South Norfolk Addendum to Greater Norwich Level 2 Strategic Flood Risk Assessment

Draft Report

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Revision History

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May 2022	Draft report	South Norfolk Council
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Contract

This report describes work commissioned by South Norfolk District Council by a letter dated 20th December 2021. Louise Goode, Helen Dawson and Edmund Mumford of JBA Consulting carried out this work.

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Purpose

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JBA Consulting has no liability regarding the use of this report except to South Norfolk District Council.

Acknowledgements

We would like to acknowledge the assistance of South Norfolk District Council in producing this report.

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Executive summary

Introduction and context

This Level 2 Strategic Flood Risk Assessment (SFRA) addendum document was created with the purpose of supporting the South Norfolk Village Clusters Housing Allocations Plan (VCHAP). The VCHAP is a document being developed by South Norfolk District Council to find suitable housing for a minimum of 1,200 new homes in the smaller villages across South Norfolk.

This Level 2 SFRA forms an addendum to the Greater Norwich Level 2 SFRA completed in 2021. It involves the assessment of 24 proposed development sites which have been identified by South Norfolk District Council. In addition, this Level 2 SFRA incorporates recent changes to national and local planning policy and considers the cumulative impact of the VCHAP development.

Following the draft submission of the Level 2 SFRA in May 2022, South Norfolk Council revised some sites and boundaries. These sites were re-screened for flood risk, and updated site tables and accompanying GeoPDFs were produced in December 2022 for a Version 2 Draft Level 2 SFRA.

SFRA objectives

The Government's Planning Practice Guidance (PPG) on Flood Risk and Coastal Change advocates a tiered approach to risk assessment involving Level 1 and Level 2 assessments.

The aim of the Level 2 assessment is to build on identified risks from Level 1 for proposed development sites, to provide a greater understanding of fluvial, surface water, groundwater, and reservoir related flooding risks to the site. From this the Local Council and Developers can make more informed decisions and pursue development in an effective and efficient manner. The Level 2 assessment also identifies sites for further risk analysis at the site-specific Flood Risk Assessment (FRA) stage.

Level 2 SFRA outputs

The Level 2 assessment includes detailed assessments of the proposed site options. These include:

- An assessment of all sources of flooding including fluvial flooding, tidal flooding, surface water flooding, groundwater flooding, mapping of the functional floodplain and the potential increase in fluvial flood risk due to climate change.
- Reporting on current conditions of flood defence infrastructure, where applicable.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff.
- Advice on whether the sites are likely to pass the second part of the Exception Test with regards to flood risk and on the requirements for a site-specific FRA.

As part of the Level 2 SFRA, detailed site summary tables have been produced for the proposed sites, covering the above. To accompany each site summary table, there is an Interactive GeoPDF map, with all the mapped flood risk outputs.

Summary of Level 2 SFRA

South Norfolk District Council provided 76 sites for assessment for the VCHAP. These were chosen through a combination of a site's potential for allocation and its flood risk as determined through the site assessment process. These sites were screened against flood risk datasets to assess how many were to be carried forward to a Level 2 SFRA assessment. In total,23 sites were carried forward to a Level 2 assessment for the VCHAP, and lower risk sites are also flagged in this report with general recommendations for developers. Detailed site summary tables and GeoPDF mapping have been produced, as provided in Appendix A.

The summary tables set out the flood risk to each site, including maps of extent, depth and velocity of flooding as well as hazard mapping for the 100-year defended event and climate change extents where modelled outputs were available. Where there were no hydraulic models present, Flood Zone 2 was used as indicative extent for fluvial climate change and the 1,000-year surface water extent as an indication of surface water climate change. The surface water mapping depth and velocity data was also used as an indication of flood risk for small watercourses. Each table sets out the NPPF requirements for the site as well as guidance for site-specific FRAs. A broadscale assessment of suitable SuDS options has been provided, giving an indication where there may be constraints to certain types of SuDS techniques.

To accompany each site summary table, there is an Interactive GeoPDF map, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use 'tick box' layers down the right-hand side and bottom of the mapping, to allow easy navigation of the data.

The following points summarise the Level 2 assessment:

- The majority of sites with a detailed Level 2 summary table are at surface water risk. The degree of flood risk varies, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected within the site. The sites at most significant surface water risk are: SN212REVA, SN2183, SN3019SL, and SN2118.
- Whilst not at significant flood risk within the site boundary, several sites have potential access and egress issues as a result of fluvial and surface water flooding of the surrounding roads. For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles. Also, consideration should be given to whether the risk forms a flow path or bisects the site where access from one side to another may be compromised.
- Most sites are not at significant risk from fluvial flooding. Site-specific modelling was undertaken for 6 sites within or close to present day Flood Zones. Of these, none were at significant fluvial risk, although flooding may impede access/egress. 2 sites (SN207REVA and SN4078) were at risk of tidal flooding from the River Waveney. There are limitations to the modelling used (See Appendix B.) and it is recommended that these issues are investigated further should these sites be bought forward.
- Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions.
- Fluvial and surface water climate change mapping indicates that flood extents are predicted to increase. As a result, the depths, velocities and hazard of flooding may also increase. The significance of the increase tends to depend on the topography of site and the percentage allowance used; fluvial extents would be larger than Flood Zone 3, but maximum extents are likely to be similar to Flood Zone 2. The 1 in 1,000 surface water flood

extent can also be used as an indication of climate change to surface water risk. Site-specific FRAs should confirm the impact of climate change using latest guidance.

- Any sites located where there is Main River (including culverted reaches of Main River) will require an easement of 8m either side of the watercourse from the top of the bank. This may introduce constraints regarding what development will be possible and consideration will also need to be for access and maintenance at locations where there are culverts. Developers will be required to apply for appropriate permits so the activity being carried out over easements does not increase flood risk.
- A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS option would be best.
- In respect of the cumulative impact assessment, there are a number of development sites proposed that have the potential to provide a betterment to existing communities downstream within the catchment and, if suitable storage facilities are implemented have the potential to complement existing flood alleviation schemes within their respective catchments. However, all of these developments also have the potential to increase flood risk offsite if both National and Local SuDS Standards are not applied.
- Developers proposing windfall sites in the high-risk Cumulative Impact Assessment catchments should demonstrate through a site-specific FRA how SuDS and surface water mitigation techniques will ensure that development does not increase flood risk elsewhere and seeks to reduce flood risk to existing communities. The catchment-based Cumulative Impact Assessment has been updated using the latest available data for the Level 2 SFRA and supersedes the catchment-based assessment in the Level 1 SFRA.

At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses so that the potential effects of proposals can be evaluated at site level and where there are no detailed hydraulic models present. The modelling should verify flood extent (including latest **climate change allowances** (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)), inform development zoning within the site and prove, if required, whether the Exception Test can be passed.

For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the developer must design the site adopting the Sequential Approach such that is appropriate flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA.

For developments that have not been allocated in the Local Plan, developers must undertake the Sequential Test followed by the Exception Test (if required) and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into in more detail to inform the Exception Test for windfall sites.

It is recommended that as part of the early discussions relating to development proposals, developers discuss requirements relating to site-specific Flood Risk Assessment and drainage strategies with both the Local Planning Authority and the LLFA, to identify any potential issues that may arise from the development proposals.

Contents

List of Figures

List of Tables

Abbreviations and glossary of terms

Term	Definition
AEP	Annual Exceedance Probability – The probability (expressed as a percentage) of a flood event occurring in any given year.
AStGWf	Areas Susceptible to Groundwater flooding
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CIRIA	Construction Industry Research and Information Association
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EDLAA	Employment Development Land Availability Assessment
EU	European Union
Exception Test	Set out in the NPPF, the Exception Test is a method used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The Exception Test is applied following the Sequential Test.
FEH	Flood Estimation Handbook
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
FWMA	Flood and Water Management Act: 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 surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a River
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRM	Flood Risk Management
Greenfield	Undeveloped parcel of land
Ha	Hectare
JBA	Jeremy Benn Associates
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance

Term	Definition
NRD	National Receptor Database
NVZs	Nitrate Vulnerability Zones
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
RBMP	River Basin Management Plan
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
Riparian owner	A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Risk Management Authority (RMA)	Operating authorities who's remit and responsibilities concern flood and/or coastal risk management.
RoFfSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW)
Sequential Test	Set out in the NPPF, the Sequential Test is a method used to steer new development to areas with the lowest probability of flooding.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SHELAA	Strategic Housing and Economic Land Availability Assessment
SPZ	(Groundwater) Source Protection Zone
Stakeholder	A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
WFD	Water Framework Directive – Under the WFD, all waterbodies have a target to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set deadline. River Basin Management Plans (RBMPs) set out the ecological objectives for each water body and give deadlines by when objectives need to be met.

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

> ***"Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.".***
>
> (National Planning Policy Framework 2021, paragraph 160)

This Level 2 Strategic Flood Risk Assessment (SFRA) 2022 document provides a Level 2 assessment of sites identified as potential sites allocated within the **South Norfolk VCHAP** (https://www.southnorfolkandbroadland.gov.uk/emerging-local-plan/south-norfolk-village-clusters-housing-allocations-plan) and was prepared in accordance with the 2021 update to the NPPF and in accordance with the Planning Practice Guidance (which at the time of preparation had not been updated to reflect the July 2021 changes to the NPPF).

An assessment of flood risk in South Norfolk was previously covered under the **Greater Norwich Level 2 SFRA**, published in February 2021, and this addendum report for the VCHAP sites should be read in conjunction with the 2021 report. The 2022 Level 2 SFRA also covers the information relevant to South Norfolk that has been superseded since the preparation of the 2021 Level 2 SFRA.

1.2 Levels of SFRA

The **Planning Practice Guidance**[1] (PPG) (Flood risk and coastal change - GOV.UK (www.gov.uk)) advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- **Level One:** where flooding is not a major issue in relation to potential development sites and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- **Level Two:** where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the National Planning Policy Framework's (NPPF) Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This report fulfils the requirements of a **Level 2** SFRA. In accordance with the July 2021 changes to the NPPF the content of the Level 2 SFRA considers actual surface water flood risk and the implications with respect to the implementation of development at the proposed allocation sites. This addresses the requirements that the Exception Test applies to surface water risk (as this additional requirement is not explicitly identified in the version of the PPG available at the time of preparation of this SFRA)

1.3 SFRA objectives

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[1] Planning Practice Guidance – Flood Risk and Coastal Change - Paragraph: 012 Reference ID: 7-012-20140306

The objectives of this Level 2 SFRA are to:

1. Provide individual flood risk analysis for site options using the latest available flood risk data, thereby assisting the Council in applying the Exception Test to their proposed site options in preparation of the South Norfolk VCHAP.
2. Using available data, provide information and a comprehensive set of maps presenting flood risk from all sources for each site option.
3. Where the Exception Test is required, provide recommendations for making the site safe throughout its lifetime.
4. Take into account most recent policy and legislation in the NPPF, PPG and LLFA SuDS guidance.
5. Update the catchments that are most sensitive to new development in flood risk terms and further review policy and recommendations for these catchments.

1.4 Context of the Level 2 assessment

JBA Consulting were commissioned by South Norfolk District Council to prepare an addendum to the Greater Norwich Level 2 SFRA completed in 2021. The purpose of this study is to provide a comprehensive and robust evidence base to inform the South Norfolk Village Clusters Housing Allocations Plan (VCHAP).

This 2022 Level 2 SFRA builds on the work undertaken in the 2021 Level 2 SFRA and assesses flood risk at potential VCHAP site allocations. In addition, there have been updates to national and local planning policy, flood event data and recommendations for the cumulative impact of development.

The SFRA will be used in decision-making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

1.5 Consultation

SFRAs should be prepared in consultation with other risk management authorities. The following parties (external to South Norfolk District Council) have been consulted during the preparation of this Level 2 SFRA:

- Environment Agency
- Water Management Alliance group of six Internal Drainage Boards
- Broads Authority
- Norfolk County Council Lead Local Flood Authority
- Anglian Water

1.6 How to use this report

Table 1-1 SFRA report guide

Section	Contents	How to use
1. Introduction	Outlines the purpose and objectives of the Level 2 SFRA	For general information and context.
2. The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.	Users should refer to this section for any relevant policy which may underpin strategic or site-specific assessments.
3. Sources of information used in preparing the Level 2 SFRA	Summarises the data used in the Level 2 assessments and GeoPDF mapping	Users should refer to this section in conjunction with the summary tables and GeoPDF mapping to understand the data presented. Developers should refer back to this section when understanding requirements for a site-specific FRA.
4. Impact of climate change	Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA Sets out how developers should apply the guidance to inform site specific Flood Risk Assessments	This section should be used to understand the climate change allowances for a range of epochs and conditions, linked to the vulnerability of a development.
5. Level 2 Assessment Methodology	Summarises the sites taken forward to a Level 2 assessment and the outputs produced for each of these sites.	This section should be used in conjunction with the site summary tables and GeoPDF mapping to understand the data presented.
6. Flood risk management requirements for developers	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Refers back to relevant sections in the L1 SFRA for mitigation guidance.	Developers should use this section to understand requirements for FRAs and what conditions/ guidance documents should be followed. Developers should also refer to the L1 SFRA for further information on flood mitigation options.

Section	Contents	How to use
7. Surface water management and SuDS	An overview of any specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority. Refers back to relevant sections in the L1 SFRA for information on SuDS and surface water management.	Developers should use this section to understand what national, regional and local SuDS standards are applicable. Hyperlinks are provided. Developers should also refer to the L1 SFRA for further information on types of SuDS, the hierarchy and management trains information.
8. Cumulative impact of development and strategic solutions	Builds on recommendations from the Level 1 SFRA, identifying the cumulative impact of development in the site catchments and providing recommendations for storage and betterment for all potential development sites in the catchment.	Planners should use this section to help develop policy recommendations for the sites specified. Developers should use this section to understand the potential storage requirements and betterment opportunities for the sites assessed.
9. Summary of Level 2 assessment and recommendations	Summarises the results and conclusions of the Level 2 assessment, and signposts to the L1 SFRA for planning policy recommendations.	Developers and planners should use this section to see a summary of the Level 2 assessment and understand the key messages from the site summary tables. Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments.
Appendix A: Level 2 assessment - Site summary tables and Interactive mapping	Provides a detailed summary of flood risk for sites requiring a more detailed assessment. The section considers flood risk, emergency planning, climate change, broadscale assessment of possible SuDS, exception test requirements and requirements for site-specific FRAs. Provides interactive PDF mapping for each Level 2 assessed site showing flood risk at and around the site.	Planners should use this section to inform the application of the Sequential and Exception Tests, as relevant. Developers should use these tables to understand flood risk, access and egress requirements, climate change, SuDS, and FRA requirements for site-specific assessments. Planners and developers should use these maps in conjunction with the site summary tables to understand the nature and location of flood risk.

Hyperlinks to external guidance documents/websites are provided in **purple** throughout the SFRA.

Advice to users has been highlighted in **amber boxes** throughout the document.

1.7 SFRA Study Area

The South Norfolk area is approximately 90,890ha and has a population of approximately 140,880[2]. Figure 1-1 below shows the South Norfolk study area in the context of the Greater Norwich area (comprising South Norfolk, Norwich and Broadlands Districts) which was the focus of the 2021 Level 2 SFRA. A map showing the main rivers running through the district is also provided.

The main rivers in the South Norfolk area are the Rivers Yare, Tiffey, Tas and Waveney.

