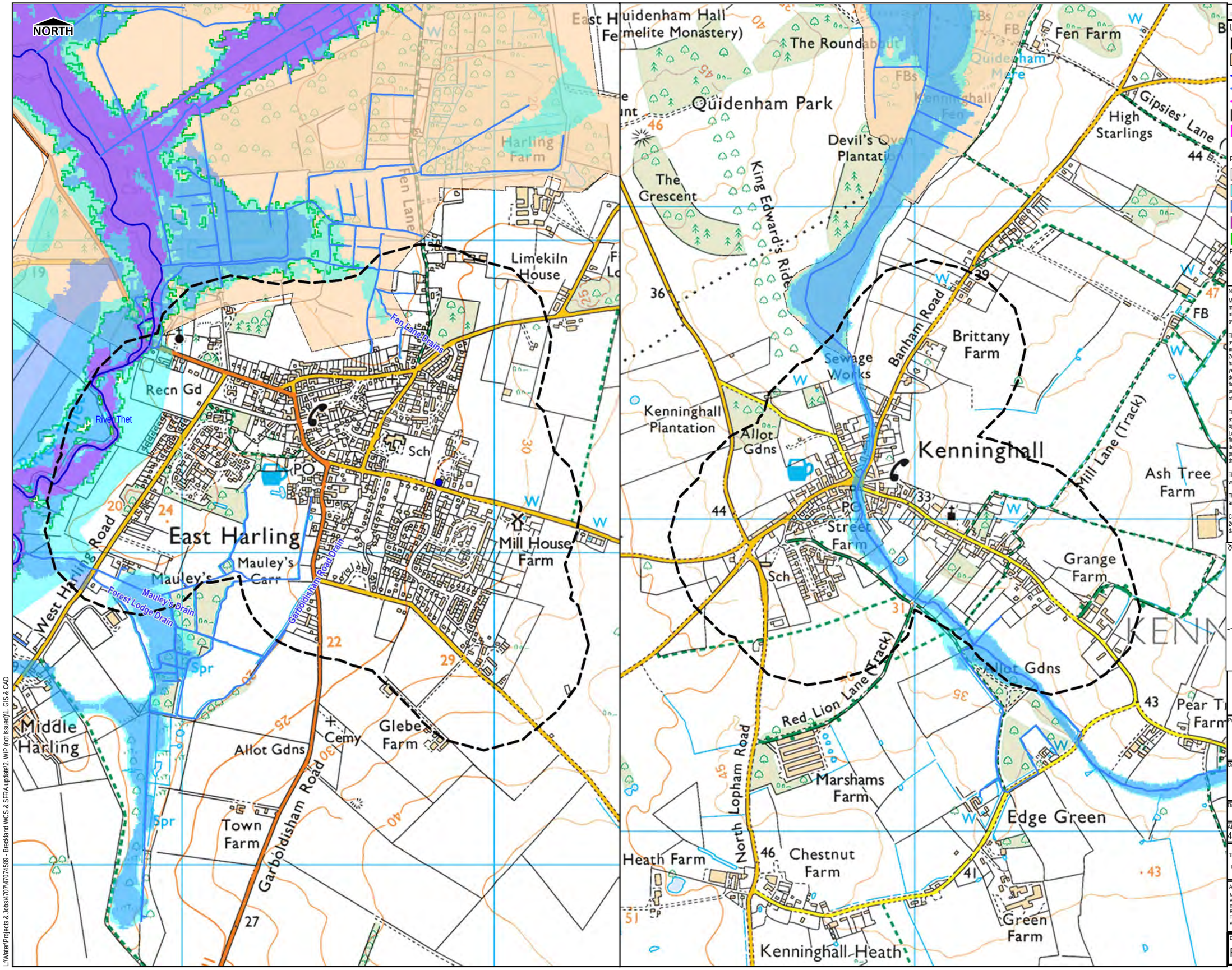
Drawing Number	Rev
FIGURE 12	FINAL



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LEGEND

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- Flood Zone 3a High Probability
- Flood Zone 3b Functional Floodplain, where available
- Defended 1% AEP incl. climate change, where available

Flood Records

- Fluvial
- Surface Water
- Sewer
- Infrastructure Failure
- Sandbag Delivery

Notes

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The Flood Map displays the location of linear raised flood defences such as embankments and walls. Flood storage areas, land designated and operated to store flood water are displayed in a separate polygon layer. Land that may benefit from the presence of flood defences during a 1% fluvial or 0.5% tidal flood event. These are areas that would flood if the defence were not present, but may not flood because the defence is present. Areas benefitting from flood storage areas may be remote from the flood defence structure.

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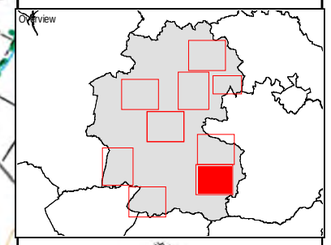
Overview



Breckland

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
East Harling, Kenninghall

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:11,000

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FIGURE 13	FINAL

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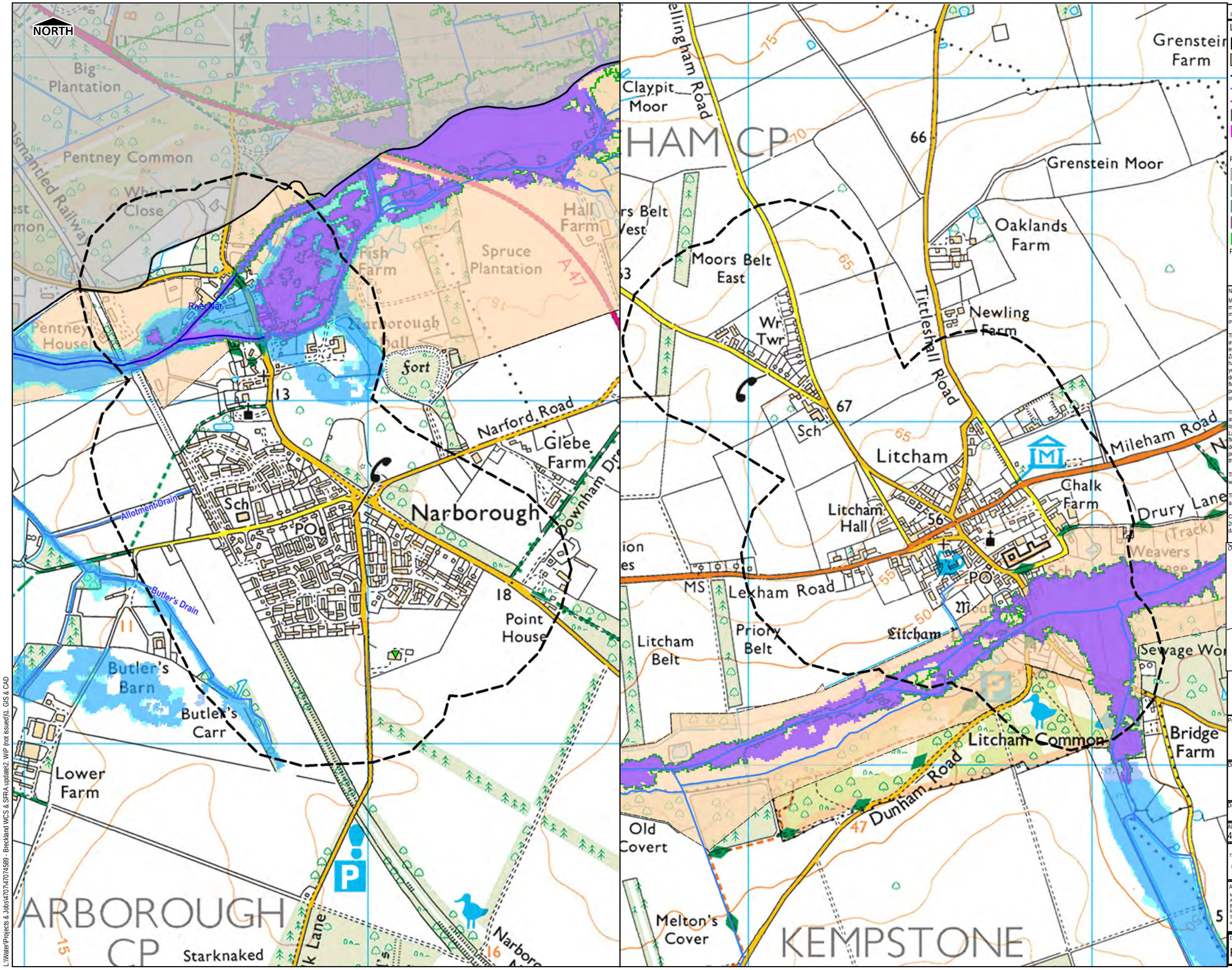

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LEGEND

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- Defended 1% AEP incl. climate change, where available

Flood Records

- Fluvial
- Surface Water
- Sewer
- Infrastructure Failure
- Sandbag Delivery

Notes

Main Rivers are designated by Defra on a 'Main River Map'. The Environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only. However overall responsibility for maintenance lies with the riparian owner.

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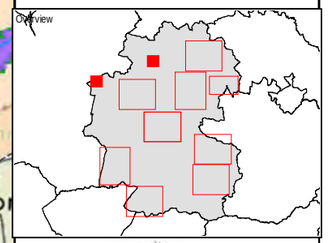

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
Narborough, Litcham

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:10,000

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Drawing Number	Rev
FIGURE 14	FINAL

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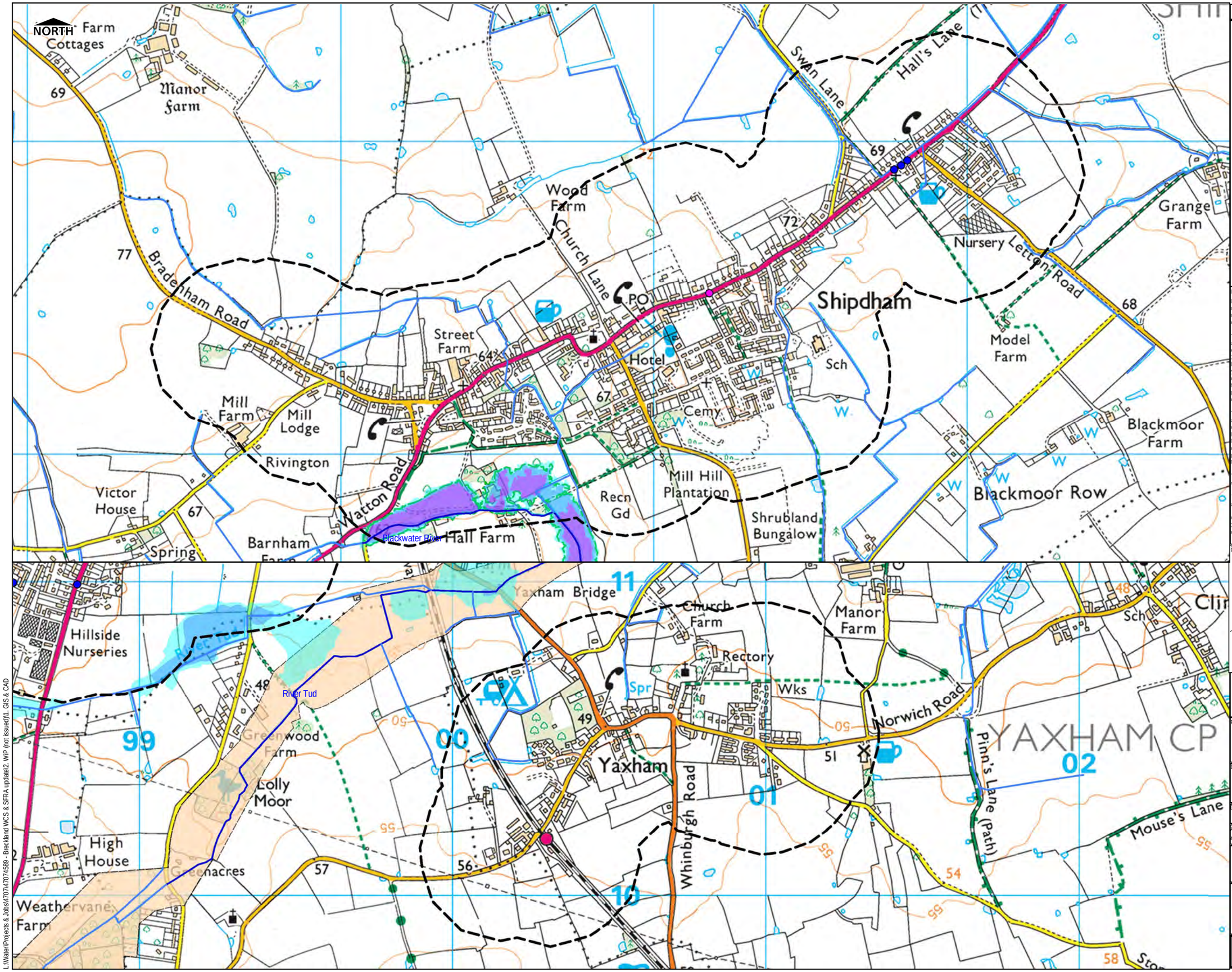

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Flood Records

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Notes

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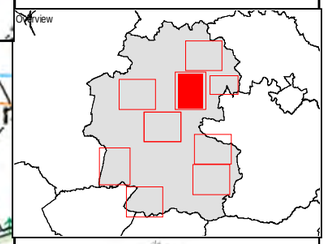

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
Shipdham, Yaxham

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:10,000

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Drawing Number	Rev
FIGURE 15	FINAL

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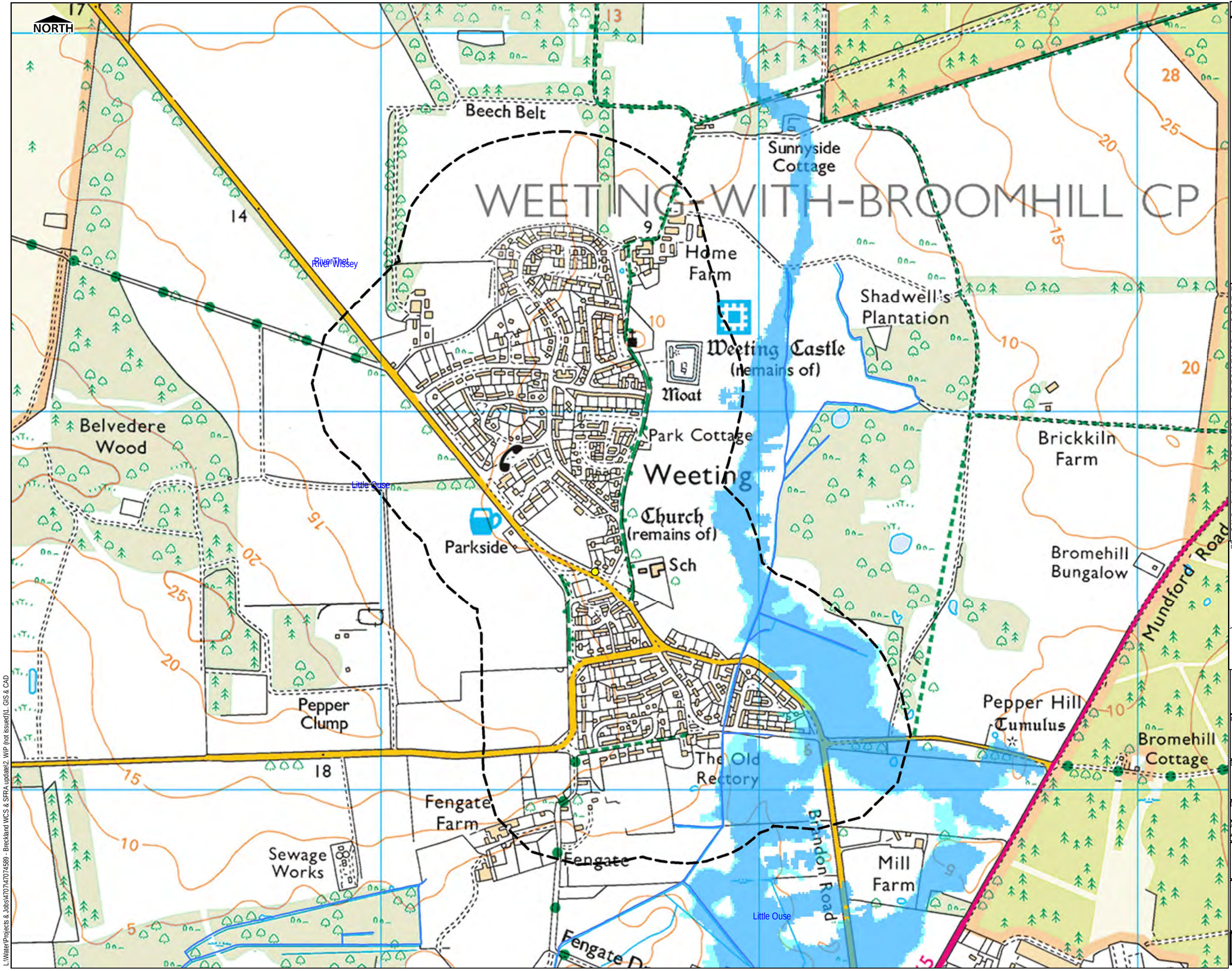