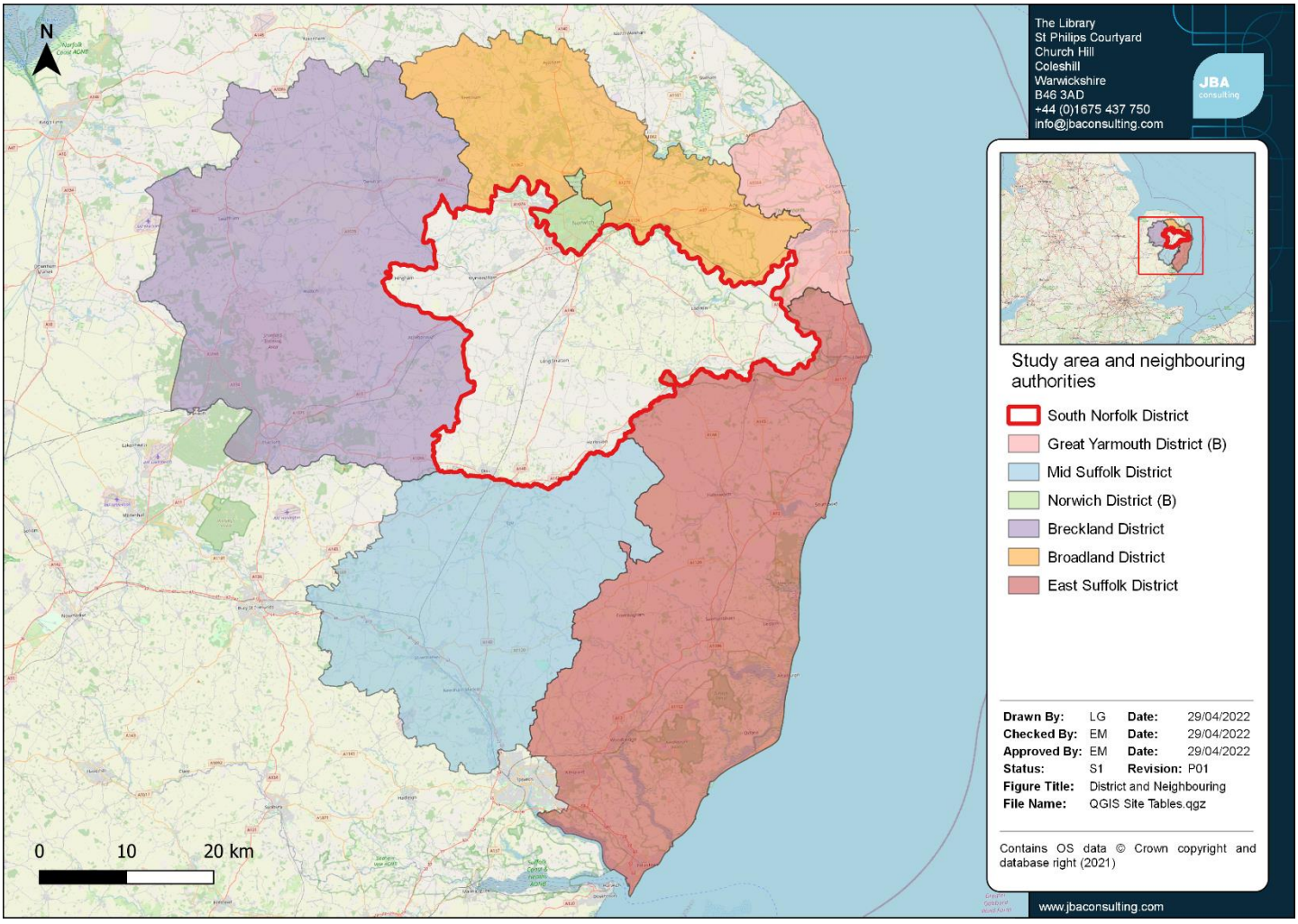

Figure 1-1 Overview map of study area and neighbouring authorities

2 Office for National Statistics. Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland. Mid-2019: April 2020 Local Authority District Codes. https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland

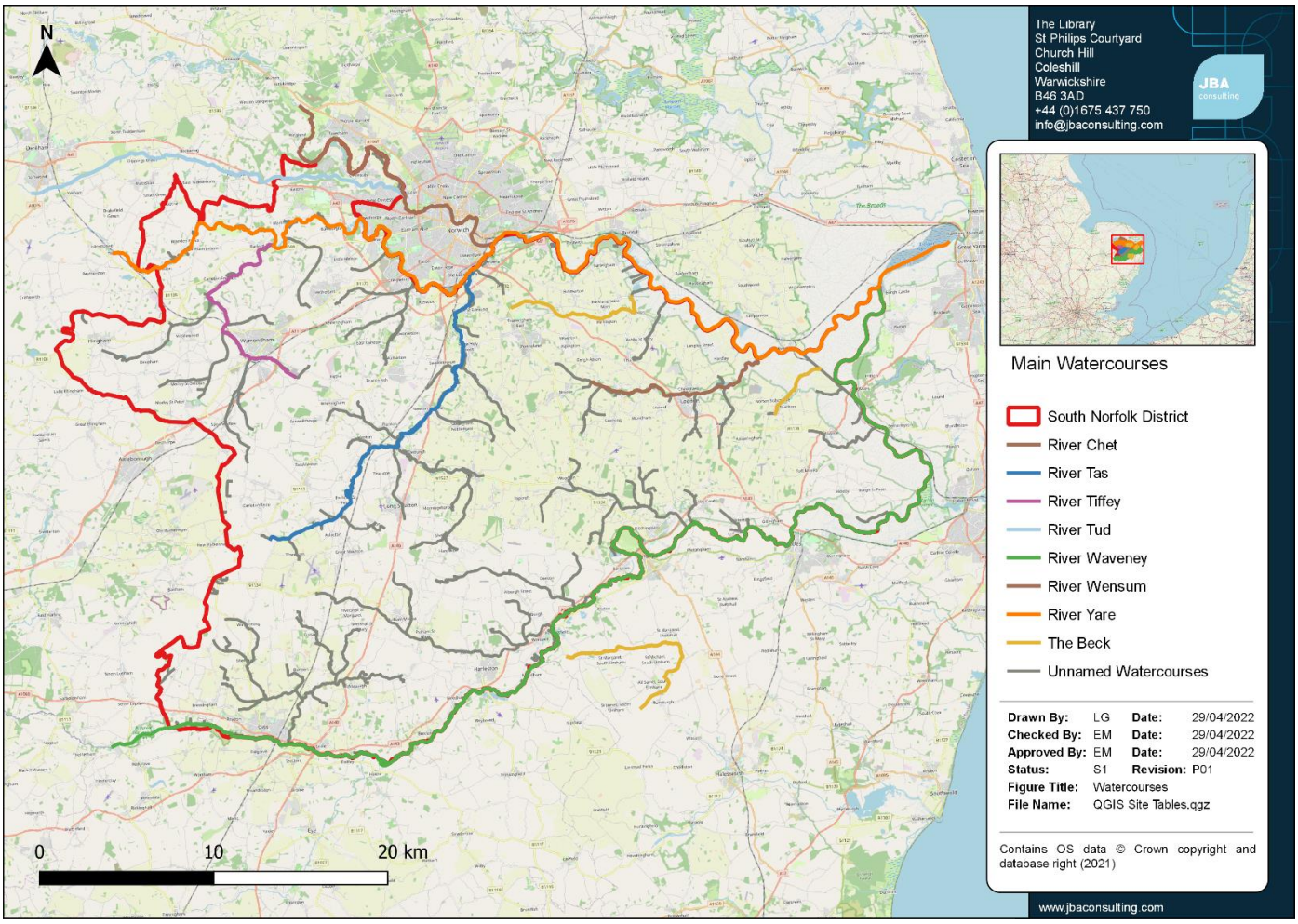

Figure 1-2 Key watercourses in the South Norfolk study area

2 The Planning Framework and Flood Risk Policy

2.1 Introduction

This section of the VCHAP Level 2 SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities, given the changes since the Greater Norwich Level 2 SFRA and updated guidance. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and considered.

2.2 Roles and Responsibilities for Flood Risk Management

Risk Management Authorities (RMAs) are comprised of different organisations that have responsibilities for flood risk management. The RMAs in and around South Norfolk are shown below in Table 2-1, with a summary of their responsibilities.

Table 2-1 Roles and responsibilities for Flood Risk Management

Risk Management Authority	Strategic Level	Operational Level	Planning Role
Environment Agency	• Strategic overview for all sources of flooding • National Strategy • Reporting and general supervision	• Main rivers • Reservoirs	• Statutory consultee for development in Flood Zones 2 and 3 for coastal and fluvial extents
Norfolk County Council - Lead Local Flood Authority (LLFA)	• Preliminary Flood Risk Assessment • Local Flood Risk Management Strategy	• Surface Water • Groundwater • Ordinary Watercourses (consenting and enforcement) • Ordinary watercourses (works)	• Statutory consultee for all major developments
South Norfolk Council, Broadland District Council, Norwich City Council - Local Planning Authority (LPA)	• Local Plans as Local Planning Authorities	• Determination of Planning Applications as Local Planning Authorities • Managing open spaces under Council ownership	• As left
Broads Authority	• Local Planning Authority • Conservation and area promotion	• Maintain waterways • Determination of Planning Applications as Local Planning Authorities	• Determination of Planning Applications as Local Planning Authorities • Managing open spaces under Council ownership
Water Management Alliance – Broads and Norfolk Rivers Internal Drainage Boards	• Water level management and environmental conservation	• Permissive powers for water level management	• Non-statutory consultee • Other statutory powers to determine development suitability

Water Companies: Anglian Water	• Asset Management Plans supported by Periodic Reviews (business cases) • Develop Drainage and Wastewater management plans	• Public sewers	• Non-statutory consultee for all major developments. Also provides comments below this threshold where a specific request is received from Council • Adoption of SuDS under Sewerage Sector Guidance
Highways Authorities: Highways England - motorways and trunk roads Norfolk County Council, Local Highway Authority – Other adopted roads	• Highway drainage policy and planning	• Highway drainage • Local Highway Authority is able to adopt some highway drainage features	• Internal planning consultee regarding highways and design standards and options

2.3 Relevant Legislation

The following legislation is relevant to development and flood risk in South Norfolk:

- **Flood Risk Regulations (2009)** transpose the EU Floods Directive (2000) into UK law and require the Environment Agency and LLFAs to produce Preliminary Flood Risk Assessments (PFRAs) and identify where there are nationally significant Flood Risk Areas. For the Flood Risk Areas, detailed flood maps and a Flood Risk Management Plan are produced. This is a six-year cycle of work and the second cycle started in 2017.
- **Town and County Planning Act (1990)**, **Water Industry Act (1991)**, **Environment Act (2005)** and **Flood and Water Management Act (2010)** – as amended and implanted via secondary legislation. These set out the roles and responsibilities for organisations that have planning, water, environment and FRM roles.
- **Land Drainage Act (1991)** and **Environmental Permitting Regulations (2016)** define where developers need to apply for additional permission (and Planning Permission) to undertake works to an ordinary watercourse or Main River.
- **Water Environment Regulations (2017)** transpose the European Water Framework Directive (2000) into law, requiring the Environment Agency to produce River Basin Management Plans (RBMPs). These aim to ensure that the water quality of aquatic ecosystems, riparian ecosystems and wetlands reach 'good status'.
- Other environmental legislation such as **the Conservation of Habitats and Species Regulations 2017, SI 2017/1012 (the Habitats Regulations)**, **Town and Country Planning (Environmental Impact Assessment) Regulations 2017 SI 2017 No571** and **Environmental Assessment of Plans and Programmes Regulations 2004, SI 2004/1633** also apply as appropriate to strategic and site-specific developments to guard against environmental damage. This has been transposed into English law by
- Note that secondary UK legislation implementing EU Directives such as the Flood Risk Regulations and Water Environment Regulations are subject to repeal/ amendment following the UK exit from the EU. At the time of publishing this report the references here were correct.

2.4 Relevant Flood Risk Policy and Strategy Documents

This section highlights policies updated since the Greater Norwich Level 2 SFRA and other relevant documents for the South Norfolk area.

- **Anglian river basin district river basin management plan (EA) -** The EA's review and update of the current RBMPs is underway. The consultation of draft RBMPs was open for responses until 22 April 2022.
- **Climate change guidance for flood risk assessment** – The EA's guidance was updated in 2021. UKCP19 projections were used to update peak river flow allowances, and these are now based on management catchments rather than river basin districts. There has also been a change in how peak river flow allowances should be applied, with a greater focus placed on the 'central' allowance. In May 2022 peak rainfall allowances were updated and are now based on management catchments rather than the previous flat rates for the whole country.
- **Anglian River Basin District Flood Risk Management Plan (FRMP) (EA) -** The FRMP is a plan to manage significant flood risks in designated Flood Risk Areas within the Anglian River Basin District. The current version was published in 2016, running through to 2021. An updated FRMP running from 2022-2027, available in draft, is currently being consulted upon, and is expected to be published in 2022.
- **Norfolk Local Flood Risk Management Strategy** – Norfolk County Council reviewed this policy in 2021 (strategy initially adopted in 2015) against new and emerging national strategies and policies. This has resulted in three new policies and minor updates to the existing policies.
- **Norfolk County Council Lead Local Flood Authority Statutory Consultee for Planning Guidance Document –** updated in October 2021 to incorporate latest changes to policy such as the July 2021 update to the NPPF.
- **South Norfolk Surface Water Management Plan –** Stage 1 was completed in 2016 and Norfolk County Council, as Lead Local Flood Authority, are in the process of bidding via the Regional Flood and Coastal Committee (RFCC) for funding to take the surface water management plan (SWMP) for South Norfolk forward into Stage 2. Once complete, the SWMP will establish a long-term action plan to manage surface water in South Norfolk and inform prioritisation of flood management schemes.
- The **South Norfolk Development Management Policies Document** is part of the Local Plan and sets out the policies that are used to determine whether development proposals should be accepted. It highlights how development should avoid areas subject to flooding and consider flood risk policy in the Joint Core Strategy and national policy and guidance. Sustainable drainage and water management is another key theme, with the encouragement of sustainable drainage systems (SuDS) being incorporated into the design of new developments.

2.5 LLFAs, Surface Water and SuDS

The 2021 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 169). When considering planning applications, local planning authorities should consult the LLFA on the management of surface water in order to satisfy that:

- The proposed minimum standards of operation are appropriate
- Through the use of planning conditions or planning obligations there are clear arrangements for on-going maintenance over the development's lifetime

A level 1 and level 2 **Strategic Flood Risk Assessment** has been prepared for a consortium of Norfolk local planning authorities and should be referred to when assessing flood risks.

For proposed development in South Norfolk reference should be made to Norfolk County Council's SuDS requirements for new developers are set out in the **Norfolk County Council Lead Local Flood Authority Statutory Consultee for Planning Guidance Document**.

The 2021 NPPF states that "All plans should apply a sequential, risk-based approach to the location of development" and should achieve this by "using opportunities provided by new development to reduce causes and impacts of flooding". As such, Norfolk County Council expects SuDS to be incorporated on minor development as well as major development and if possible development in areas at material risk of flooding should be avoided. Masterplans should be designed to ensure that space is made for above ground SuDS features and that the requirements of existing surface water flow paths and storage volumes are appropriately accommodated. Underground tanks should only be used on sites as a last resort.