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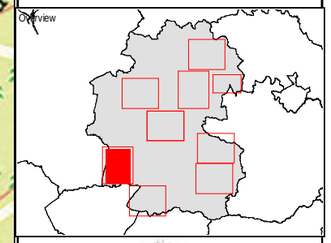

Breckland

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:
Weeting

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:10,000

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FIGURE 16	FINAL

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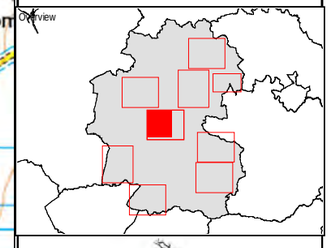

Breckland Council

Project Title

Breckland District Council
Strategic Flood
Risk Assessment

Drawing Title

Local Service Centres:Ashill

Drawn	Checked	Approved	Date
SL	CP	CP	12/01/17

AECOM Internal Project No.	Scale at A3
47074589	1:10,000

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Drawing Number	Rev
FIGURE 17	FINAL

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Appendix C. Area Assessments

C.1 Attleborough – Key Settlement

Attleborough – Key Settlement
Assessing Flood Risk – Flooding from Rivers
There are no Main Rivers in Attleborough and the town is located in the headwaters of the River Thet. The north and north east areas of Attleborough and Besthorpe drain to a tributary of the Thet which flows alongside the northern edge of the A11 bypass road and joins the Thet at Swangey Fen. The southern and western part of Attleborough drains to the south, via an East Harling IDB drain which forms the main River Thet at Swangey Fen. The majority of Attleborough is designated Flood Zone 1, low probability of flooding from fluvial sources. A narrow strip of land adjacent to the A11 is classified as Flood Zone 3b Functional Floodplain associated with the tributary of the River Thet. This land is undeveloped. There is some history of flooding from Besthorpe Stream at Mill Lane and from the main Attleborough Stream north of the A11. There are some ditch capacity issues in the area of Besthorpe, and sandbags have been delivered at several occasions.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW identifies significant extents of surface water ponding either side of the A11 to the north east of Attleborough. The uFMfSW also clearly shows the flow paths and areas of ponding associated with the watercourses that form the headwaters of the River Thet which flow right through Attleborough, including the Besthorpe Stream, Fowler's Lane Drain and the Industrial Estate IDB Drain. Surface water flooding is reported to have occurred on the A11 to the north of Attleborough at several locations.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. This is overlain by Happisburgh Glacigenic Formation and Lowestoft Formation in the main part of Attleborough, with Alluvium along the floodplain adjacent to the A11. Alluvium and Lowestoft Formation are designated Secondary A Aquifer, and Happisburgh Glacigenic Formation is designated Unproductive Strata. The AStGWF mapping in **Appendix A Figure 7** shows that the majority of the settlement is covered with 1km squares in which 50-75% or >75% of the area is susceptible to groundwater emergence. This is attributed to the permeable drift geology which provides potential pathways for groundwater to flow. There are no records of groundwater flooding in the area.
Assessing Flood Risk – Flooding from Sewers
There are no known records of sewer flooding within this area.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Attleborough. The nearest reservoir to Attleborough is Swangey Farm Reservoir, located to the west, and downstream of the settlement.

C.2 Thetford – Key Settlement

Thetford – Key Settlement

Assessing Flood Risk – Flooding from Rivers

Thetford is located in the south west of the district, at the confluence of the River Thet and Little Ouse River. The two rivers join in the town centre and upstream of this they flow parallel to each other, with many sluice gates and channels allowing the transfer of water between the two rivers. These two main rivers present the only significant source of fluvial flood risk to the town. No formal fluvial flood defences have been constructed in Thetford.

The modelled Flood Zones show that the floodplain of the River Thet and Little Ouse River is relatively wide, and a large part of the centre of the town is designated Flood Zone 3b Functional Floodplain, areas which should be used to store water in times of flood. The modelling shows that properties along Foxglove Road, Fennel Way and Harebell Close, Rosecroft Way, Hurth Way (A1066) are within Flood Zone 2 and 3 associated with the River Thet, as well as properties on Castle Street, Castle Lane and The Meadows, Green Lane and Redgate.

In the south of the town, the floodplain of the Little Ouse River is immediately adjacent to properties on Wagtail Way, Kingfisher Close and Partridge Drive. The Little Ouse River then turns west and flows adjacent to the grounds of Thetford Grammar School and the ruins of the Priory. The floodplain is largely undeveloped and flows through forested sections.

Assessing Flood Risk – Flooding from Surface Water

The uFMfSW mapping shows there are several areas in Thetford that may be susceptible to surface water flooding. These include:

- Surface water ponding adjacent to the railway line, just to the north of Drake Infant School, and north of Tennyson Way.
- Surface water ponding on the adjacent to the northern side of the A1075 Norwich Road.
- To the west of A1066 Hurth Way in Thetford centre.
- Newtown.

Surface water flooding at several locations on the A11 has been reported by the Highways Agency. It was reported that some of this was due to blocked gullies.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. Along the corridor of the River Thet and Little Ouse River this is overlain by undifferentiated River Terrace Deposits and Alluvium, which are designated Secondary A Aquifer. In the north of Thetford and to the south east, the chalk is overlain by Lowestoft Formation which varies in designated between Secondary B and Unproductive Strata.

The AStGWF mapping in **Appendix A Figure 7** shows that a real variation in the 1km square designations. In the north east of Thetford, the dataset shows no groundwater emergence, or less than 25% within the 1km grid squares. In the south and west this can increase to 25-50% or >75%. This correlates with the presence of permeable drift geology associated with the routes of the rivers which provides potential pathways for groundwater to flow.

There are no records of groundwater flooding in the area.

Assessing Flood Risk – Flooding from Sewers

Anglian Water reported that sewer flooding occurred in the town centre at Bridges Walk in August 2006, and to the north of the town in Fairfields with a 2:10 year frequency.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that a potential failure of infrastructure associated with the following reservoirs, could pose a potential risk to Thetford:

- Euston Reservoir.
- Shadwell Park Lake.

The mapping shows that in such an event, floodwaters would be constrained to the natural fluvial floodplains of the River Thet and Little Ouse River.

C.3 Dereham – Market Town

Dereham – Market Town

Assessing Flood Risk – Flooding from Rivers

Dereham is in close proximity to three watercourses, the River Tud, Dereham Stream and Wendling Beck.

There is a limited floodplain associated with the River Tud in this area as the land rises steeply away from the river. Similarly, the Wendling Beck has a limited floodplain as the land rises quickly away from the river and an embankment is present.

Dereham Stream experiences numerous localised flooding problems, largely due to constraints of the channel capacity and susceptibility to blockages at structures. Properties at Toftwood and Swanton Road are reported by Breckland DC to have been affected in the past.

Dereham Stream flows through the western section of the town. By studying the modelled Flood Zone map it is possible to see that this settlement is largely outside of the floodplain. However, there is a small group of properties just south of where Dereham Road crossed the stream that are within the Flood Zone 3. The buildings within this group that are furthest from the stream intersect with the Flood Zone 2 only. These areas should used to store water in times of flood.

There is one previous record of fluvial flooding in the north of Dereham.

Assessing Flood Risk – Flooding from Surface Water

Dereham has some history of surface water flooding, sewer flooding and infrastructure failure. The Environment Agency has reported that Dereham has been flooded by surface water in June 2007. Surface water flooding occurred on A47 at several locations through the town.

The uFMfSW mapping shows clearly the nature flowpath associated with the upper parts of the Dereham Stream, including ponding around the Neatherd Moor area and Dereham Hospital ordinary watercourses.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. This is overlain by Lowestoft Formation across the majority of the town, with Alluvium along the floodplain of the Dereham Stream and River Tud. Alluvium and Lowestoft Formation are designated Secondary A Aquifer.

The AStGWF mapping in **Appendix A Figure 7** shows that the west of Dereham, adjacent to the Dereham Stream floodplain, is covered with 1km squares in which 25-50% or >75% of the area is susceptible to groundwater emergence. This is attributed to the presence of permeable geology which provides potential pathways for groundwater to flow. The remainder of the town is covered with 1km squares with a lower proportion of emergence.

There are no records of groundwater flooding in the area.

Assessing Flood Risk – Flooding from Sewers

As highlighted in the Broadlands River CFMP, East Dereham is heavily reliant on maintenance and pumping. Records from Breckland Council show that it has been flooded in St George Drive due to a blocked pipe and in a garden in Larner's Drift, Toftwood, due to undersized pipes under the garage. Sewer flooding occurred throughout the town, including Norwich Road, South Green and a critical point in the north-east of Dereham at Swanton Road. According to the Environment Agency, sewer flooding in Larner's Drift and Lavender Grove occurred in the past due the unauthorised connection of surface water drainage facilities into the foul sewer.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Dereham. The nearest reservoir to Attleborough is Dillington Carr.

C.4 Swaffham – Market Town

Swaffham – Market Town

Assessing Flood Risk – Flooding from Rivers

The town of Swaffham is at least 4 km from any main river and is located entirely within Flood Zone 1 Low Probability of flooding. It is therefore considered not to be at flood risk from this source. In addition, there are no watercourses marked on the Environment Agency Detailed River Network or Ordnance Survey maps in the Swaffham area. A site visit has shown that Swaffham is generally higher than the area surrounding it and there are no watercourses in the valleys surrounding the town.

Assessing Flood Risk – Flooding from Surface Water

The town lies on a chalk basin, covered with poorly draining clay soils. This means that flooding may occur due to the collection of surface water from precipitation. At present there is no positive drainage system for the town, with surface water either draining to deep drainage boreholes direct to the chalk aquifer or pumped to the River Wissey at North Pickenham.

The Breckland District Council has reported surface water flooding incidents in Northwell Road. The Highways Agency reported a surface water incident on the A47 sliproad to the west of the town.

The uFMfSW mapping shows there are several areas in Swaffham that may be susceptible to surface water flooding. These include:

- Surface water ponding over Brandon Road (A1065) in the south of Swaffham
- There is a low risk of surface water ponding in the east, adjacent to the church and over North Pickenham Road
- In the most northerly area of Swaffham there is high risk of surface water flooding next to the superstore complex.

Assessing Flood Risk – Flooding from Groundwater

The AStGWF mapping in **Appendix A Figure 7** shows that Swaffham is located in an area with no susceptibility to groundwater emergence.

There are no records of groundwater flooding in the area.

Assessing Flood Risk – Flooding from Sewers

The Lynn News reported regular sewer flooding in Swaffham on Sporle Road, New Sporle Road and West Acre Road.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Swaffham. The nearest reservoirs to Swaffham are Fourteen Acre Field to the south west and Hullgate Field to the east.

C.5 Watton – Market Town

Watton – Market Town

Assessing Flood Risk – Flooding from Rivers

Watton is located in the centre of the district, immediately south of Watton Brook. Watton Brook has several tributaries joining from the north at this point, before flowing west towards Little Cressingham. Any development proposed in the north of the town is partially at risk of flooding[46].

The modelled Flood Zones map highlights that the floodplain of Watton Brook is relatively wide just north of Watton. The floodplain is undeveloped and therefore during a flood event water can be stored here rather than impacting the village.

Assessing Flood Risk – Flooding from Surface Water

Surface water naturally drains away from the town of Watton. To the west the surface water drains towards the ordinary watercourse Merton drain before flooding into Watton Brook. In the north water drains directly into the brook via a series of drainage ditches. In the east water drains directly into the upstream section of the brook via a series of drains. To the south the site drains into the ordinary watercourse Thompson brook before eventually flowing into the River Wissey near Buckenham Tofts Park[24].

The uFMfSW mapping shows there are a few locations in Watton that may be susceptible to surface water flooding. These include:

- The road northwest of Rokeles Hall.
- In an area of properties in the east of Watton, south of the B1108.
- Ponding over the A1075, directly north of Barn Rucher.
- Across the development far west of Watton, south of the B1108.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. Downstream of Watton along the corridor of Watton Brook the chalk is overlain by alluvium and the surrounding area is Lowestoft Formation, these are a designated Secondary A, and unproductive aquifers respectively.

The AStGWF mapping in **Appendix A Figure 7** shows a real variation in the 1km square designations. The west and north of Watton is characterised as having a greater than or equal to 75% susceptibility to ground water flood emergence. The area to the centre and the east is classified as having a less than 25% susceptibility to groundwater flooding. The higher susceptibility of groundwater flooding in the northwest correlated with the presence of alluvium along the route of the river which provides potential pathways for groundwater to flow.

There are no records of groundwater flooding in the area.

Assessing Flood Risk – Flooding from Sewers

Anglian Water has reported several sewer flood incidents in Watton, including: Brandon Road, Swaffham Road, Saham Road, and particularly Norwich Road with 2:10 years frequency (internal and external) [24].

There are four potential sewage works outflows near Watton. There all eventually discharge into Watton Brook downstream of the town; none of them has a consented discharge volume. Of these outfalls only Watton STW discharges into a Main River. As all outfalls discharge into the same system, Watton STW has been given the highest rank since additional discharge is assessed to have the smallest impact. Information from the SFRA maps shows that this watercourse will potentially flood in a 1% flood event, although no residential areas are currently shown to be at flood risk[24].

To assess the full impact of additional discharge downstream of the STW a detailed assessment would be required, taking into account the specific nature and size of any future proposed development.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Watton.

[46] Mott McDonald, 2007. Breckland SFRA 2007 Update Report

C.6 Banham – Local Service Centre

Banham – Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Banham is located in the headwaters of the River Wittle, a tributary of the Thet which flows in a westerly direction, south of the A11 and joins the Thet at Roudham and Larling. The majority of Banham is designated Flood Zone 1, with a low probability of flooding from fluvial sources. There is a small area of Flood Zone 3a and Flood Zone 2 to the west of Banham, this land is undeveloped. There is no history of flooding from Church Farm Stream in the north of Banham or Wash Farm Stream in the south.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping shows that the surface water accumulates from the higher ground surrounding Banham and flows in three distinct pathways to the north of Banham, in the centre and the south. The southern flow path is the most extensive of the three. There are no historic records of surface water flooding in Banham.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The Banham area is overlain by the Lowestoft Formation in the east and Peat in the west. Within the Peat there are areas overlain with River Terrace Deposits (3) and a strip of Head, which follows the corridor of Wash Farm Stream. The area is entirely designated Secondary B aquifer status, apart from the strip of Head, which is designated Secondary (undifferentiated). The AStGWF mapping in **Appendix A Figure 7** shows only the northern section of Banham to have a susceptibility to groundwater flooding, which is less than 25%. The rest of Banham has no susceptibility to groundwater flooding. The higher susceptibility of groundwater flooding in the north correlates with the presence of River Terrace Deposits along the route of the river which provides potential pathways for groundwater to flow. There are no records of groundwater flooding in the area.
Assessing Flood Risk – Flooding from Sewers
There are no previous records of sewer flooding in the Banham area.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Banham.

C.7 Bawdeswell – Local Service Centre

Bawdeswell – Local Service Centre

Assessing Flood Risk – Flooding from Rivers

Bawdeswell is located southwest of the River Whitewater, a tributary of the River Wensum that flows in the south easterly direction. It confluences with the River Wensum just outside the Breckland administrative boundary, in Broadland.

Bawdeswell is a designated Flood Zone 1, with a low probability of flooding from fluvial sources. There are small areas of Flood Zone 2 to the north of Bawdeswell adjacent to the River Whitewater where it flows beneath Reepham Road just north of Bawdeswell.

There is no history of flooding from the River Whitewater in Bawdeswell.

In the town itself there are no ordinary watercourses or ditches, however, to the south there is a small ordinary watercourse flowing into Bylaugh Wood.

Assessing Flood Risk – Flooding from Surface Water

The uFMfSW mapping shows that there are several areas at high risk of surface water flooding sporadically spread across Bawdeswell and the surrounding area. Of particular note is a large area in the west of Bawdeswell adjacent to the A1067. This area in largely undeveloped, however, there are a few properties here that could be at risk of surface water flooding and it is likely to cause issues for the A1067.

There are no historic records of surface water flooding in Bawdeswell.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. The Bawdeswell area is overlain by Till, Mid Pleistocene, which is an unproductive aquifer.

The AStGWF mapping in **Appendix A Figure 7** shows that Bawdeswell is almost completely unsusceptible to groundwater flooding; however, there is an area to the north that has a less than 25% susceptibility to groundwater flooding. This is likely due to the area of designated Secondary A aquifer to the north where the River Whitewater flows.