2.6 Updated Strategic Flood Risk Assessment Guidance

There have been several updates (the latest being in March 2022 to the **'How to prepare a Strategic Flood Risk Assessment guidance')** since the issue of the previous SFRA including a new section on setting up governance arrangements when preparing your SFRA which lists who to consult and when, and what to include in Level 1 SFRAs. It also includes links to various nature strategies, management plans and local design guidance. There is also guidance on improving the clarity on the sequential test and use of SuDS. This Level 2 assessment is undertaken in accordance with this guidance.

3 Sources of information used in preparing the Level 2 SFRA

This chapter outlines the datasets used in assessing the sites in the Level 2 SFRA.

3.1 Data used to inform the SFRA

Table 3-1 provides an overview of the supplied data, used to inform the appraisal of flood risk for South Norfolk District Council.

Table 3-1 Overview of supplied data for South Norfolk District Council Level 2 SFRA

Source of flood risk	Data used to inform the assessment	Data supplied by
Historic (all sources)	Historic Flood Map and Recorded Outlines Hydraulic Modelling Reports, where provided	Environment Agency
Fluvial (including climate change)	Lower Waveney model (2013, with 2017 and 2022 amendments by JBA Consulting) Flood Zones Risk of Flooding from Rivers and Sea	Environment Agency
Surface Water	Risk of Flooding from Surface Water dataset Local Flood Risk Management Strategy Communities at Risk	Environment Agency JBA Consulting
Groundwater	Areas Susceptible to Groundwater Flooding dataset Bedrock geology/superficial deposits dataset JBA's Groundwater Mapping	Environment Agency JBA Consulting
Sewer	At Risk Register Historic flooding records	Anglian Water
Reservoir	National Reservoir Flood Mapping	Environment Agency

3.2 Flood Zones 2 and 3a

Flood Zones 2 and 3a have been taken from the Environment Agency's Flood Map for Planning and all latest modelled Flood Zones.

Where there are no detailed models, the Flood Zones are represented by older 2D generalised model outputs (EA's Flood Map for Planning).

3.2.1 Flood Zone 3b

Flood Zone 3b has been identified as land which would flood with an annual probability of 1 in 20 years (5% AEP). It has been derived from the 20-year defended modelled flood extent (or 25-year in the absence of 20-year), where detailed Environment Agency hydraulic models exist, and where no detailed models exist, Flood Zone 3a should be used as an indication of Flood Zone 3b.

Note on the Environment Agency Flood Map for Planning

Where flood outlines are not informed by detailed hydraulic modelling, the Flood Map for Planning is based on generalised modelling to provide an indication of flood risk. Whilst the generalised modelling is generally accurate on a large scale, they are not provided for specific sites or for land where the catchment of the watercourse falls below 3km^2.

For watercourses with smaller catchments, the Risk of Flooding from Surface Water map provides an indication of the floodplain of small watercourses and ditches. It is more accurate in upper to mid river valley locations than lower valley locations near the coast. This is because it does not represent the floodplain for small watercourses as well in largely flat areas.

Even where more detailed models of Main Rivers have been used by the Environment Agency to inform the Flood Map for Planning, they will be largely based on remotely detected ground model data and not topographic survey. In this area, the Flood Map for Planning does not include all modelled outputs, hence the Level 1 SFRA derived its own Flood Zones based on latest available data.

For this reason, the Flood Map for Planning is not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. Accordingly, for site-specific assessments it will be necessary to perform more detailed studies in circumstances where flood risk is an issue.

In 2022, the Environment Agency updated the Waveney hydraulic model to inform the Flood Zone 3b as 3.3% AEP following the updated Planning Practice Guidance in August 2022. This modelling has been used to inform sites upstream of Gillingham, however the extent of the updated model does not reach sites further downstream therefore this has not been used to inform Flood Zones.

3.3 Fluvial/Tidal Modelling

High-level hydraulic modelling has been undertaken to support the assessment of flood risk in relation to six proposed development sites in the villages of Brockdish, Needham, Wortwell and Gillingham, South Norfolk for the Level 2 SFRA addendum.

The area of the River Waveney around the proposed development sites contains a complex system of tributaries and other small drainage systems which are not explicitly included in the existing Environment Agency Lower Waveney model. High level 2D TUFLOW modelling has therefore been conducted to provide a high-level understanding of the potential fluvial flood risk from key tributaries which were considered to have potential impacts on flood risk for proposed development sites.

Proposed development sites SN0274REVA, SN0274REVB and SN4078 are located in Gillingham, South Norfolk. Given the location of the sites both tidal and fluvial flood risk require consideration. A tidal boundary condition has been based on the Lowestoft model results just upstream of Mutford Lock to provide a representation of the potential tidal risk to the proposed development sites however should these sites be taken forward, detailed modelling should be undertaken to inform the flood risk assessments. Full details of modelling undertaken for the study may be found in Appendix B.

3.4 Climate change

The mapping provides a strategic assessment of climate change risk; developers should undertake detailed modelling of climate change allowances as part of a site-specific FRA, following the **Climate Change Guidance** set out by the Environment Agency.

This would include the peak rive flow Central (1% AEP +9%), Higher Central (1% AEP +19%) and Upper End (1% AEP +45%) climate change allowances for the Broadlands basin's 2080s epoch, and peak rainfall Central (1% AEP +10%) and Upper End (1% AEP +40%) for the Broadland's basin's 200s epoch. The sensitivity to the extreme H++ scenario should be assessed for significant urban extensions and new settlements.

For surface water, the Level 1 SFRA surface water modelling (which used a 40% uplift in rainfall intensity) was used in the assessment. In May 2022, the Environment Agency updated the surface water climate change projections, which are now based on management catchments. For South Norfolk, the relevant uplifts for the 1% AEP event in the 2070's epoch are +20% in the Central and +40% in the Upper End scenario.

For this Level 2 SFRA, site specific modelling was undertaken based on the Environment Agency's 2013 Lower Waveney Model including modelling the latest Central and Upper End allowances.

Table 3-2: Representation of updated climate change scenarios for the 2080s epoch

	Central	Higher Central	Upper End
July 2021 updated allowance	11%	20%	44%

For any sites not covered by the EA's detailed modelling, Flood Zone 2 was used as a conservative indication of climate change extent, and the 1,000-year surface water extent as an indication for smaller watercourses not shown to be in the Flood Zones.

Developers may need to undertake detailed modelling of climate change allowances as part of a site-specific FRA, following the **climate change guidance** (https://www.gov.uk/government/publications/peak-river-flow-climate-change-allowances-by-management-catchment) set out by the Environment Agency. They should also contact the Environment Agency to determine the latest models publicly available, given the ongoing phased modelling studies. To appropriately investigate the potential effects of flood risk at a site scale it is probable that more detailed site specific modelling will be required so that FRA models can appropriately represent the potential effects of changes resulting from the implementation of proposed development.

3.5 Surface Water

Mapping of surface water flood risk in South Norfolk has been taken from the Environment Agency's Risk of Flooding from Surface Water (RoFfSW) mapping. Surface water flood risk is subdivided into the following four categories:

- **High**: An area has a chance of flooding greater than 1 in 30 (3.3%) each year.
- **Medium**: An area has a chance of flooding between 1 in 100 (1%) and 1 in 30 (3.3%) each year.

- **Low**: An area has a chance of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%) each year.
- **Very Low**: An area has a chance of flooding of less than 1 in 1,000 (0.1%) each year.

The results should be used for high-level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be required to illustrate the flood risk more accurately at a site-specific scale. Such an assessment should use the RoFSW in partnership with other sources of local flooding information to confirm the presence of a surface water risk at that particular location.

Detailed modelling based on site survey will be necessary where there is a significant risk of surface water flooding. It is the intention that the Environment Agency will prepare updated and improved surface water mapping in the course of updating the National Flood risk Assessment (NaFRA). It is anticipated that this data will be available in 2024 and at that time it is recommended that the surface water risk assessment is reviewed. It is not anticipated that the updated mapping will fundamentally change the locations identified to be at risk from surface water flooding, but the improved analysis techniques will reduce some of the uncertainties associated with the assessment.

3.6 Groundwater

In comparison to fluvial flooding, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. Groundwater level monitoring records are available for areas on Major Aquifers; however, for lower lying valley areas, which can be susceptible to groundwater flooding caused by a high-water table in mudstones, clays, and superficial alluvial deposits, very few records are available. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted as a result of elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater Flooding (AStGWF) dataset.

The AStGWF dataset is a strategic-scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring and does not take account of the chance of flooding from groundwater rebound. 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.

The AStGWF data should be used only in combination with other information, for example local data or historical data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

3.7 River networks

Main Rivers are represented by the Environment Agency's Statutory Main River layer. Ordinary Watercourses are represented by the Environment Agency's Detailed River Network (DRN) layer. Caution should be taken when using these layers to identify culverted watercourses which may appear as straight lines but in reality, are not.

Developers should be aware of the need to identify the route of and flood risk associated with culverts. CCTV condition survey will be required to establish the current condition of the culvert and hydraulic assessments will be necessary to establish culvert capacity of both culverts on site and those immediately offsite that could pose a risk to the site. The risk of flooding should be established using site survey, including the residual risk of culvert blockage.

3.8 Flood warning

Flood Warning Areas and Flood Alert Areas are represented by the Environment Agency's Flood Warning Area GIS dataset.

3.9 Reservoirs

The risk of inundation as a result of reservoir breach or failure of a number of reservoirs within the area has been identified from the Environment Agency's **Long Term Flood Risk Information website** (https://flood-warning-information.service.gov.uk/long-term-flood-risk/map).

3.10 Sewer flooding

Historical incidents of flooding are detailed by Anglian Water through their sewer flooding register. The sewer flooding register records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. Due to licencing and confidentiality restrictions, sewer flooding data has not been represented on the mapping.

3.11 Historic flooding

Historic flooding was assessed using the Environment Agency's Historic Flood Map.

3.12 Flood defences

Flood defences are represented by Environment Agency's Asset Information Management System (AIMS) Spatial Defences data set. Their current condition and standard of protection are based on those recorded in the tabulated shapefile data. None of the sites being assessed are formally protected by a defence.

3.13 Residual risk

The residual flood risk to sites is identified as where potential blockages or overtopping/ breach of defences could result in the inundation of a site, with the sudden release of water with little warning.

Potential culvert blockages that may affect a site were identified on OS Mapping and the Environment Agency's Detailed River Network Layer to determine where watercourses flow into culverts or through structures (i.e. bridges) in the vicinity of the sites. Any potential locations were flagged in the site summary tables. These will need to be considered by the developer as part of a site-specific Flood Risk Assessment.

Residual risk from breaches to flood defences, whilst rare, needs to be considered in Flood Risk Assessments. Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches. There are currently no national standards for breach assessments and there are various ways of assessing breaches using hydraulic modelling. Work is currently being undertaken by the Environment Agency to collate and standardise these methodologies. It is recommended that the Environment Agency are consulted if a development site is located near to a flood defence to understand the level of assessment required and to agree the approach for the breach assessment, if required.

3.14 Depth, velocity and hazard to people

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people during the defended fluvial 100-year event. The 100-year flood event has been investigated in further detail because the Level 2 assessment helps inform the Exception Test and usually flood mitigation measures and access/ egress requirements focus on flood events lower than the 1,000-year event (e.g. the 100-year plus climate change event).

Where detailed model outputs were available, i.e. along the River Waveney the 100-year plus climate change depth, velocity and hazard data has been used. This data is only present where models have a 2D element, representing the floodplain in detail. In the absence of detailed hydraulic models (or models with detailed 1D-2D outputs), the Risk of Flooding from Rivers and Sea dataset has been used, as well as the Risk of Flooding from Surface Water datasets. The depth, hazard, and velocity of the 100-year surface water flood event has also been mapped and considered in this assessment. Hazard to people has been calculated using the below formula as suggested in Defra's FD2321/TR2 "Flood Risk to People". The different hazard categories are shown in. Developers should also test the impact of climate change depths, velocities, and hazard on the site, at Flood Risk Assessment stage.

Table 3-3 Defra's FD2321/TR2 "Flood Risks to People" classifications

Description of Flood Hazard Rating	Flood Hazard Rating	Classification Explanation
Very Low Hazard	< 0.75	Flood zone with shallow flowing water or deep standing water"
Danger for some (i.e. children)	0.75 - 1.25	"Danger: flood zone with deep or fast flowing water"
Danger for most	1.25 - 2.00	Danger: flood zone with deep fast flowing water"
Danger for all	>2.00	"Extreme danger: flood zone with deep fast flowing water"

As part of a site-specific FRA, developers will need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood depth, velocity and hazard based on the relevant 100-year plus climate change event, using the relevant climate change allowance based on the type of development and its associated vulnerability classification. Not all this information is known at the strategic scale and the level of resolution may not be appropriate to enable site scale assessment of proposed development schemes.

3.15 Note on SuDS suitability

The hydraulic and geological characteristics of each site were assessed to determine the factors that potentially constrain schemes for surface water management. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

The assessment is based on catchment characteristics and additional datasets such as the AStGWF map, JBA's Groundwater Mapping and British Geological Survey (BGS) Soil maps of England and Wales which allow for a basic assessment of the soil characteristics on a site-by-site basis. LIDAR data was used as a basis for determining the topography and average slope across each development site. Other datasets were used to determine other factors. These datasets include:

- Historic landfill sites

- Groundwater Source Protection Zones
- Detailed River Network
- Flood Zones derived as part of this Level 2 SFRA.

This data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. SuDS techniques were categorised into five main groups, as shown in Table 3-4. This assessment should not be used as a definitive guide as to which SuDS would be suitable but used as an indicative guide of general suitability. Further site-specific investigation should be conducted to determine what SuDS techniques could be used on a particular development, informed by detailed ground investigations.

Table 3-4 Summary of SuDS categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Under-drained Swale, Wet Swale

The suitability of each SuDS type for the site options has been described in the summary tables, where applicable. The assessment of suitability is broadscale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS.

4 Impact of Climate Change

The NPPF sets out that flood risk should be managed over the lifetime of a development, taking climate change into account. This section sets out how the impact of climate change should be taken into account.

The Climate Change Act 2008 creates a legal requirement for the UK to put in place measures to adapt to climate change and to reduce carbon emissions by at least 80% below 1990 levels by 2050.

4.1 Revised climate change guidance

The Environment Agency published **updated climate change guidance** (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances) in 2019 on how allowances for climate change should be included in both strategic and site specific FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development.

In 2018, the government published new UK Climate Projections (UKCP18).

The Environment Agency have used these to further update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances. The **new climate change allowances** (https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow) were released in July 2021 for peak river flows and May 2022 for peak rainfall allowances and should be used when undertaking a detailed Flood Risk Assessment.

4.2 Applying the climate change guidance

To apply the climate change guidance, the following information needs to be known:

- The vulnerability of the development.
- The likely lifetime of the development – in general 60 years is used for commercial development and 100 for residential, but this needs to be confirmed in an FRA.
- The River Basin that the site is in
- Likely depth, speed, and extent of flooding for each allowance of climate change over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s).
- The 'built in' resilience measures used, for example, raised floor levels.
- The capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

4.3 Relevant allowances for South Norfolk

Table 4-1 shows the peak river flow allowances that apply to South Norfolk for fluvial flood risk, and Table 4-2 shows the peak rainfall intensity allowances that apply in South Norfolk when considering surface water flood risk. For large catchments (more than 5km^2) and rural catchments, the allowances in Table 4-2 are used for peak rainfall intensity. Both the central and upper end allowances should be considered to understand the range of impact.