There are no records of groundwater flooding in the area.

Assessing Flood Risk – Flooding from Sewers

Sewer flooding has been recorded in Bawdeswell on Reepham Road in 1998.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Bawdeswell.

C.8 Great Ellingham – Local Service Centre

Great Ellingham – Local Service Centre

Assessing Flood Risk – Flooding from Rivers

Great Ellingham is located in the headwaters of the River Thet. The only watercourses identified within the village are the drains adjacent to Penhill Lane and the drain which runs along Long Street. Breckland District Council reported that localised flooding occurred in Long Street due to the lack of maintenance and/or lack of capacity of the drain.

Great Ellingham is a designated Flood Zone 1, with a low probability of flooding from fluvial sources.

Assessing Flood Risk – Flooding from Surface Water

The uFMfSW mapping shows that there is a high risk of surface water flooding along Long Street and the surrounding roads feeding onto it.

In the past Long Street has been prone to surface water flooding due to the lack of maintenance and/or lack of capacity of the ditch[24]. There was also a low severity surface water flood after 2005 due to highway runoff and lack of ditch maintenance.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. Great Ellingham is overlain with Lowestoft Formation, which is a designated unproductive aquifer.

The AStGWF mapping in **Appendix A Figure 7** shows a real variation in the 1km square designations. The south of Great Ellingham has a less than 25% susceptibility to groundwater flooding; the northeast has a 25%-50% susceptibility to groundwater flooding; and the southeast a greater than 75% susceptibility to groundwater flooding. This is likely due to the area of designated Secondary A aquifer to the east where a tributary of the River Thet flows.

There are no records of groundwater flooding in the area.

Assessing Flood Risk – Flooding from Sewers

There are no previous records of sewer flooding in Great Ellingham.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Great Ellingham.

C.9 Hockering – Local Service Centre

Hockering – Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Hockering is located north of the River Tud which flows eastward over the administrative boundary into Broadland. There is one ordinary watercourse that flows through the town centre from the northwest and another ordinary watercourse that flows south to the east of Hockering until it eventually confluences with the River Tud. Hockering is a designated Flood Zone 1, with a low probability of flooding from fluvial sources. In 2004 there was flooding reported as a "torrent" across the A47, heading eastbound.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping shows that there is a high risk of surface water flooding along the two ordinary watercourses flowing from the north. This ponds to the east of Hockering, where the two watercourses confluence along The Street. There are no previous records of surface water flooding.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. Hockering is overlain with the Lowestoft Formation, which is a designated unproductive aquifer. Where the ordinary watercourse flows through the town is a corridor of alluvium, which is a Secondary A aquifer. The AStGWF mapping in Appendix A Figure 7 shows that the north of Hockering is less than 25% susceptible to groundwater flooding and the south is 25-50% susceptible to groundwater flooding. This will be due to the alluvium deposits, which provide a potential pathway for groundwater to flow and are more abundant in the south of Hockering. There are no records of groundwater flooding in the area.
Assessing Flood Risk – Flooding from Sewers
There are no previous records of sewer flooding in Hockering.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Hockering.

C.10 Mattishall – Local Service Centre

Mattishall – Local Service Centre

Assessing Flood Risk – Flooding from Rivers

Mattishall drains from the south to north towards the River Tud, which is located approximately 1.5 km north of the village. There are two main tributaries of the River Tud which flow through Mattishall, the most easterly Jacbo's Island Drain on the outskirts of the village and The Moat Stream, which flows through the centre of the village from north to south.

Mattishall is a designated Flood Zone 1, with a low probability of flooding from fluvial sources.

Assessing Flood Risk – Flooding from Surface Water

The uFMfSW mapping shows that there is a high risk of surface water flooding surrounding the three ordinary watercourses: Jacob's Island Drain, Moat Stream and Occupation Road Drain. There is also two other pathways of surface water that adjoin Jacob's Island Drain and Moat Stream, both from the east.

There are no previous records of surface water flooding.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. Mattishall is primarily overlain with the Lowestoft Formation with ribbons of River Terrace Deposits (1) and a small area of Happisburgh Glacigenic Formation. Where the latter two superficial deposits dominate the area has been designated a Secondary A aquifer, whereas the Lowestoft Formation is a designated unproductive aquifer.

The AStGWF mapping in Appendix A Figure 7 shows a real variation in the 1km square designations. The south of Great Ellingham has a less than 25% susceptibility to groundwater flooding, the northeast has a 25%-50% susceptibility to groundwater flooding and the northwest has a greater than 75% susceptibility to groundwater flooding. The southeast has no susceptibility to groundwater flooding.

There are no records of groundwater flooding in the area.

Assessing Flood Risk – Flooding from Sewers

There are no previous records of sewer flooding in Mattishall.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Mattishall.

C.11 Ashill – Local Service Centre

Ahill – Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Ashill is located east of the River Wissey, that flows in the south westerly direction towards Foulden. Ashill is a designated Flood Zone 1, with a low probability of flooding from fluvial sources. There is no history of flooding from the River Wissey in Ashill.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping shows that there is a low to medium risk of surface water flooding surrounding Ashill. To the south-east of Ashill a flowpath exists which eventually flows to a tributary of the Watton Brook and this shows a medium risk of flooding. A surface water flow path also exists in the north-west of Ashill which eventually flows to a tributary of the River Wissey and is demonstrated to have a medium to high risk of flooding. There are no previous records of surface water flooding in Ashill.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The Ashill area is primarily overlain with Lowestoft Formation. There is a small pocket of River Terrace Deposits (Undifferentiated) in the north west of Ashill. Ashill is entirely underlain by a Secondary B aquifer. The AStGWF mapping in **Appendix A Figure 7** shows a real variation in the 1km square designations. Ashill is not designated as an area susceptible to Groundwater Flooding with areas surrounding the town having 0 – 25% and 25 – 50% susceptibility to groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There are no previous records of sewer flooding in Ashill.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Ashill.

C.12 Garboldisham – Local Service Centre

Garboldisham – Local Service Centre
Assessing Flood Risk – Flooding from Rivers
A tributary of the River Waveney flows from the north through Garboldisham. The floodplain is a Flood Zone 3a and flows There are no previous fluvial flood records for this location.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping highlights high risk flow paths from the north, following the route of the river to join the River Waveney south of Garboldisham. There are no previous records of surface water flooding.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk, which is overlain by a mixture of Lowestoft Formation, Peat, Happisburgh Glacigenic Formation and Head. The latter three follow the route of the Waveney tributary. The Lowestoft and Happisburgh Glacigenic Formations are both designated unproductive aquifers, whereas the peat deposit is a designated Secondary A aquifer. The small ribbons of classified as Secondary (undifferentiated) aquifers can be attributed to the areas of Head deposit. The AStGWF mapping in **Appendix A Figure 7** shows a real variation in the 1km square designations. The centre of Garboldisham has a groundwater flood susceptibility of 25-50%. The north of Garboldisham has a groundwater flood susceptibility of less than 25% and the south between 50-75%. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There are no previous records of sewer flooding in Garboldisham.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Garboldisham.

C.13 Harling – Local Service Centre

Harling – Local Service Centre
Assessing Flood Risk – Flooding from Rivers
The River Thet flows along the western edge of East Harling. East Harling generally drains from east to west down towards the River Thet. However, the northern edge of the village drains to a low area to the north of the village before entering the Thet and the southern edge of the village drains south to join a tributary of the Thet. Flood Zone 2 of the River Thet intersects with a row of properties on the western edge of East harling. There is an expanse of Flood Zone 3a surrounding Forest Lodge Drain, which flows south to join the River Thet. The land in this area in undeveloped forestry. Fluvial flood extents provided by the EA show flooding on the River Thet at east Harling in 1947 and 1968. East Harling IDB reported that the River Thet regularly experiences flooding at Larling to the north of East Harling. East Harling IDB reported that the water meadows along the Attleborough Stream are regularly flooded[47]
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping highlights significant areas of surface water flood risk across the Harling area. In East Harling there is ponding over Garboldisham Road and in the adjacent field. Along Forest Lodge Drain there are several areas susceptible to surface water ponding. There are no previous records of surface water flooding.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The overlying superficial deposits are fairly complex in this area and consist of a mixture of Head, Peat, River Terrace Deposits (1, 2 and undifferentiated) and alluvium. Due to the complexity of the superficial deposits the town of East Harling overlies a mixture designated aquifers, including: Secondary undifferentiated, A and unproductive. The AStGWF mapping in **Appendix A Figure 7** shows a real variation in the 1km square designations. The majority of the East Harling has a greater than 75% susceptibility to groundwater flooding due to the underlying River Terrace Deposits which provide a potential pathway for groundwater to flow. South of East Harling the groundwater flood susceptibility is less, at 50-75% due to the different River Terrace Deposits lying beneath. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
Mauley's Drain in East Harling is prone to blockages due to the 1 metre culvert on West Harling Road. Forest Lodge Drain in East Harling is prone to blockages because there is no outlet (connection to Mauley's drain has probably been removed).
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Harling.