For tidal flooding, allowances are given in the form of total sea level rise. Table 4-3 shows the relevant sea level allowances for the Anglian Basin considered in this study.

Table 4-1 2021 Peak river flow allowances for the Broadland River Basin District

Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 69)	Total potential change anticipated for '2080s' (2070 to 2115)
Extreme (H++)	25%	40%	80%
Upper end	25%	35%	65%
Higher Central	15%	20%	35%
Central	10%	15%	25%

Table 4-2 Peak rainfall intensity allowance in Broadland River Basin

Allowance category	Total potential change anticipated for '2050s' (2040 to 69)	Total potential change anticipated for '2070s' (2061 to 2125)
3.3% AEP Central	20%	40%
3.3% AEP Upper end	20%	40%
1% AEP Central	20%	45%
1% AEP Upper end	20%	40%

Table 4-3 Sea level allowances in the Anglian Area

River Basin district	Cumulative Rise to 2125
Central	1.2m
Upper end	1.6m
H++	1.9m

4.4 Representing climate change in the Level 2 SFRA

For this Level 2 SFRA, additional 2D Domains were added sections of the River Waveney (2013) model where this aligned with sites being assessed. The latest Central and Higher Central scenarios were modelled.

For any sites not covered by the EA's detailed modelling, Flood Zone 2 was used as an indicative climate change extent. This is appropriate given the 100-year +60% flows are often similar to the Flood Zone 2 extents; therefore, the impacts of climate change would be minimal.

The 1% AEP +40% surface water event was considered as part of this SFRA. This equates to the 2070's epoch Upper End Climate Change scenario.

Developers may need to undertake a more detailed assessment of climate change as part of the planning application process when preparing FRAs, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development. In areas where no modelling is present, this may require development of a 'detailed' hydraulic model, using channel topographic survey. The Environment Agency should be consulted to provide further advice for developers on how best to apply the new climate change guidance.

Climate change mapping for each site has been provided in Appendix A: GeoPDFs.

It is important to note that although the flood extent may not increase noticeably on some watercourses, the flood depth, velocity, and hazard may increase compared to the 100-year current-day event. It is recommended that the impact of climate change on a proposed site is considered as part of a detailed Flood Risk Assessment, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development. The Environment Agency should be consulted to provide further advice for developers on how best to apply the new climate change guidance.

When undertaking a site-specific Flood Risk Assessment, developers should:

- Confirm which national guidance on climate change and new development applies by visiting **GOV.uk** (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)
- Apply this guidance when deciding the allowances to be made for climate change, having considered the potential sources of flood risk to the site (using this SFRA), the vulnerability of the development to flooding and the proposed lifetime of the development. If the site is just outside the indicative climate change extents in this SFRA, the impact of climate change should still be considered because these may get affected should the more extreme climate change scenarios materialise.

4.5 Impact of climate change on groundwater flood risk

The effect of climate change on groundwater flooding, and those watercourses where groundwater has a large influence on winter flood flows, is more uncertain. There is no technical modelling data available to assess climate change impacts on groundwater. It would depend on the flooding mechanism, historic evidence of known flooding and geological characteristics, for example prolonged rainfall in a chalk catchment. Flood risk could increase when groundwater is already high or emerged, causing additional overland flow paths or areas of still ponding.

Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months.

A high likelihood of groundwater flooding may mean infiltration SuDS are not appropriate and groundwater monitoring may be recommended.

4.6 Impact of climate change on the functional floodplain

The potential impacts from Flood Zone 3b (20-year modelled extent) plus climate change may need to be considered at site-specific assessment stage. If this is not explicitly modelled, the modelled 20-year output could be compared against a return period similar to that expected if the 20-year flow was to be uplifted by say 11% or 20% as per the EA's guidance. This may equate to a 75-year or 100-year flood event (possibly higher in some locations). Elsewhere, it could be assumed that FZ3a could be considered an indicative extent for FZ3b with climate change.

4.7 Impact of climate change on sewers

Surface water and fluvial flooding with climate change have the potential to impact on the sewerage system, so careful management of these is needed for development. Due to differing ages of settlements, there will be drainage systems consisting of different types of sewers. Increasing pressures from climate change, urban creep and infill development could impact on the performance of the sewerage system.

4.8 Adapting to climate change

The NPPG Climate Change guidance contains information and guidance for how to identify suitable mitigation and adaptation measure in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime.
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development.
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses; and
- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity, for example by leaving areas shown to be at risk of flooding as public open space.
- Considering the standard of protection of defences and sites for future development, in relation to sensitivity to climate change. The Council and developers will need to work with RMAs and use the SFRA datasets to understand whether development is affordable or deliverable. Locating development in such areas of risk may not be a sustainable long-term option.

It is recommended that the differences in flood extents from climate change are compared by the Council when allocating sites, to understand how much additional risk there could be, where this risk is in the site, whether the increase is marginal or activates new flow paths, whether it affects access/ egress and how much land could still be developable overall.

5 Level 2 assessment methodology

This chapter outlines how sites were screened against flood risk datasets to determine which sites needed a Level 2 assessment. It also identifies other sites at lower risk with general recommendations for developers.

5.1 Site screening

South Norfolk Council provided 76 sites for assessment. These sites were screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site, including:

- The proportion of the site in each Flood Zone derived from the Level 1 SFRA, which includes modelling data
- Whether the site is shown to be at risk from surface water flooding in the RoFfSW and, if so, the lowest return period from which the site is at surface water flood risk
- Whether the site is within, or partially within, the Environment Agency's Historic Flood Map
- Whether the site is within 100m of a detailed river network.

The screening was undertaken using JBA in-house software called "FRISM". FRISM is an internal JBA GIS package that computes a range of flood risk metrics based on flood and receptor datasets.

The results of the screening provide a quick and efficient way of identifying sites that are likely to require a Level 2 Assessment, assisting South Norfolk Council with Sequential Test decision-making so that flood risk is taken into account when considering allocation options.

The screening also provides an opportunity to identify sites which may show to be 100% in Flood Zone 1, but upon visual inspection in GIS, have an ordinary watercourse flowing through or adjacent to them but for which no Flood Zone information is currently available. *Note: although there are no Flood Zone maps available for these watercourses, it does not mean the watercourse does not pose a risk, it just means no modelling has yet been undertaken to identify the risk.*

The Flood Zones are not provided for specific sites or land where the catchment of the watercourse falls below 3km^2. For this reason, the Flood Zones are not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. The Risk of Flooding from Surface Water has been used in these cases because this provides a reasonable representation of the floodplain of such watercourses to use for a strategic assessment.

5.2 Sites taken forward to a Level 2 assessment

Out of the 76 sites provided by the South Norfolk Council, 23 sites were carried forward to a Level 2 assessment.

A Red-Amber-Green system was applied to the sites on the basis, that: red sites needed a Level 2 assessment, amber sites did not need a Level 2 due to lower flood risk but are flagged in this report for developer considerations (recommendations provided in section 5.3), and green sites that had no/ negligible risk.

Sites were taken forward if they were at fluvial flood risk or if surface water risk was deemed significant. In order to assess whether a site was deemed to have significant surface water risk, professional judgment was used based on the extent and location of the surface water issues relative to the site and access and egress.

For example, if there was an area of deep ponding, a prominent flow route bisecting a site, immediate constraints to site access at the boundary, potential for highly vulnerable types of development to occupy a site etc.

For other sites with less significant but still noteworthy surface water issues, these have been highlighted in Table 5-2 and the LLFA expect the developer to take these into account at an early stage when planning the form and layout of the site, the surface water drainage system and any surface water mitigation measures that may be necessary.

Table 5-1 summarises the sites which have been taken forward to the Level 2 assessment on this basis.

Table 5-1 Sites[1] carried forward to a Level 2 assessment

Site Code	Reason for Level 2	Flood Zones % FZ3a	Flood Zones % FZ2	Flood Zones % FZ1	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
SN4078 /VCGIL1	Fluvial	9%	13%	87%	0%	0%	<1%
SN2065REV /VCNEE1	Fluvial	8%	10%	90%	0%	0%	0%
SN2036	Fluvial	0%	10%	90%	0%	0%	0%
SN0274REVA	Fluvial	0%	0%	100%	<1%	<1%	3%
SN0432REVB /VCBRO1	Surface Water	0%	0%	100%	2%	3%	10%
SN4069SL	Fluvial /Surface Water*	0%	0%	100%	0%	<1%	<1%
SN0274REVB	Surface Water	0%	0%	100%	3%	7%	19%
SN4055 /VCWIN2	Surface Water	0%	0%	100%	<1%	2%	31%
SN3019SL	Surface Water	0%	0%	100%	3%	16%	66%
SN2183	Surface Water	0%	0%	100%	45%	54%	69%
SN2118	Surface Water	0%	0%	100%	0%	0%	42%
SN1052REV /VCPSM1	Surface Water	0%	0%	100%	0%	0%	11%
SN1015	Surface Water	0%	0%	100%	0%	1%	22%
SN0488	Surface Water	0%	0%	100%	3%	13%	24%
SN0400/VCALP1	Surface Water	0%	0%	100%	0%	0%	14%
SN0348	Surface Water	0%	0%	100%	<1%	2%	19%
SN0308/VCHAL1	Surface Water	0%	0%	100%	1%	2%	61%
SN0242 & SN0017SL/	Surface Water	0%	0%	100%	1%	1%	10%

Site Code	Reason for Level 2	Flood Zones % FZ3a	Flood Zones % FZ2	Flood Zones % FZ1	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
VCASH1							
SN5029 & SN2121REVA /VCWOR2	Surface Water	0%	0%	100%	34%	35%	47%
SN0262	Surface Water	0%	0%	100%	8%	9%	15%
SN0552REVB /VCBAR1	Surface Water*	0%	0%	100%	0%	0%	0%
SN4051 /VCBB1	Surface Water	0%	0%	100%	1%	3%	9%
SN0373 /VCDIT1	Surface Water	<1%	<1%	<98%	1%	2%	10%
SN0567 & SN2082 /VCSPO2	Surface Water	0%	0%	100%	2%	2%	9%

**Whilst the site is not at risk, it is in very close proximity to sources of flood risk and may be at risk in future.*

The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. For example: If 50% of a site is in the Flood Zones, taking each Flood Zone individually, 50% would be in Flood Zone 2 but say only 30% might be in Flood Zone 3a and only 10% in Flood Zone 3b. This would be displayed as stated above, i.e. the total % of that particular Flood Zone in that site. Flood Zone 1 is the remaining area of the site outside of Flood Zone 2, so Flood Zone 2 + Flood Zone 1 will equal 100%.

5.3 Recommendations for sites not taken forward to a Level 2 assessment

The 'amber' sites identified as having some lower-level flood risk, but not requiring a Level 2 assessment, are shown in Table 5-2 below. These pose a risk from surface water flooding only, or an ordinary watercourse does not present in the EA's Flood Zones due to catchment size. Surface water mapping at these sites is presented in Appendix B.

Table 5-2 Sites[1] flagged at lower flood risk

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
SN4051	There is some minor surface water ponding on the site during the 100 and 1,000-year surface water events, which is unlikely to be prohibitive to development. During the 30, 100 and 1,000-year surface water events, significant surface water flow paths form along Norwich Road, Honingham Road and Mill Road, and through Rush Green. Whilst the site itself is not significantly impacted, these flows are likely to limit access/egress to the site. This should be considered further as part of a site-specific flood-risk assessment. Developers will need to demonstrate safe access and egress is possible during the 100-year surface water event, including an allowance for climate change. Given the low risk to the site, a shelter-in-situ policy may be appropriate dependent on the expected duration of flooding. This should be quantified as part of a site-specific FRA.	>1%	3%	11%
SN0433	Whilst no significant surface water flooding is shown on the site at 30 and 100-year surface water events, the site is surrounded by significant surface water flow paths which may impact on access and egress or form a dry island. This surface water extent then encroaches on to over a third of the site at 1000-year scenario. Therefore, this should be further investigated as part of a site-specific FRA to allow for safe access and egress to site.	0%	0%	36%
SN4020	The site is unaffected by surface water flooding in any of the available scenarios. Whilst the is not located within a fluvial flood zone, the northern and eastern boundaries of the site border Flood Zone 2 and it is possible that the site may be at risk in the future. This should be investigated using detailed modelling as part of a site-specific FRA, and if Flood Zone 2 is shown to encroach on the site in future this will limit the land available for development. Whilst access and egress to the site via Yarmouth Road is not currently impacted by flooding from any source, it is possible that it may be affected by fluvial flooding in the future. This should again be investigated using detailed modelling as part of a site-specific flood risk assessment. Developers will need to demonstrate safe access and egress during the 100-year fluvial and surface water events including an allowance for climate change.	0%	0%	0%

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
SN4052	The site is unaffected by surface water during the 100-year event, and a minor surface water flow forms in the northwest corner of the site during the 1,000-year event. Provided development is sited away from this flow path, this is unlikely to be prohibitive to development. The site is accessed by an unnamed road leading off Green Lane. The access road is impacted by a significant surface water flow path in the 30, 100, and 1,000 year surface water events, which is likely to significantly impact access/egress to the site. This should be considered further as part of a site-specific flood-risk assessment. Developers will need to demonstrate safe access and egress is possible during the 100-year surface water event, including an allowance for climate change. Given the low risk to the site, a shelter-in-situ policy may be appropriate dependent on the expected duration of flooding. This should be quantified as part of a site-specific FRA.	0%	0%	>1%
SN4036	The site is unaffected by surface water flooding in any of the available scenarios. The site is accessed by School Road. School Road is impacted by a significant surface water flow path in the 30, 100, and 1,000 year surface water events, which is likely to significantly impact access/egress to the site. This should be considered further as part of a site-specific flood-risk assessment. Developers will need to demonstrate safe access and egress is possible during the 100-year surface water event, including an allowance for climate change. Given the low risk to the site, a shelter-in-situ policy may be appropriate dependent on the expected duration of flooding. This should be quantified as part of a site-specific FRA.	0%	0%	>1%

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
SN2110	During the 30, 100 and 1,000-year surface water events, a surface water flow path along Norwich Road, on the northern boundary crosses into the site. The extent is limited and is unlikely to limit the area available for development provided development is located outside the area at risk. During the 30, 100 and 1,000-year surface water events, significant surface water flow paths form along Norwich Road, Honingham Road and Mill Road, and through Rush Green. Whilst the site itself is not significantly impacted, these flows are likely to limit access/egress to the site. This should be considered further as part of a site-specific flood-risk assessment. Developers will need to demonstrate safe access and egress is possible during the 100-year surface water event, including an allowance for climate change. Given the low risk to the site, a shelter-in-situ policy may be appropriate dependent on the expected duration of flooding. This should be quantified as part of a site-specific FRA.	>1%	>1%	5%
SN0444	The site is unaffected by surface water flooding during all 3 available scenarios, and the site is located entirely within Flood Zone 1. However the site borders Flood Zone 2 on the northern boundary and might be at risk in future as a result of climate change. This should be investigated using detailed modelling as part of a site-specific FRA, and if Flood Zone 2 is shown to encroach on the site in future this will limit the land available for development. The site is accessed via Bunwell Road, which is impacted by a significant surface water flow path in the 30, 100, and 1,000 year surface water events. This is likely to significantly impact access/egress to the site. This should be considered further as part of a site-specific flood-risk assessment. Developers will need to demonstrate safe access and egress is possible during the 100-year surface water event, including an allowance for climate change.	0%	0%	>1%

Further recommendations relating to managing the cumulative impacts of development are stated in Chapter 8 for consideration at the site-specific Flood Risk Assessment stage.

5.4 Site summary tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for the sites listed above in Table 5-1. The summary tables can be found in Appendix A.

Where available, the results from existing detailed Environment Agency hydraulic models were used in the assessment to provide depth, velocity, and hazard information. Additional modelling was undertaken based on the Environment Agency's Lower Waveney model (2013) to provide depth velocity and hazard outputs for specific sites.

Using the model information combined with the Flood Zones, climate change and Risk of Flooding from Surface Water (RoFfSW) extents, detailed site summary tables have been produced for the site options (see Appendix A). Each table sets out the following information:

- Basic site information
- Location of site in the catchment
- Area, type of site, current land use (greenfield/ brownfield), proposed site use
- Sources of flood risk
- Existing drainage features
- Fluvial – proportion of site at risk including description from mapping/ modelling
- Surface Water – proportion of site at risk including description from RoFfSW mapping
- Reservoir
- Flood History
- Flood risk management infrastructure
- Description of residual risk
- Emergency Planning
  - Flood Warning Areas
  - Access and egress
- Climate change
- Summary of climate change allowances and increase in flood extent compared to Flood Zones
- Requirements for drainage control and impact mitigation
- Broadscale assessment of possible SuDS to provide indicative surface water drainage advice for each site assessed for the Level 2 SFRA.
  - Groundwater Source Protection Zone
  - Historic Landfill Site
- NPPF Planning implications
  - Exception Test requirements
- Requirements and guidance for site-specific FRA (including consideration of opportunities for strategic flood risk solutions to reduce flood risk)
- Key messages – summarising considerations for the Exception Test to be passed
- Mapping information – description of data sources for the following mapped outputs:
  - Flood Zones
  - Climate change
  - Fluvial depth, velocity, and hazard mapping

- Surface water
- Surface water depth velocity and hazard mapping

5.4.1 Interactive GeoPDF mapping

To accompany each site summary table, there is an Interactive GeoPDF map in Appendix A, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use 'tick box' layers down the right-hand side and bottom of the mapping, to allow navigation of the data.

Flood risk information in the GeoPDFs include:

- Site boundary and Council boundary
- Title bar showing area, grid reference, site name, proposed development use (e.g. residential/ employment) and percentage Flood Zone coverage
- Flood Zones 2, 3a and 3b (functional floodplain) and indicative FZ3b (FZ3a in the absence of detailed models)
- Modelled 100-year plus climate change fluvial depth, velocity, and hazard rating
- Fluvial climate change extents – Central, Higher Central and Upper End allowances (where detailed models are available) and Indicative climate change extents (FZ2, where no detailed models are available)
- Flood risk from surface water dataset (30-years, 100-years, and 1,000-years)
- Surface water 30-year, 100-year and 1,000-year depth, velocity, and hazard rating
- Areas Susceptible to Groundwater Flooding
- JBA's Groundwater Levels Risk Mapping
- Flood Warning and Flood Alert Areas
- Historic Landfill
- Historic Flood Map
- Defences (embankment and wall)
- Main Rivers/ Ordinary watercourses

6 Flood risk management requirements for developers

This chapter provides guidance on site specific Flood Risk Assessments (FRAs). These are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with Planning Applications and should demonstrate how flood risk will be managed over the development's lifetime, considering climate change and vulnerability of users.

The report provides a strategic assessment of flood risk in South Norfolk. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk and any defences at a site are considered in more detail. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the Exception Test can be satisfied.

A detailed Flood Risk Assessment undertaken for a windfall site[3] may find that the site is entirely inappropriate for development of a particular vulnerability, or even at all.

6.1 Principles for new developments

Apply the Sequential and Exception Tests

Developers should refer to the Level 1 SFRA for more information on how to consider the Sequential and Exception Tests. For allocated sites, the Norfolk County Council have already applied the Sequential and Exception Tests. For windfall sites a developer must undertake the Sequential Test, which includes considering reasonable alternative sites at lower flood risk. Only if it passes the Sequential Test should the Exception Test then be applied if required. The Sequential and Exception Tests in the NPPF apply to all developments and an FRA should not be seen as an alternative to proving these tests have been met.

Developers should also apply the sequential approach to locating development within the site. The following questions should be considered:

- Can risk be avoided through substituting less vulnerable uses or by amending the site layout?
- Can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
- Can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?

Consult with the statutory consultees at an early stage to understand their requirements

Developers should consult with the Environment Agency, Norfolk County Council as LLFA and Anglian Water as the water and sewerage company, at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design.

Consider the risk from all sources of flooding and that they are using the most up to date flood risk data and guidance

The SFRA can be used by developers to scope out what further detailed work is likely to be needed to inform a site-specific Flood Risk Assessment. At a site level, Developers will need to check before commencing on a more detailed Flood Risk Assessment that they are using the latest available datasets. Developers should

[3] 'Windfall sites' is used to refer to those sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan.

apply the 2019 Environment Agency climate change guidance and ensure the development has taken into account climate change adaptation measures.

Ensure that development does not increase flood risk elsewhere and in line with the NPPF, seeks to reduce the causes and impacts of flooding

Chapter 8 sets out these requirements for taking a sustainable approach to surface water management. Developers should also ensure mitigation measures do not increase flood risk elsewhere and that floodplain compensation is provided where necessary.

Ensure the development is safe for future users

Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered. Developers should consider both the **actual and residual risk of flooding** to the site.

Further flood mitigation measures may be needed for any developments in an area protected by flood defences, where the condition of those defences is 'fair' or 'poor', and where the standard of protection is not of the required standard.

Enhance the natural river corridor and floodplain environment through new development

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for an amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted. Where possible, developers should identify and work with partners to explore all avenues for improving the wider river corridor environment. Developers should open up existing culverts and should not construct new culverts on site except for short lengths to allow essential infrastructure crossings.

Consider and contribute to wider flood mitigation strategy and measures in South Norfolk and apply the relevant local planning policy

Wherever possible, developments should seek to help reduce flood risk in the wider area e.g., by contributing to a wider community scheme or strategy for strategic measures, such as defences or natural flood management or by contributing in kind by mitigating wider flood risk on a development site. Developers must demonstrate in an FRA how this has been considered at a site level.

6.2 Requirements for site-specific Flood Risk Assessments

6.2.1 When is an FRA required?

Site-specific FRAs are required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development such as non-residential extensions, alterations which do not increase the size of the building or householder developments 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).
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1); the Environment Agency should be contacted to agree the breach assessment approach.
- Where evidence of historical or recent flood events have been passed to the LPA.
- In an area where surface water flood risk is a material consideration.

6.2.2 Objectives of site-specific FRAs

Site-specific FRAs should be proportionate to the degree of flood risk, as well as appropriate to the scale, nature, and location of the development. Site-specific FRAs should establish:

- whether a proposed development will be at risk of flooding, from all sources, both now and in the future, taking into account climate change.
- whether a proposed development will increase flood risk elsewhere.
- whether the measures proposed to deal with the effects and risks are appropriate.
- the evidence, if necessary, for the local planning authority to apply the Sequential Test; and
- whether, if applicable, the development will be safe and pass the Exception Test.

FRAs should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and Leicestershire County Council. Guidance and advice for developers on the preparation of site-specific FRAs include:

- **Standing Advice on Flood Risk** (https://www.gov.uk/guidance/flood-risk-assessment-standing-advice)(Environment Agency).
- **Flood Risk Assessment for Planning Applications** (https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications)(Environment Agency);
- FRA Guidance Note (Environment Agency SHWG area);
- **Site-specific Flood Risk Assessment: CHECKLIST** (https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section)(NPPF PPG, Defra).

Guidance for local planning authorities for reviewing Flood Risk Assessments submitted as part of planning applications has been published by Defra in 2015 – **Flood Risk Assessment: Local Planning Authorities** (https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities).

6.3 Local requirements for mitigation measures

The Level 1 SFRA provides details on the following mitigation measures in Section 8.3, and should be referred to alongside this report:

- Site layout and design (8.3.1)
- Modification of ground levels (8.3.2)
- Raised floor levels (8.3.3)
- Development and raised defences (8.3.4)
- Developer contributions (8.3.5)

6.4 Flood warning and emergency planning

Section 3 of the Level 1 SFRA discusses NPPF requirements and what an Emergency Plan will need to consider and other relevant information on emergency planning. Further information is provided by the **Norfolk Local Resilience Forum** in reducing flood risk from other sources

Section 8.5 of the Level 1 SFRA discusses how to reduce flood risk from other sources, such as groundwater, surface water and sewer flooding.

6.5 Reservoirs

The risk of reservoir flooding is extremely low. However, there remains a residual risk to development from reservoirs and the allocation of proposed new development downstream of a an reservoir can have implications for the risk designation of the reservoir which can trigger the need for substantive investment in the reservoir assets so that a flood can be safely passed. Accordingly, care should be taken when allocating development downstream of a reservoir so that the implications with respect to risk designation and any necessary investment to improve the safety of the asset are appropriately addressed. In addition developers should consider the following during the planning stage:

- Developers should contact the reservoir owner for information on:
- the Reservoir Risk Designation
- reservoir characteristics: type, dam height at outlet, area/volume, overflow location
- operation: discharge rates/maximum discharge
- discharge during emergency drawdown; and
- inspection/maintenance regime.
- The EA and NRW online Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975). Consideration should be given to the extent, depths and velocities shown in these online maps.
- The GOV.UK website on **Reservoirs: owner and operator requirements** (https://www.gov.uk/guidance/reservoirs-owner-and-operator-requirements) provides information on how to register reservoirs, appoint a panel engineer, produce a flood plan and report and incident.

Developers should consult the **Norfolk Local Resilience Forum** about emergency plans for reservoir breach.

Developers should use the above information to:

- Apply the sequential approach to locating development within the site.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond, and whether in fact it is appropriate to place development immediately on the downstream side of a reservoir.
- Assess the potential hydraulic forces imposed by sudden reservoir failure event and check that that the proposed infrastructure fabric could withstand the structural loads.
- Develop site-specific Emergency Plans and/ or Off-site Plans if necessary and ensure the future users of the development are aware of these plans. This may need to consider emergency drawdown and the movement of people beforehand.

6.6 Duration and onset of flooding

The duration and onset of flooding affecting a site depends on a number of factors:

- The position of the site within a river catchment, with those at the top of a catchment likely to flood sooner than those lower down. The duration of flooding tends to be longer for areas in lower catchments.
- Upstream reservoirs in these catchments will provide some online flood storage that reduce the flood risk downstream and delays the onset of flooding. At the confluence of the larger watercourses and smaller tributaries, there may be different timings of peak flows, for example smaller tributaries would peak much earlier than the larger catchments.
- The principal source of flooding: where this is surface water, depending on the intensity and location of the rainfall, flooding could be experienced within 30 minutes of the heavy rainfall event e.g., a thunderstorm. Typically, the duration of flooding for areas at risk of surface water flooding or from flash flooding from small watercourses is short (hours rather than days).
- The preceding weather conditions prior to the flooding: wet weather lasting several weeks will lead to saturated ground. Rivers respond much quicker to rainfall in these conditions.
- Whether a site is defended, noting that if the defences were to fail, a site could be affected by very fast flowing and hazardous water within 15 minutes of a breach developing (depending on the size of the breach and the location of the site in relation to the breach), causing danger to life.
- Catchment geology, for example chalk catchments take longer to respond than typical clay catchments.

Table 6-1 Guidelines on the duration of and onset of flooding

Principal source of flooding	Duration	Onset
Surface water	Up to 4 hours	Within 30 minutes
Fluvial	4 – 24* hours	Within 2 - 8 hours

**Depending on where in the catchment a site is located, flooding could be rapid and flashy in the upper catchment (e.g. small tributaries), and slower responding and longer in duration in the lower catchment.*

It is recommended that a site-specific Flood Risk Assessment refines this information, based on more detailed modelling work where necessary.

7 Surface water management and SuDS

This chapter provides guidance and advice on managing surface water runoff and flooding.

The Level 1 SFRA summarises guidance and advice on managing surface water runoff and flooding in Chapter 9. Below is a guide to what is included in sections not expanded on here, for reference alongside this Level 2 SFRA:

- Section 9.1 – Role of the LLFA and LPA in surface water management
- Section 9.2 – Sustainable Drainage Systems (SuDS)

7.1 Sources of SuDS guidance

7.1.1 C753 CIRIA SuDS Manual (2015)

The **C753 CIRIA SuDS Manual** (2015) (https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspxhttps://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx) provides guidance on planning, design, construction and maintenance of SuDS. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document.

7.1.2 Non-statutory Technical Guidance, Defra (March 2015)

Non-Statutory Technical guidance (https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards) provides non-statutory standards on the design and performance of SuDS. It outlines peak flow control, volume control, structural integrity, flood risk management and maintenance and construction considerations.

7.1.3 Non-statutory Technical Guidance for Sustainable Drainage Practice Guidance, LASOO (2016)

The Local Authority SuDS Officer Organisation produced their **Practice guidance** (https://www.susdrain.org/files/resources/other-guidance/lasoo_non_statutory_suds_technical_standards_guidance_2016_.pdf) in 2016 to give further detail to the Non-statutory technical guidance.

7.1.4 Groundwater Vulnerability Zones

The Environment Agency have published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise of the underlying bedrock. The map shows the vulnerability of groundwater at a location based on the hydrological, hydro-ecological and soil propertied within a one-kilometre grid square.

The groundwater vulnerability maps should be considered when designing SuDS. Depending on the height of the water table at the location of the proposed development site, restrictions may be placed on the types of SuDS appropriate to certain areas. Groundwater vulnerability maps can be found on **Defra's interactive mapping** (https://magic.defra.gov.uk/MagicMap.aspx).

7.1.5 Groundwater Source Protection Zones (GSPZ)

The Environment Agency also defines Groundwater Source Protection Zones (SPZs) near groundwater abstraction points. These protect areas of groundwater used for drinking water. The Groundwater SPZ requires attenuated storage of runoff to

prevent infiltration and contamination. Groundwater Source Protection Zones can be viewed on the **Defra website** (https://magic.defra.gov.uk/MagicMap.aspx).

South Norfolk is located in a Groundwater Source Protection Zone.

7.1.6 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies. The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The NVZ coverage can be viewed on **Defra's interactive mapping** (https://magic.defra.gov.uk/MagicMap.aspx). Parts of South Norfolk are located within a surface water NVZ.

7.2 SuDS suitability across the study area

The suitability of SuDS techniques is dependent upon many variables, including the hydraulic and geological characteristics of the catchment.

The permeability of the underlying soils can determine the infiltration capacity and percolation capacities. As such, a high-level review of the soil characteristics has been undertaken using BGS soil maps of England and Wales which allow for a basic assessment of the soil characteristics and infiltration capacity. A high level assessment of the suitability of SuDS is included in the site tables in Appendix A.

This strategic assessment should not be used as a definitive site guide as to which SuDS would be suitable but rather as an indicative guide of general suitability based solely on soil type. Several other factors can determine the suitability of SuDS techniques including land contamination, the depth and fluctuation of the water table, the gradient of local topography and primary source of runoff etc. When considering NVZs and if areas have pollutants, infiltration may only be suitable where treatment measures are provided, prior to any discharge to surface or groundwaters.

Further site-specific investigation should be conducted to determine what SuDS techniques could be utilised at a particular development. The result of this assessment does not remove the requirements for geotechnical investigation or detailed infiltration testing and does not substitute the results of site-specific assessments and investigations. The LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors.