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C.14 Kenninghall – Local Service Centre

Kenninghall – Local Service Centre
Assessing Flood Risk – Flooding from Rivers
A tributary of the River Thet flows northwards through the centre of Kenninghall. At Allot Gardens an ordinary watercourse joins the main river, having passed around the edge of the forest. Alongside the river there are buildings within Flood Zone 3a in the centre of Kenninghall, which therefore have a medium probability of flooding. There are no historic fluvial flood records for this location.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping highlights that there is very high risk of surface water flooding in this area with several large surface water flow pathways from the north east and west. The mapping highlights that the top centre has a high risk of surface water flooding. There are no previous records of surface water flooding.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The overlying superficial deposits consist of Head deposits correlating with the river valley, two extents of Happisburgh Glacigenic Formation to the north and south of Kenninghall and Lowestoft Formation and Peat in the surrounding areas. The Head deposits are a designated Secondary (undifferentiated) aquifer and the Happisburgh Glacigenic are a Secondary A. Surrounding this, the Lowestoft Formation and Peat are designated unproductive aquifers. The AStGWF mapping in **Appendix A Figure 7** shows a real variation in the 1km square designations. The majority of the village has a groundwater flood susceptibility of 50-75%, the north and east is less than 25% likely to experience groundwater flooding and the south east is 25-50% susceptible. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There are no previous records of sewer flooding.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Kenninghall.

C.15 Litcham – Local Service Centre

Litcham – Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Litcham sits immediately north of a confluence between the River Nar and one of its tributaries flowing from the south. There is a small extent of ordinary watercourse flowing out of Litcham to the main river. Although Litcham itself is not in a the flood plain (i.e. it is within a Flood Zone 1), Flood Zone 3b associated with the River Nar is extensive over Dunham Road and Litcham Road which lead into the village. There are a small number of dwellings in the southernmost part of Litcham that intersect with the Flood Zone 3b. There are no historic fluvial flood records for this location.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping highlights that there is very high risk of surface water flooding surround the River Nar and its tributaries. In Litcham there is one high risk area in the north where the petro station is located. There are no previous records of surface water flooding.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The overlying superficial deposit is entirely Lowestoft Formation, which has a designated unproductive aquifer in this location. The AStGWF mapping in Appendix A Figure 7 shows that Litcham and the surrounding area has no susceptibility to groundwater flooding. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There are no previous records of sewer flooding.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Litcham.

C.16 Necton – Local Service Centre

Necton – Local Service Centre

Assessing Flood Risk – Flooding from Rivers

Necton is located to the north of the River Wissey. At this point the river is about 2 metres wide and the floodplain is not well defined. In addition to the Wissey, there are several ordinary watercourses around the village. The full area of Necton drains either directly, or via a series of drains, from north to south into the River Wissey.

South of Necton there is an extensive area of Flood Zone 3a of the River Wissey. Most of the land within this zone is underdeveloped bar a few buildings in the southernmost point of Necton.

According to the Breckland District Council records and the Lynn News, Necton Brook has flooded many times in Necton, Chantry Lane, affecting several properties, due to blacked/undersized culvert. In 2004 flooding was quite bad eastbound at the A47.

Assessing Flood Risk – Flooding from Surface Water

The uFMfSW mapping highlights that there is significant risk of surface water flooding in Necton, with several established flow paths, particularly where Necton Brook is.

Surface water flooding occurred in Necton in the area of Chantry lane due to blacked drains (Lynn News, June 2007). The Highways Agency reported that surface water flooding occurred on 12 August 2004 on the A47 to the north of the village.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. The bedrock is overlain by Lowestoft Formation, Alluvium and River Terrace Deposits (undifferentiated). Where the latter two are present there is a designated Secondary A aquifer, the rest of the area is a designated unproductive aquifer.

The AStGWF mapping in **Appendix A Figure 7** shows that Necton mainly has a 25-50% susceptibility to groundwater flooding, however, the southernmost part has a higher susceptibility of greater than 75%.

There are no previous records of groundwater flooding.

Assessing Flood Risk – Flooding from Sewers

The Lynn News reported that sewage polluted flood water was threatening bungalows in Chantry Lane, Chantry Court and Mill Street following torrential rain on Monday 29 June 2007. The flooding seems to have originated from several sources.

The Lynn news reported that sewer flooding occurred in Necton, Chantry Lane, in June 2007 due to a manhole cover being lifted up.

Becton Brook is prone to blockages along Chantry Lane culvert which results in frequent flooding.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Necton.

C.17 North Elmham – Local Service Centre

North Elmham – Local Service Centre

Assessing Flood Risk – Flooding from Rivers

The Wendling Beck (Black Water) flows into the River Wensum on the eastern edge of North Elmham.

The full area of the village of North Elmham drains into Town Beck, an ordinary watercourse that flows from north west to south east and enters the River Wensum on the outskirts of the village at Mill House Farm. The Town Beck has a number of drains feeding into it, including the Street Farm Drain.

The area which is drained by the Town Beck and Street Farm Drain is designated Flood Zone 2and 3a, corresponding to Medium and High Probability of fluvial flooding. In the eastern part of the settlement the floodplain is largely undeveloped. In the western part of the settlement there are properties adjacent to

Where Town Beck and Street Farm Drain the surrounding floodplain is a Flood Zone 3a. This land is largely undeveloped, aside a few dwellings in the northern area adjacent to Brookside Farm[48].

There are no previous fluvial flood records.

Assessing Flood Risk – Flooding from Surface Water

The uFMfSW mapping highlights that there is significant risk of surface water flooding following Town Beck and Street Farm Drain flow pathways. There is also ponding adjacent to the B1145, which ultimately flows northeast towards the larger flow pathway.

There are no prior records of surface water flooding.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. The overlying superficial geology is very complex and follows the pattern of the river corridor. There is a layer of Alluvium which joins River Terrace Deposits (undifferentiated), Peat, Glaciofluvial Deposits and Banham Member. Because of this mixture of deposits, the associated aquifers are a mixture of Unproductive, Secondary A and B. Underneath the town the Secondary A is most prominent.

The AStGWF mapping in **Appendix A Figure 7** shows that the majority of the settlement has a less than 25% susceptibility to ground water flooding bar the eastern most part which has a much higher 75%+ chance of groundwater flooding.

There are no previous records of groundwater flooding.

Assessing Flood Risk – Flooding from Sewers

There are no previous records of sewer flood incidents.

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to North Elmham.

[48] Mott McDonald, 2007. Breckland SFRA 2007 Update Report

C.18 Old Buckenham – Local Service Centre

Old Buckenham – Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Old Buckenham is located in the headwaters of the River Thet. The village is located on a ridge, with the northern edges of the village draining to the north and west and the southern part of the village draining to the south. There are no significant watercourses within the settlement. The only potential sources of flood risk were some small drains on the southern outskirts of the village. The watercourse to the south of the village which forms one of the upper reaches of the River Thet was visited. The land rises steeply from this stream up to the village of Old Buckenham, therefore it was not considered to be a source of flood risk to the village. The settlement is a designated Flood Zone 1, therefore has a low probability of fluvial flooding. Residents of Cake Street requested sandbags twice in January 2007. It is unsure whether it did actually flood, and what the source of flooding was.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping highlights that there is significant risk of surface water flooding following the flow pathway of the main river. There are also additional high risk areas along Oaklands Drain, Crown Road Drains and Harlingwood Lane Drain. There is a very larger surface water flow pathway flowing from the north to the east of New Buckenham. There are no prior records of surface water flooding.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The overlying superficial geology is a combination of Happisburgh Glacigenic Formation and Alluvium along the river corridor surrounded by Lowestoft Formation. The latter two are designated Secondary A aquifers and the surrounding by Unproductive. The AStGWF mapping in **Appendix A Figure 7** shows that there is a mixture of groundwater susceptibilities, ranging from less than 25%in the west, 25-50% in the centre and higher out towards the east. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There are no previous records of sewer flood incidents.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Old Buckenham.