8 Cumulative impact of development, schemes and strategic solutions

This chapter provides a summary of flood alleviation schemes, catchments with highest flood risk and summarises strategic solutions applicable to South Norfolk.

8.1 Background

8.1.1 Introduction

Under the revised 2021 NPPF, strategic policies and their supporting Strategic Flood Risk Assessments (SFRAs), are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para. 160).

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume. Whilst the loss of storage for individual developments may only have minimal impact on flood risk, the cumulative effect of multiple developments may be more severe.

Conditions imposed by South Norfolk Council should allow for mitigation measures so any increase in runoff as a result of development is properly managed and should not exacerbate flood risk issues, either within, or outside of the Councils' administrative areas.

The cumulative impact of development should be considered at both the Local Plan making and the planning application and development design stages. Appropriate mitigation measures should be undertaken to ensure flood risk is not exacerbated, and where possible the development should be used to reduce existing flood risk issues.

8.1.2 Cross-Boundary Issues

The majority of rivers within the study area join the Rivers Waveney, Yare and Bure and flow into the sea through the Borough of Great Yarmouth. The River Waveney flows along the southern district boundary from Mid Suffolk District. The River Yare flows along the northern boundary of the study area from Breckland District to the east. As such, future development both within and outside South Norfolk can have the potential to affect flood risk to development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation.

The watercourses within the study area that flow into neighbouring authorities comprise the headwater tributaries of the River Thet, such as the River Wittle, Buckenham Stream and Stow Bedon Stream. However, most catchments within the region are tributaries to the River Yare and river Waveney, which form the majority of the northern and southern district boundaries; The watershed between these two major catchments lies east to west through the south of the district.

Although outside of the South Norfolk study area, the River Bure flows through and forms a significant proportion of The Broads, to which the lower River Yare is also connected. Therefore, impacts to this catchment should also be considered.

As such, future development, both within and outside the South Norfolk can have the potential to affect flood risk to existing development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation.

South Norfolk has boundaries with the following Local Authorities:

- Breckland District
- Broadland District
- East Suffolk
- Great Yarmouth District

- Mid Suffolk District
- North Norfolk District
- Norwich District

Catchments under the potential influence of development within South Norfolk and that could impact flood risk or have their flood risk impacted upon by development within South Norfolk, extent into district beyond those listed above. Namely:

- North Norfolk District
- West Suffolk District

Development control should ensure that the impact on receiving watercourses from development in South Norfolk has been considered during the planning stage and appropriate development management decisions put in place so there is no adverse effect on flood risk or water quality. All developments are required to comply with the NPPF and demonstrate they will not increase flood risk elsewhere. Therefore, providing developments near watercourses in neighbouring authorities comply with the latest guidance and legislation relating to flood risk and sustainable drainage, they should result in no increase in flood risk within South Norfolk. The neighbouring authorities were contacted for information on their site allocations, to determine where development in neighbouring authorities may have an impact on.

8.2 Findings from the Greater Norwich Level 2 SFRA CIA

A Catchment scale Cumulative Impact Assessment (CIA) was undertaken as part of the Level 2 SFRA for Greater Norwich which also involved a Broadscale CIA usually associated with L1 SFRA's, however the L1 SFRA did not include a CIA, thus both a Broadscale and Catchment scale assessment was carried out.

The CIA is prepared to identity those catchments at highest risk of flooding, where development might have the potential to increase flood risk and where, with appropriate planning policies in place, there is the opportunity for development to contribute towards a reduction in flood risk across the wider area. This assessment was performed in parallel with the Surface Water Management Plan tasks, which involved identification of surface water hotspot areas for localised flooding.

The following catchments within the area of South Norfolk were identified as those at high risk:

- Tiffey (u/s Wymondham STW): This catchment was identified due to the significant development proposal within a predominantly rural catchment and the associated potential effects on the total runoff volumes and the magnitude of peak flows. Preliminary estimates indicate that there is potentially a predicted approximate increase of 13% during a 1 in 100 event assuming no SuDS intervention or mitigation.
- Yare (Tiffey to Wensum): This is a large catchment, draining approximately 470km^2, of which only 13% is urban extent. Development proposals were shown to be low in area coverage in relation to the catchment area, however the potential loss of floodplain storage was identified as potentially having a greater effect on flood risk downstream than increased runoff.
- Wensum (d/s Norwich): For the initial L2 assessment for Greater Norwich, this catchment was divided into 3 subsections (East; Catton Grove & Sewell; and Nelson & Town Close) to allow for independent assessment of existing Critical Drainage Areas. It was not possible to easily prepare representative hydrographs for this catchment due to tidal influences, however it was concluded that runoff increased would be limited due to brownfield site locations, and loss of floodplain storage could potentially have a greater effect on flood risk downstream than increased runoff.

8.3 Broadscale Cumulative Impact Assessment

The Greater Norwich Level 2 Strategic Flood Risk Assessment included a broadscale Cumulative Impact Assessment, that has been rerun for this assessment using updated development data and assessed for the South Norfolk study area only. The broadscale assessment determines where the cumulative impacts of development may have the biggest effect on flood risk based on historic and predicted flood risk. Catchments at the highest risk are taken forward to a catchment-level analysis.

Table 8-1 Summary of datasets used in the Broadscale Cumulative Impact Assessment

Dataset	Coverage	Source of Data	Use of Data
Catchment Boundaries	South Norfolk Study Area	Water Framework Directive Catchments	Assessment of susceptibility to cumulative impacts of development by catchment.
National Receptor Dataset (2014)	South Norfolk Study Area	Environment Agency	Assessing the number of properties at risk of surface water flooding within each catchment.
Risk of Flooding from Surface Water	South Norfolk Study Area	Environment Agency	Assessing the number of properties at risk of surface water flooding within each catchment.
Fluvial Flood Zone 2	South Norfolk Study Area	Environment Agency	Assessing the number of properties at risk of fluvial flooding within each catchment
Future development areas (recently built out sites/sites under construction/sites with planning permission/previously allocated sites/currently allocated sites)	South Norfolk & neighbouring authorities	South Norfolk Council	Assessing the impact of proposed future development on risk of flooding.
Historic Flooding Incidents	South Norfolk Study Area	South Norfolk Council	Assessing incidences of historic flooding within the study area.

8.3.1 Broadscale Methodology

Future development sites within the study area were provided by South Norfolk Council. Catchments within South Norfolk study area were ranked on five metrics: sensitivity to increased fluvial flood risk, prevalence of recorded historic flood incidents, sensitivity to increased risk of surface water flooding, prevalence of recorded flooding incidences and area of new development proposed within the catchment. Figure 3-1 shows the catchments considered for the purpose of preparing the assessment.

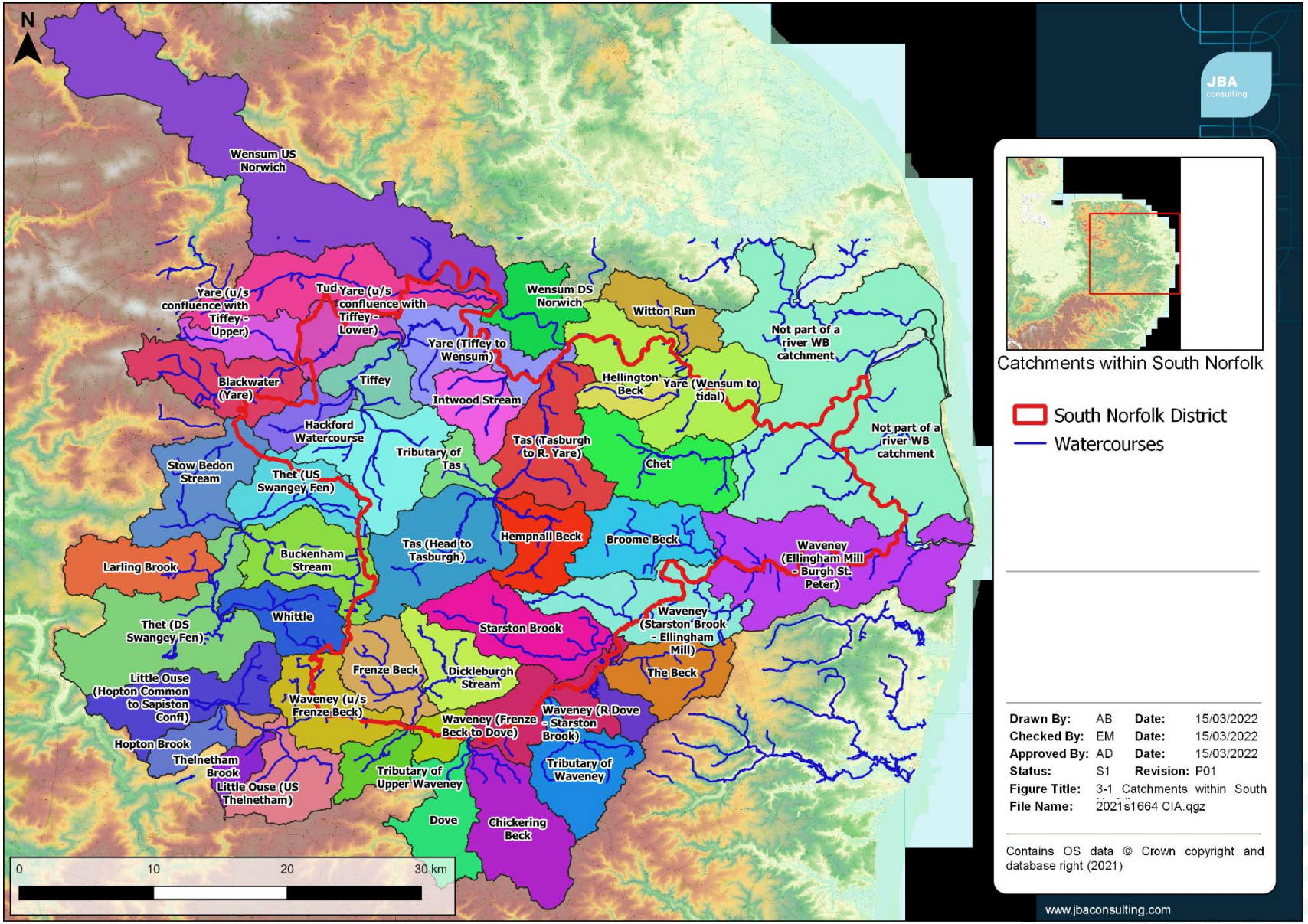

Figure 8-1 Catchments within South Norfolk

The results of this assessment provide a rating of low, medium, or high risk for each metric, for each catchment within the study area, the boundaries of which were derived from WFD. The rating of each catchment in each of these assessments was combined to give an overall ranking.

8.3.1.1 Catchment information

Two catchments that are partly within South Norfolk District are not classified as river waterbodies as they comprise part of the tidal Norfolk Broads, though these waterbodies are formed of the lower catchments of the River Yare and River Bure.

Other catchments have been included in this assessment that are outside of the Study Area but are tributaries of catchments that are within South Norfolk. Therefore, any proposed development within these catchments by neighbouring authorities are likely to impact on flood risk within South Norfolk, however no neighbouring authority's proposed development site data was submitted for inclusion within this assessment.

Risk of Flooding from Surface Water extents are calculated for catchments within the South Norfolk Study Area boundary only.

8.3.1.2 Sensitivity to fluvial flooding

The number of properties within Flood Zone 2 not presently within Flood Zone 3 was taken, as a percentage of the total properties in the catchment. These properties are considered to be potentially sensitive to increased flood risk as a result of climate change.

Catchments with greater than 1% properties at increased risk were considered high risk.

Table 8-2 Catchments considered highly sensitive to increased fluvial flood risk in future

Catchment	% properties sensitive to increased fluvial flood risk	Rank
Not part of a river WB Catchment (Tidal Bure)	3.8	1
Waveney (Starston Brook – Ellingham Mill	3.28	2
Waveney (u/s Frenze Beck)	3.06	3
Wensum d/s Norwich	3.06	4
Waveney (Frenze Beck to Dove)	2.74	5
Waveney (R Dove – Starston Brook)	2.06	6
Yare (u/s confluence with Tiffey – Lower)	1.09	7

8.3.1.3 Sensitivity to surface water flooding

The number of properties within the 1000-year surface water extent not presently within the 100-year extent was taken, as a percentage of the total properties in the catchment. These properties are considered sensitive to increased flood risk as a result of climate change.

Catchments with greater than 4% properties at increased risk were considered high risk.

Table 8-3 Catchments considered highly sensitive to increased surface water flood risk in future

Catchment	% properties sensitive to increased surface water flood risk	Rank
Tributary of Tas	6.1	1
Dickleburgh Stream	5.89	2
Broome Beck	5.71	3
Starston Brook	5.31	4
Tas (Tasburgh to R. Yare)	4.77	5
Hempnall Beck	4.56	6
Tas (Head to Tasburgh)	4.56	7
Frenze Beck	4.15	8

8.3.1.4 Prevalence of historic flooding incidents

South Norfolk Council provided a list of historic flood incidents and the number of flood incidents in each catchment was identified. Catchments with more than 800 recorded incidents were considered high risk. Two of these however comprise the tidal Norfolk Broads and thus are not considered as part of any particular river catchment.

Table 8-4 Catchments with the highest number of recorded historic flood incidents

Catchment	Number of recorded incidents	Rank
Not part of a river WB catchment (Tidal Yare)	1574	1
Wensum u/s Norwich	1417	2
Not part of a river WB catchment (Tidal Bure)	1305	3
Yare (Wensum to tidal)	950	4
Wensum d/s Norwich	842	5

8.3.1 Area of proposed development

South Norfolk Council and neighbouring authorities provided a list of likely new development sites and the total area of new development in each catchment was measured, as a percentage of catchment area. Development proposals overall are comprised of small site areas in relation to catchment areas. Therefore, catchments with more than 0.00002% area earmarked for development were considered high risk, although the extent of proposed development is negligible in comparison to the catchment area.

Table 8-5 Catchments with the highest percentage cover of proposed development

Catchment	Area of proposed development (ha)	Rank
Yare (u/s confluence with Tiffey – Lower)	7.1	1
Chet	12.34	2

8.3.2 Overall rankings

As can be seen from the above tables and Figure 3-2, there are catchments that are at high risk in multiple categories. Rankings from each assessment have been combined to give an overall ranking. A Red-Amber-Green (RAG) rating was then applied to the catchments, with red being high risk, amber being medium risk and green being low risk. The catchments with a combined ranking score between 30 and 50 were deemed high risk.

The catchments rated as high-risk in the broadscale assessment are:

- Tas (Head to Tasburgh)
- Starston Brook
- Waveney (u/s Frenze Beck)
- Yare (u/s confluence with Tiffey – Lower)
- Tiffey (u/s Wymondham STW)
- Chet
- Frenze Beck
- Broome Beck

Whilst the Hellington Beck and Intwood Stream catchments are ranked as medium, this because of low rankings of historic events and medium and low increased risk from fluvial flooding ranking. However, development in these catchments ranked high and medium for increased risk from surface water flooding. Consideration should therefore still be made in these catchments with regards to surface water attenuation and the potential loss of natural surface storage in the catchment as a consequence of proposed new development, despite their final ranking score of medium.

The two tidal zones of the rivers Yare and Bure are ranked high for historic flooding incidents and fluvial flooding (as the dataset used considers coastal flooding within its extent, "Risk of Flooding from Rivers and Sea"), however this is due to their tidal proximity which skewed the ranking results and is considered to reflect the sensitivity to changes in mean sea level rather than upstream contributing flow. The catchments have been ranked Low for proposed development and surface water flooding.