C.19 Shipdham – Local Service Centre

Shipdham– Local Service Centre

Assessing Flood Risk – Flooding from Rivers

The village is surrounded by agricultural land. The village of Shipdham lies at the top of the catchments for the River Blackwater (Upper Yare) and River Wissey. Most of the drainage serving the village is provided by a system of soakaways.

The watercourse impacting on Shipdham are the Main River Blackwater and ordinary watercourses.

The Blackwater River flows to the south of Shipdham. At this point the river is about a metre wide and unlikely to provide significant flood risk as the land rises steeply away from the stream.

Flood Zone 3a of the Blackwater River and the Parkland Stream exists in the north eastern area of the village. Most of the land this intersects is undeveloped, apart from Hall Farm that sit immediately adjacent to the Black Water River. These areas have a high probability of fluvial flooding. The rest of the village is in a Flood Zone 1 and therefore has a low probability of fluvial flooding.

Breckland Council have reported that sandbags have been issued several times in 2006 and 2007 in Market Street, at the north-east corner of the village.

Assessing Flood Risk – Flooding from Surface Water

Surface water at the site drains naturally in three directions, away from a ridge in the middle of the village[24]:

- To the east and south, the site drains directly into River Blackwater
- To the west, the sites drain into sink holes via a series of drains
- To the north, the site drains via a series of drains into the River Wissey, which becomes a Main River downstream Bradenham.

The uFMfSW mapping highlights that high risk surface water flooding following the route of the River Yare as well as extending north and eastward through the village. All of the surface water ultimately flows into the River Yare.

There are no previous records of surface water flooding in this area.

Assessing Flood Risk – Flooding from Groundwater

The bedrock geology in this area is chalk. The overlying superficial geology is Lowestoft Formation, which is a designated Secondary A aquifer in the centre and Unproductive on the outskirts.

The AStGWF mapping in **Appendix A Figure 7** shows that the area has a mixture of ground water flood susceptibilities. The west of the village has a susceptibility of 25-50% and the east has less than 25% susceptibility.

There are no previous records of groundwater flooding.

Assessing Flood Risk – Flooding from Sewers

Anglian water reported that sewer flooding occurs in Chapel Street with a frequency of twice every 10 years[24].

The Swaffham Town Mayor told the Lynn News in September 2002 that he has been complaining about flooding in the Sporle Road after heavy rains for the past 30 years. He stated 'We get raw sewage coming up and that creates a health problem because in hot weather there are children paddling in the floodwater.'

Assessing Flood Risk – Reservoirs, canals, other artificial sources

Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Shipdham.

C.20 Sporle – Local Service Centre

Sporle– Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Sporle is located in the headwaters of the River Wissey, to the northeast of one of its tributaries. There is an ordinary watercourse flowing south through the centre of the village to join the River Wissey. Sporle is located entirely within a Flood Zone 1, meaning it is at very low risk of fluvial flooding, There are no previous flood records for this area.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping highlights that there is a high risk surface water flood pathway intersecting the village flowing southwards to join the tributary of the River Wissey. Surface water from the surrounding fields joins this high risk flow path. There have been complaints of flooding on Sporle Road after heavy rains for the past 30 years.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The overlying superficial geology is largely Lowestoft Formation. The village consists Secondary A aquifer and Unproductive aquifer. The AStGWF mapping in **Appendix A Figure 7** shows that the area has no susceptibility to groundwater flooding. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
Anglian water reported that sewer flooding occurs in Chapel Street with a frequency of twice every 10 years[24]. There have been complaints of flooding on Sporle Road after heavy rains for the past 30 years, which has resulted in raw sewage erupting out of the drains.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Sporle.

C.21 Swanton Morley – Local Service Centre

Swanton Morely– Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Swanton Morley is located on an escarpment above the River Wensum valley. The village drains from west to east via two small steep valleys down to the River Wensum. The flood risk of these two small streams Church Stream and Woodgate Stream has been assessed. They have a combined length of 650 metres. The village itself is located entirely within a Flood Zone 1, and is therefore considered to beat low risk of fluvial flooding. There are no previous flood records for this area.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping highlights that the surface water risk in the area is low. There is a flow pathway branching to the River Wensum and Wendling Beck from the Swanton Morley area, yet none that directly intersect the village itself. There are no previous records of surface water flooding in this area.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The overlying superficial geology is primarily Till, Mid Pleistocene, however, there are some Glaciofluvial Deposits and Alluvium where the river valley is. The village primarily sits on top of an Unproductive Aquifer with Secondary A aquifers to the north and easy where the Till and Alluvium deposits dominate. The AStGWF mapping in **Appendix A Figure 7** shows that the area mainly has no susceptibility to groundwater flooding; however, there is less than 25% chance of groundwater flooding to the east and north. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There are no previous records of sewer flooding in the area.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Swanton Morley.

C.22 Yaxham – Local Service Centre

Yaxham– Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Yaxham sits south of the River Tud, which from south west to the east. There are several small ordinary watercourses flowing north from the village centre. The village is located entirely within a Flood Zone 1, therefore has a low probability of fluvial flooding. There are no previous flood records for this area.
There are three ordinary water courses flowing northward out of the village toward the River Tud. One flows from the west across fields to the River. The centre one flows around the camping park before confluencing the River Tud and the third, most easterly starts in the centre of the village before reaching the River Tud.
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping highlights that there are several high risk surface water flow pathways flowing through Yaxham to join the River Tud, which cross Norwich Road. There are no previous records of surface water flooding in this area.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is chalk. The overlying superficial geology is predominately Lowestoft Formation, with ribbons of Alluvium and River Terrace deposits (1), which follow the river corridor. Most of the Yaxham area is classified as an Unproductive aquifer, apart from where the ribbons of Alluvium and River Terrace Deposits lie, which is a designated Secondary A aquifer. The AStGWF mapping in **Appendix A Figure 7** shows that the area is largely less than 25% susceptible the groundwater flooding, however, to the north there are areas over 75% susceptible to groundwater flooding. This can be attributed to the present of Alluvium and River Terrace Deposits that allow the pathway of water through the ground. There are no records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There are no records of sewer flooding in the area.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Yaxham.

C.23 Narborough – Local Service Centre

Narborough– Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Narbourgh is surrounded by agricultural land and playing fields. The northern end of the Narborough lies on the River Nar. The river hasd been diverted and divided to supply to disused mills. Although disused, a complicated series of sluice gates and weirs still exist. The principal watercourse impacting on the site is the River Nar. There are also several ordinary watercourses. Of all the settlements only Narborough is considered to be under any risk of being affected by sea level rise. However, the outfall from the River Nar into the River Great Ouse is protected by a gated structure - meaning the River nar is not directly affected by the tide[24] There are no previous flood records for this area.
Assessing Flood Risk – Flooding from Surface Water
Surface water at the site drains naturally towards the River Nar, either directly or via a series of drains. The village is within an IDB areas operated by the Kinds Lynn Consortium. The uFMfSW mapping shows small areas of surface water flooding spread throughout the village, particularly in the southwest. There are no previous records of surface water flooding in this area.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is West Melbury Marly Chalk Formation and Zig. The overlying superficial deposits are River Terrace Deposits (undifferentiated). These deposits are associated with a designated Secondary A aquifer. The AStGWF mapping in **Appendix A Figure 7** shows that the west of the village has a 25-50% chance of groundwater flooding and the east has a slightly higher 50-75% susceptibility to groundwater flooding. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There is no previous history of ground water flood incidents.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Hanger End reservoir near Narborough is classified as a category "B", which means that fewer than 10 lives are at risk but there could be extensive property damage[24]. Narford Lake and Soigne Reservoir also pose flood risk on Narborough.

C.24 Weeting – Local Service Centre

Weeting– Local Service Centre
Assessing Flood Risk – Flooding from Rivers
Weeting is more than 1 km from the Little Ouse River and is well outside the extreme flood outline. Therefore it is considered not to be at risk of flooding from the Main River and is designated as Flood Zone 1.
There is an ordinary watercourse that passes to the east of Weeting and drains a catchment with an area of 13km^2. The stream runs adjacent to fields, which are often prone to water logging. It then passes through a culvert under Brandon Road. This culvert is susceptible to blockage, especially given the poor condition of the stream. However, the blockage will mean that water collects upstream of the bridge as is unlikely to spill over the road, which is at higher elevation. This means properties downstream of this culvert are at a lower flood risk, although the new residential development in this area appears to be at a lower elevation that the existing properties. Further downstream, the stream passes through a larger culvert on Rectory Lane and then across open fields with no clearly defined floodplain[24].
Assessing Flood Risk – Flooding from Surface Water
The uFMfSW mapping shows areas of surface water ponding sporadically distributed across Weeting. There is a slight correlation with the ordinary watercourse to the east; otherwise risk to surface water shows no distinct pattern. Surface water road flooding has been reported in Weeting in July 2003 (Lynn News, 2003). A site visit showed that the fields upstream of Brandon Road had surface water ponding on the surface and were waterlogged. Road flooding was reported on 17 July 2003 in Weeting, but was not particularly significant.
Assessing Flood Risk – Flooding from Groundwater
The bedrock geology in this area is West Holywell Nodular Chalk Formation. There appears to be no overlying superficial deposits in the area. Where the River Ouse flows in the south there are extents of Alluvium deposits. Because of this, there is no designated aquifer under the settlement, however, there the Alluvium deposits are present there is a designated Secondary A aquifer. The AStGWF mapping in **Appendix A Figure 7** shows that the settlement has a greater than 75% susceptibility to surface water flooding. There are no previous records of groundwater flooding.
Assessing Flood Risk – Flooding from Sewers
There is no previous history of ground water flood incidents.
Assessing Flood Risk – Reservoirs, canals, other artificial sources
Reference to the Environment Agency Risk of Flooding from Reservoirs mapping online shows that there are no reservoirs which could pose a potential risk to Weeting.

Appendix D. Flood Risk Assessment (FRA) Checklist

Table C-1 Site-Specific Flood Risk Assessment Checklist (building on guidance in PPG)

What to Include in the FRA		Source(s) of Information
1.Site Description		
Site address	-	-
Site description	-	-
Location plan	Including geographical features, street names, catchment areas, watercourses and other bodies of water	SFRA Appendix A and B
Site plan	Plan of site showing development proposals and any structures which may influence local hydraulics e.g. bridges, pipes/ducts crossing watercourses, culverts, screens, embankments, walls, outfalls and condition of channel	OS Mapping Site Survey
Topography	Include general description of the topography local to the site. Where necessary, site survey may be required to confirm site levels (in relation to Ordnance datum). Plans showing existing and proposed levels.	Site Survey
Geology	General description of geology local to the site.	SFRA Appendix A, Figure A2, A3 Ground Investigation Report
Watercourses	Identify Main Rivers and Ordinary Watercourses local to the site.	SFRA Appendix A, Figure A1
Status	Is the development in accordance with the Council's Spatial Strategy?	Breckland Council website
2. Assessing Flood Risk		
The level of assessment will depend on the degree of flood risk and the scale, nature and location of the proposed development. Refer to Table 7-1 regarding the levels of assessment. Not all of the prompts listed below will be relevant for every application.		
Flooding from Rivers – Main Rivers	Provide a plan of the site and Flood Zones. Identify any historic flooding that has affected the site, including dates and depths where possible. How is the site likely to be affected by climate change? Determine flood levels on the site for the 1% annual probability (1 in 100 chance each year) flood event including an allowance for climate change. Determine flood hazard on the site (in terms of flood depth and velocity). Undertake new hydraulic modelling to determine the flood level, depth, velocity, hazard, rate of onset of flooding on the site.	SFRA Appendix B Environment Agency Flood Map for Planning (Rivers and Sea). Environment Agency Products 1-7. New hydraulic model.
Flooding from Ordinary Watercourses	Is the site at risk of flooding from an ordinary watercourse? If possible, provide a plan of flood zones. If the watercourse has not been modelled, can the uFMfSW be used to identify the risk from the watercourse? Consider whether a simple hydraulic model will need to be developed for the site (refer to section 7.3.2).	SFRA Appendix B Environment Agency Flood Map for Planning (Rivers and Sea). Environment Agency Flood Risk from Surface Water mapping.

		New hydraulic model.
Flooding from Land	Identify any historic flooding that has affected the site. Review the local topography and conduce a site walkover to determine low points at risk of surface water flooding. Review the Risk of Flooding from Surface Water mapping. Where necessary, undertake modelling to assess surface water flood risk.	SFRA Area Assessments. Topographic survey. Site walkover. Risk of Flooding from Surface Water mapping (EA website). New modelling study.
Flooding from Groundwater	Desk based assessment based on high level BGS mapping in the SFRA. Ground survey investigations. Identify any historic flooding that has affected the site.	SFRA Appendix A, Figure A7. Ground Investigation Report
Flooding from Sewers	Identify any historic flooding that has affected the site.	Refer SFRA Section 3.7, Appendix B Figures. Where appropriate an asset location survey can be provided by Anglian Water Services.
Reservoirs, canals and other artificial sources	Identify any historic flooding that has affected the site. Review the Risk of Flooding from Reservoirs mapping.	Risk of Flooding from Reservoirs mapping (EA website). Refer SFRA Section 3.8.
3. Proposed Development		
Current use	Identify the current use of the site.	-
Proposed use	Will the proposals increase the number of occupants / site users on the site such that it may affect the degree of flood risk to these people?	-
Vulnerability Classification	Determine the vulnerability classification of the development. Is the vulnerability classification appropriate within the Flood Zone?	SFRA Table 4-2 SFRA Table 4-3
4. Avoiding Flood Risk		
Sequential Test	Determine whether the Sequential Test is required. Consult Breckland BC to determine if the site has been included in the Sequential Test. If required, present the relevant information to Breckland DC to enable their determination of the Sequential Test for the site on an individual basis.	SFRA Section 4.
Exception Test	Determine whether the Exception Test is necessary. Where the Exception Test is necessary, present details of: Part 1) how the proposed development contributes to the achievement of wider sustainability objectives as set out in the Breckland DC Sustainability Appraisal Report. (Details of how part 2) can be satisfied are addressed in the following part 5 'Managing and Mitigating Flood Risk'.)	SFRA Table 4-3 Refer to Breckland SA objectives presented in SFRA Table 4-4.
5. Managing and Mitigating Flood Risk		
Section 6 of the SFRA presents measures to manage and mitigate flood risk and when they should be implemented. Where appropriate, the following should be demonstrated within the FRA to address the following questions: How will the site/building be protected from flooding, including the potential impacts of climate change, over the development's lifetime? How will you ensure that the proposed development and the measures to protect your site from flooding will not increase		

flood risk elsewhere? Are there any opportunities offered by the development to reduce flood risk elsewhere? What flood-related risks will remain after you have implemented the measures to protect the site from flooding (i.e. residual risk) and how and by whom will these be managed over the lifetime of the development (e.g. flood warning and evacuation procedures)?		
Development Layout and Sequential Approach	Plan showing how sensitive land uses have been placed in areas within the site that are at least risk of flooding.	SFRA Section 5.2
Riverside Development Buffer Zone	Provide plans showing how a buffer zone of relevant width will be retained adjacent to any Main River or Ordinary Watercourse in accordance with requirements of the Environment Agency or Norfolk County Council.	SFRA Section 5.3
Floodplain Compensation Storage	Provide calculations or results of a hydraulic modelling study to demonstrate that the proposed development provides compensatory flood storage and either will not increase flood risk to neighbouring areas or will result in an overall improvement. This should be located and designed to achieve level for level and volume for volume compensation, should be provided on land that is in hydrological continuity with the site within the applicant's ownership and subject to appropriate maintenance regimes for its lifetime. Include cross sectional drawings clearly showing existing and proposed site levels.	SFRA Section 5.4
Finished Floor Levels	Plans showing finished floor levels in the proposed development in relation to Ordnance Datum taking account of indicated flood depths.	SFRA Section 5.5
Flood Resistance	Details of flood resistance measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 5.6
Flood Resilience	Details of flood resilience measures that have been incorporated into the design. Include design drawings where appropriate.	SFRA Section 5.7
Safe Access / Egress	Provide a figure showing proposed safe route of escape away from the site and/or details of safe refuge. Include details of signage that will be included on site. Where necessary this will involve mapping of flood hazard associated with river flooding. This may be available from Environment Agency modelling, or may need to be prepared as part of hydraulic modelling specific for the proposed development site.	SFRA Section 5.9
Flow Routing	Provide evidence that proposed development will not impact flood flows to the extent that the risk to surrounding areas is increased. Where necessary this may require modelling.	SFRA Section 5.12
Flood Warning and Evacuation Plan	Where appropriate reference the Flood Warning and Evacuation Plan or Personal Flood Plan that has been prepared for the proposed development (or will be prepared by site owners).	SFRA Section 5.13
Surface Water Management	Completion of SuDS Drainage Statement, as described in Section 7.	SFRA Section 6. Norfolk County Council website - https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers

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