Some catchments that border the South Norfolk Study area or are within neighbouring catchments were discounted from the final RAG Assessment outputs as their results were not applicable due to their being no countable data for one or more assessment criteria, as well as them being located outside of the study area.

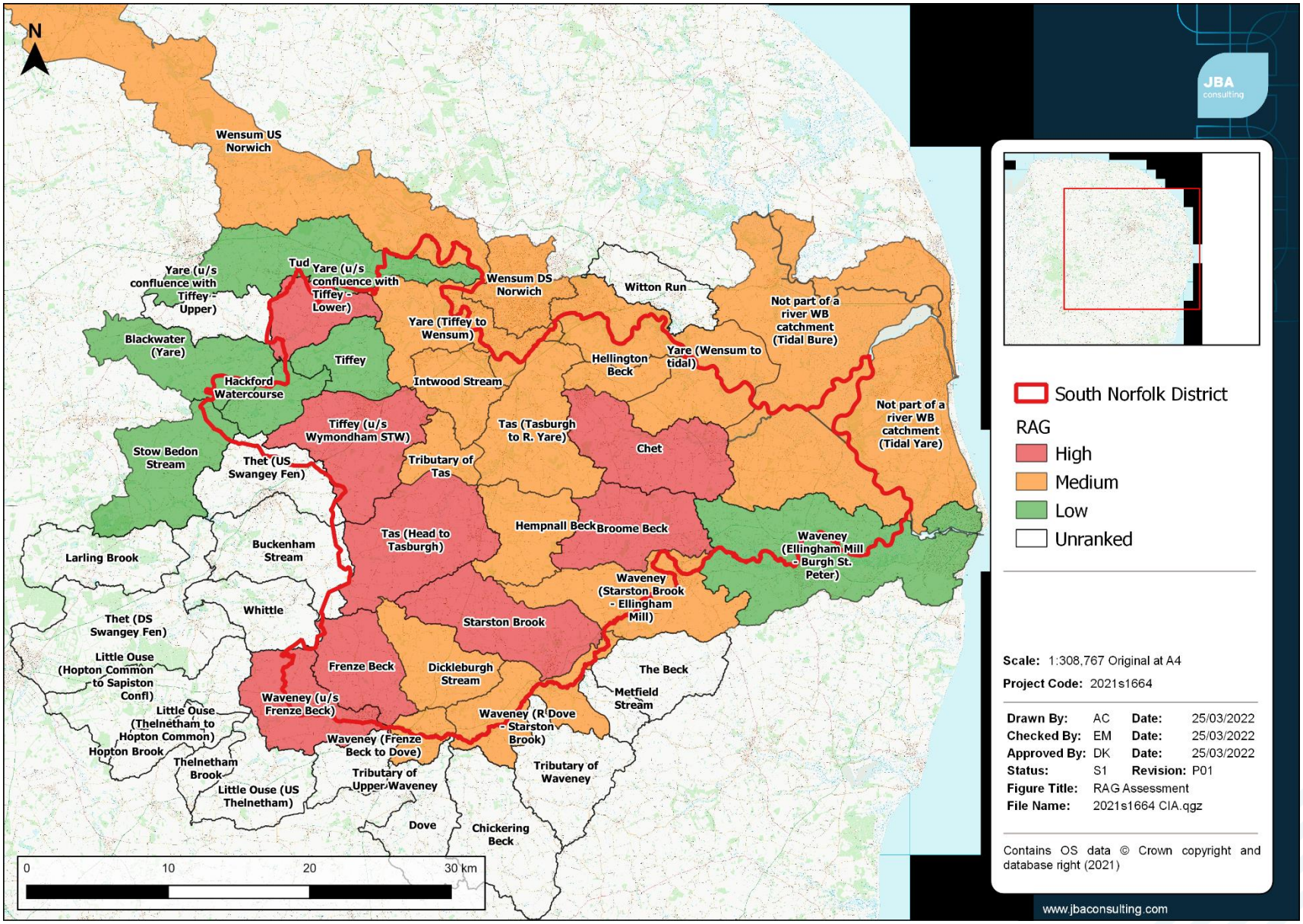

Figure 8-2: Final catchment rankings of susceptibility to the impacts of cumulative impacts within South Norfolk

8.4 Catchment-Level Assessment

8.4.1 Catchment-Level Assessment

In the catchment-level assessment, a detailed analysis of the high-risk catchments, as identified in the broadscale assessment, is undertaken. Other factors, such as the catchments' existing urban extent, topography and location within the wider river drainage network, are also considered to determine policy recommendations to address the specific risks within the catchment.

Historic flooding incidents are also considered and presented as a Hotspot 250m grid across the catchments to indicate areas potentially sensitive to flooding.

8.4.1.1 Tas (Head to Tasburgh)

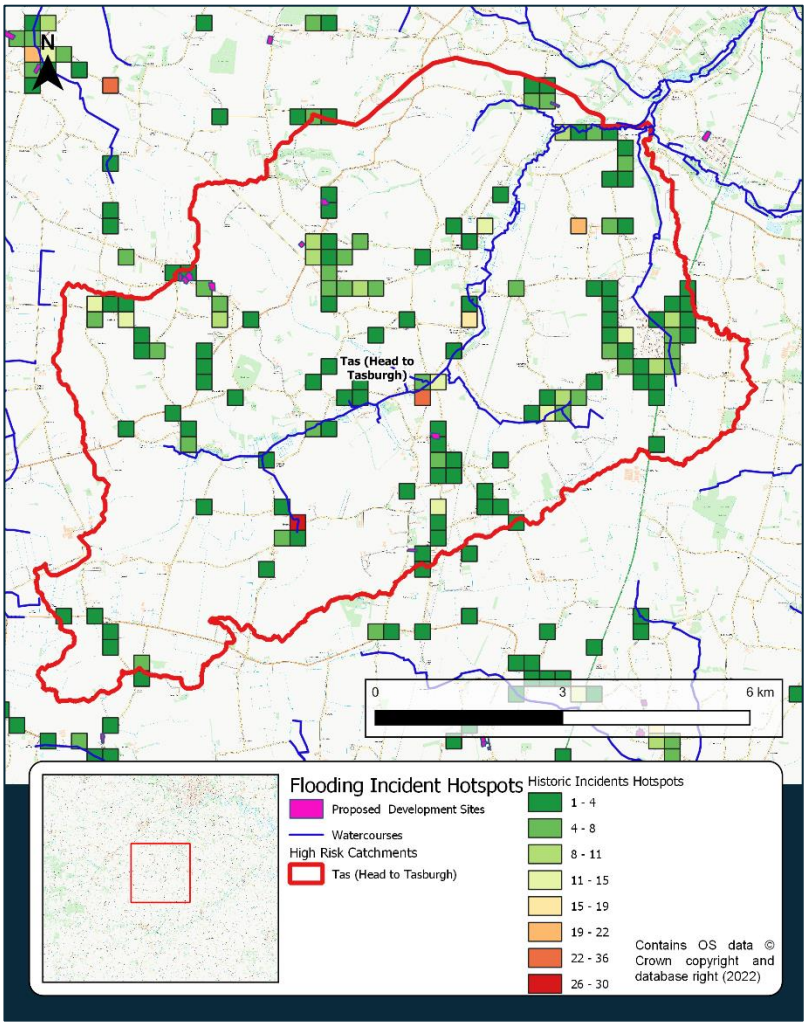

Figure 8-3: Proposed development and historic flooding hotspots within the Tas (Head to Tasburgh) catchment

The headwater catchment of the River Tas rises near Cargate Common and flows northwest towards its' confluence with the Hempnall Beck at Tasburgh. The river passes through rural farmland and is joined by numerous field drains and irrigation channels, as well as other minor watercourses. The quantity of incoming channels may pose a cumulative risk by increasing connectivity to the watercourse during high rainfall events. This can be seen as a positive trend

between the drainage/irrigation channels and flooding hotspots along the main watercourse.

In terms of fluvial flood risk, the most significant areas of flooding are near Forncett St Mary, Rookwood, and Low Common, where the two primary upstream channels of this catchment converge with overland flows as well as numerous field drains and still water features. Modelling suggests that a large number of properties may be at increased risk of flooding in future if flows in the Tas catchment were to increase in future as a result of development and climate change.

As the main areas of risk are distributed across the catchment, there is the potential for upstream measures, such as SuDS implementation and preservation and enhancement of natural surface water storage mechanisms, to reduce the risk to these areas. The majority of potential future development within the catchment appears to be predominantly at greenfield locations, therefore there are likely to be many potential opportunities to provide additional betterment for SuDS and surface water attenuation beyond the existing runoff rate.

Given the highly rural nature of the catchment, surface water flood risk is largely restricted to natural topographic depressions and natural channels although properties in the sporadic urban areas in the catchment are susceptible to increased surface water flooding in future. It is therefore particularly important that development does not increase runoff and contribute to the existing known surface water issues and that careful consideration is given to proposals that affect the natural storage and flow of surface water.

8.4.1.2 Starston Brook

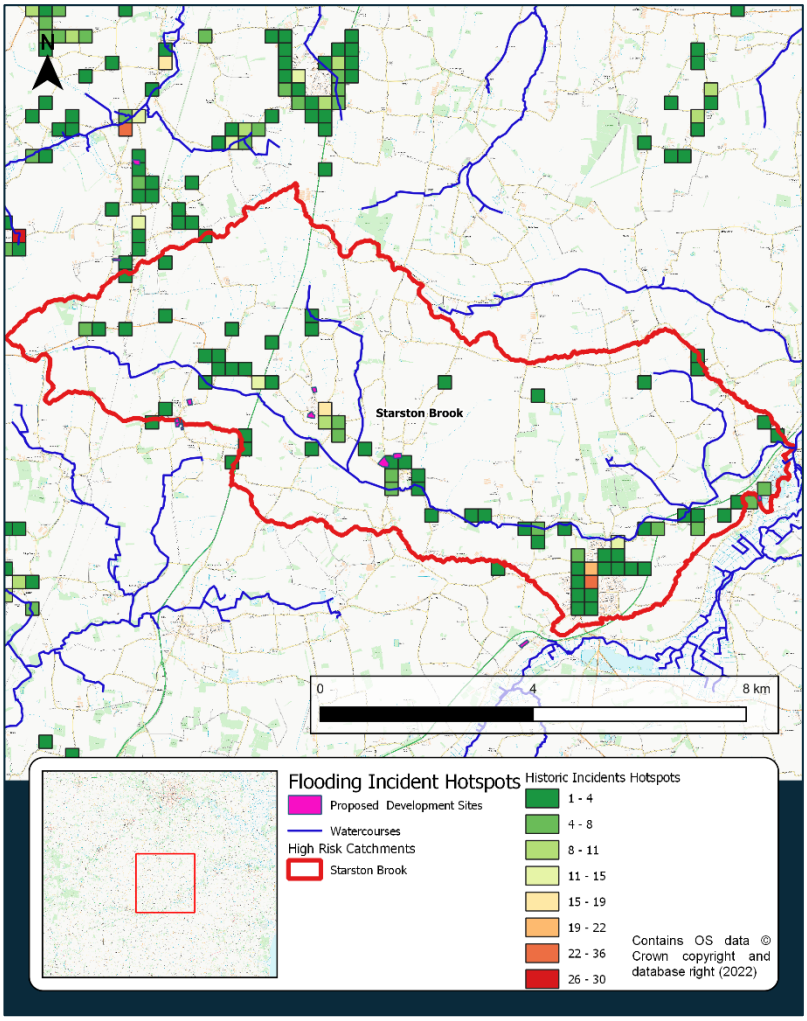

Figure 8-4: Proposed development and historic flooding hotspots within the Starston Brook catchment

The Starston Brook rises near Yew Tree Farm, west of Pulham Market and Tivetshall St Margaret, and flows through mainly rural land before flowing past Harleston before joining the River Waveney at Homersfield. The Brook is joined by three small tributaries that drain the middle and lower catchments agricultural land.

In terms of fluvial flood risk, the area's most sensitive to increasing flood risk in the future are Harleston itself and Pulham Market, though historic events trend positively along the entire watercourse. Given the rural nature of the catchment and the catchment, there are likely to be opportunities for upstream measures such as flood storage and natural flood management (NFM) techniques to be implemented to reduce the flood risk issues downstream.

The highly rural nature of the catchment means surface water flood risk is largely restricted to natural topographic depressions and natural channels although properties in the urban areas in the catchment are susceptible to increased surface water flooding in future. Modelling suggests that properties and proposed development sites within Pulham Market and Pulham St Mary may be at increased surface water flood risk in the future if flows in the Starston Brook catchment were to increase as a result of development and climate

change. It is therefore particularly important that development does not increase runoff and contribute to the existing known surface water issues.

There is very little development proposed within the catchment, therefore there are limited opportunities for SuDS to be implemented as part of development; however, this assessment highlights these issues and the importance of ensuring that runoff does not increase in future and that careful consideration is given to proposals that affect the natural storage and flow of surface water. There remains the potential for the retrofitting of SuDS within the existing urban areas to reduce runoff.

8.4.1.3 Waveney (u/s Frenze Beck)

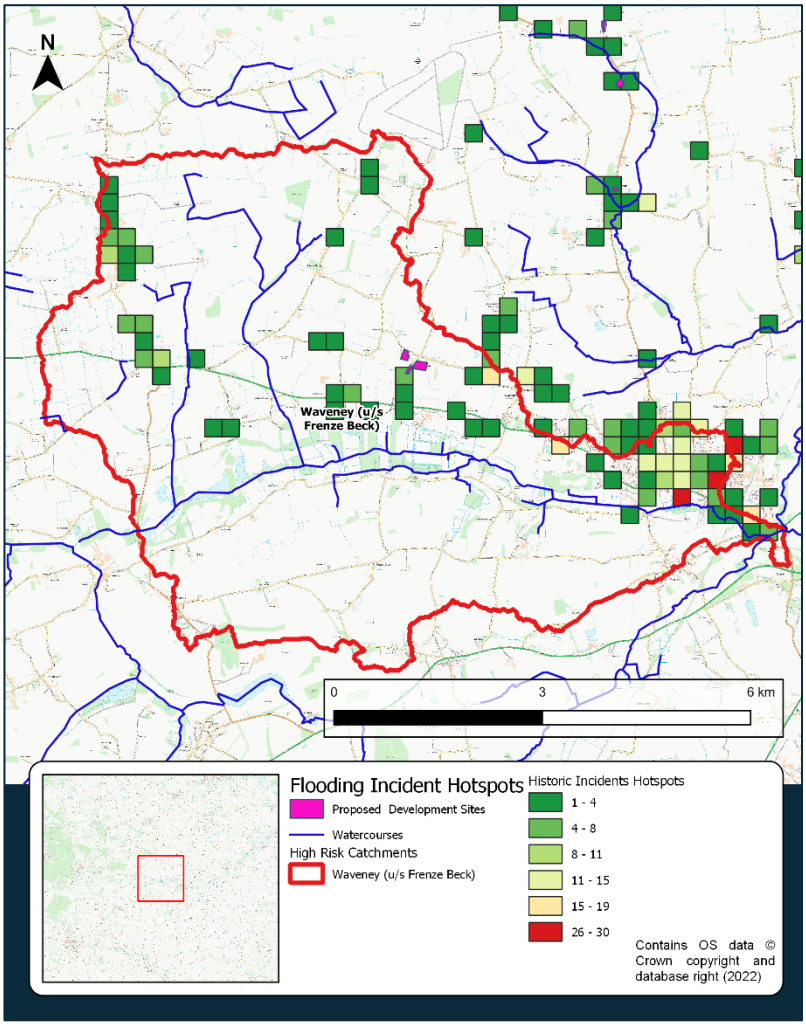

Figure 8-5: Proposed development and historic flooding hotspots within the Waveney (u/s Frenze Beck) catchment

The Waveney (u/s Frenze Beck) is the upper-most headwater catchment of the River Waveney which rises near North Lopham and flows westward towards its confluence with the Frenze Beck at Diss, the only urban area in the catchment, before flowing west to become a major watercourse in South Norfolk. There are 2 small ordinary watercourses and numerous field drains and still waters within the catchment which drain into this upstream catchment.

In terms of fluvial flood risk, the main area of risk is within Diss itself as the hotspots data exemplifies (**Figure 8-5**). The Waveney (u/s Frenze Beck) catchment appears very sensitive to increased flows in future and its topography allows surface water to enter watercourses quickly. Given the rural nature of the catchment and the catchment, there are likely to be opportunities for upstream measures such as flood storage and natural flood management (NFM) techniques to be implemented to reduce the flood risk issues downstream.

Surface water flood risk is topographically controlled to natural channels although properties in the urban area of Diss are susceptible to increased surface water flooding in future. The only development sites within this catchment are in Bressingham which is located on high ground, and surface water risk here is contained to the highways and adjacent ditches, however this risk may be

increased in the future if flows in the catchment were to increase as a result of further development and climate change. It is therefore particularly important that development does not increase runoff and contribute to the existing known surface water issues.

The small amount of proposed development also means there are limited opportunities for SuDS to be implemented as part of development; however, this assessment highlights these issues and the importance of ensuring that runoff does not increase in future and that careful consideration is given to proposals that affect the natural storage and flow of surface water. There remains the potential for the retrofitting of SuDS within the existing urban areas to reduce runoff.

8.4.1.4 Yare (u/s confluence with Tiffey – Lower)

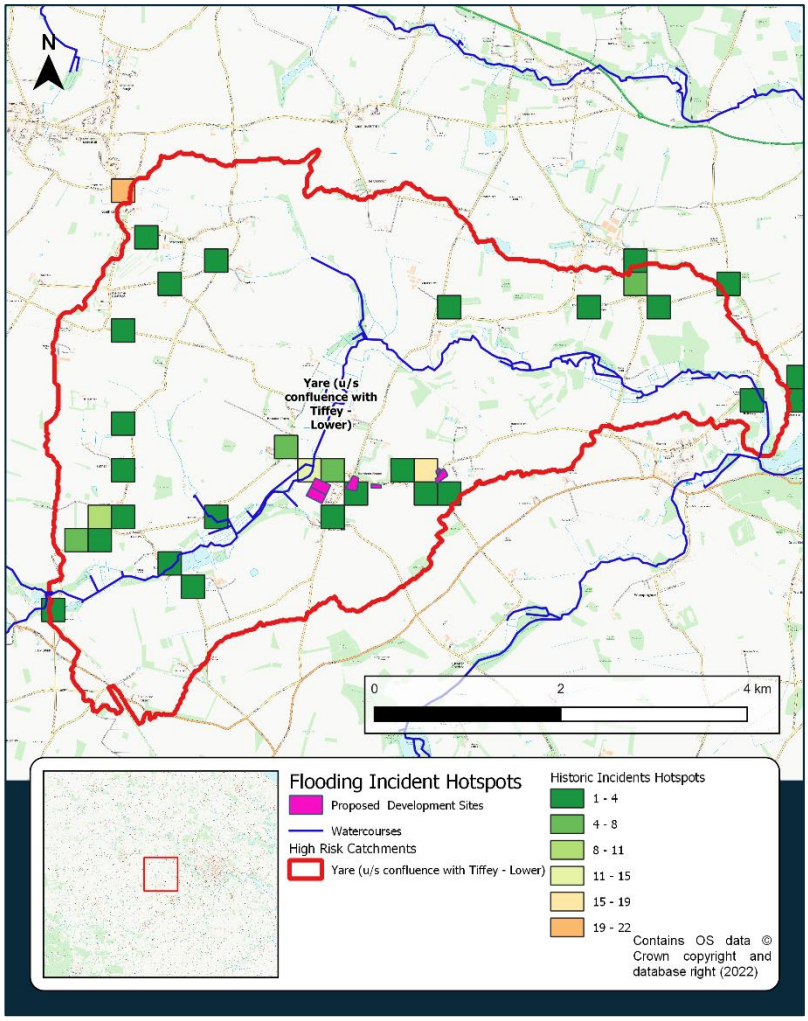

Figure 8-6: Proposed development and historic flooding hotspots within the Yare (u/s confluence with Tiffey - Lower) catchment

The Yare (u/s confluence with Tiffey – Lower) is the middle section of the River Yare before it meets the Tiffey. It enters the catchment near Low Street after forming from the Yare (u/s confluence with Tiffey – Upper) and Blackwater (Yare) catchments, which both rise near Shipdham. It then flows through the narrow valley in the Lower catchment before joining the River Tiffey downstream of Barford. There are no tributaries that join the river through this catchment, though the valley flood is scattered with numerous field which all have drains that discharge into the river.

Given the rural nature of the catchment and the catchment, there are likely to be opportunities for upstream measures such as flood storage and natural flood management (NFM) techniques to be implemented to reduce the flood risk issues downstream. The catchment is predominantly high ground with the narrow, deep valley passing through the centre. This means surface water flood risk is largely restricted to topographic depressions and natural channels although properties in the urban areas in the catchment are susceptible to increased surface water flooding in future.

The only development sites within this catchment are in Barnham Broom which is mostly located on high ground, and surface water risk here is contained to

natural channels and the highways, however this risk may be increased in the future if flows in the catchment were to increase as a result of further development and climate change. It is therefore particularly important that development does not increase runoff and contribute to the existing known surface water issues. These sites however are located within the historic flooding hotspot grids, so surface water management should be seriously considered when developing these sites.

The small amount of proposed development also means there are limited opportunities for SuDS to be implemented as part of development; however, this assessment highlights these issues and the importance of ensuring that runoff does not increase in future and that careful consideration is given to proposals that affect the natural storage and flow of surface water. There remains the potential for the retrofitting of SuDS within the existing urban areas to reduce runoff.

8.4.1.5 Tiffey (u/s Wymondham STW)

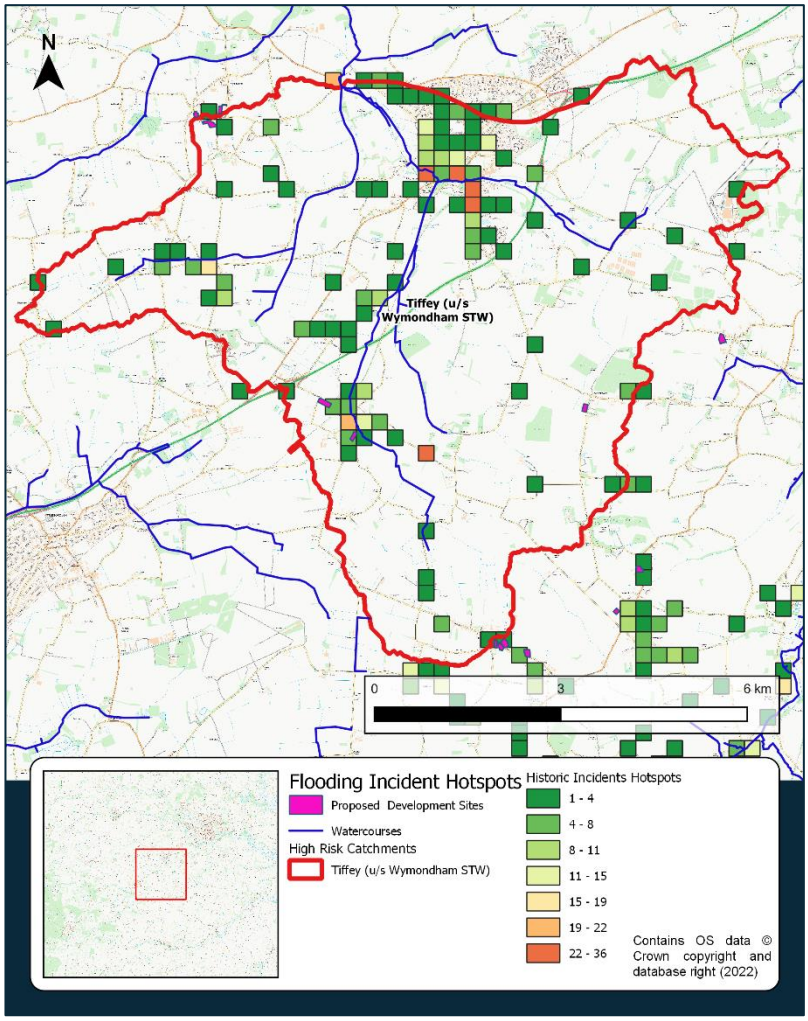

Figure 8-7: Proposed development and historic flooding hotspots within the Tiffey (u/s Wymondham STW) catchment

The Tiffey (u/s Wymondham STW) rises near Bunwell Bottom and flows northward towards its confluence with the River Tiffey. The catchment comprised 3 primary watercourses, two converge at Wymondham where a significant number of flooding hotspots are recorded, which drain the south and west of the catchment; and the other joins at the downstream end of the catchment. This drains the eastern portion of the catchment. The catchment is designated as 'heavily modified' with numerous physical modifications including weirs, land drains and abstraction.

In terms of fluvial flood risk, the main area of risk is within Wymondham itself as the hotspots data exemplifies (**Figure 8-7**), although flood zones 2 and 3 are confined to the channels passing southeast of the town. Other areas of significant flood risk include Morley St Botolph and Spooner Row, where the only proposed development sites in this catchment are located.

Given the rural nature of the majority of the catchment, there are likely to be opportunities for upstream measures such as flood storage and natural flood management (NFM) techniques to be implemented to reduce the flood risk issues downstream in Wymondham.

Surface water flood risk is distributed significantly across the catchment, with risk extents covering highways that bisect the upper catchment as well as numerous areas of risk associated within the urban area of Wymondham, where properties are susceptible to increased surface water flooding in future.

The development sites within Spooner Row are located on high ground, and surface water risk here is contained to the highways and adjacent ditches, however this risk may be increased in the future if flows in the catchment were to increase as a result of further development and climate change. It is therefore particularly important that development does not increase runoff and contribute to the existing known surface water issues.

The small amount of proposed development also means there are limited opportunities for SuDS to be implemented as part of development; however, this assessment highlights these issues and the importance of ensuring that runoff does not increase in future and that careful consideration is given to proposals that affect the natural storage and flow of surface water. There remains the potential for the retrofitting of SuDS within the existing urban areas to reduce runoff.

A Flood Investigation Report was produced for Station Road, Wymondham in 2014 following a flooding event in 2012. This location is also exemplified in the flooding hotspots data, with between 22-36 incidents reported here since 1998.

8.4.1.6 Chet

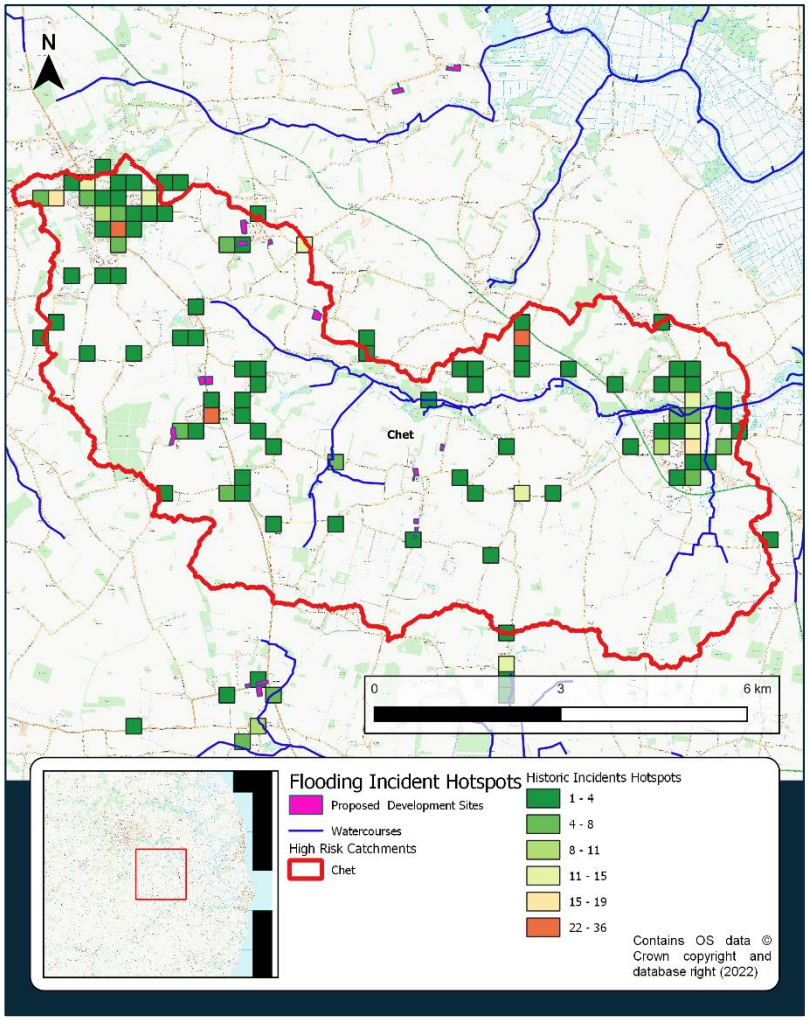

Figure 8-8: Proposed development and historic flooding hotspots within the Chet catchment

The Chet rises near Poringland and flows eastward towards its confluence with the River Yare. There are two minor tributaries that join the watercourse which drain the hills to the south of the catchment.

In terms of fluvial flood risk, the main area of risk is within Loddon at the downstream end of the catchment as the hotspots data exemplifies (**Figure 8-8**), although flood zones 2 and 3 are confined to the channels passing through the centre of the town, and no properties are modelled to be at risk within either FZ2 or FZ3 within the Chet.

Given the rural nature of the majority of the catchment, there are likely to be opportunities for upstream measures such as flood storage and natural flood management (NFM) techniques to be implemented to reduce the flood risk issues downstream in Loddon.

The development sites within this catchment are distributed sparsely across the upper and middle catchment, in villages such as Brooke, Yelverton and Seething, and are mostly located on high ground, and surface water risk here is contained to natural channels and the highways, however this risk may be increased in the future if flows in the catchment were to increase as a result of further development and climate change. It is therefore particularly important that

development does not increase runoff and contribute to the existing known surface water issues. These sites however are located within the historic flooding hotspot grids, so surface water management should be seriously considered when developing these sites.

The small amount of proposed development also means there are limited opportunities for SuDS to be implemented as part of development; however, this assessment highlights these issues and the importance of ensuring that runoff does not increase in future and that careful consideration is given to proposals that affect the natural storage and flow of surface water. There remains the potential for the retrofitting of SuDS within the existing urban areas to reduce runoff.

A Flood Investigation Report was produced for Church of England V.C Primary School, Brooke in 2013 following a flooding event in 2013. This location is also exemplified in the flooding hotspots data, with between 22-36 incidents reported here since 1998.

8.4.1.7 Frenze Beck

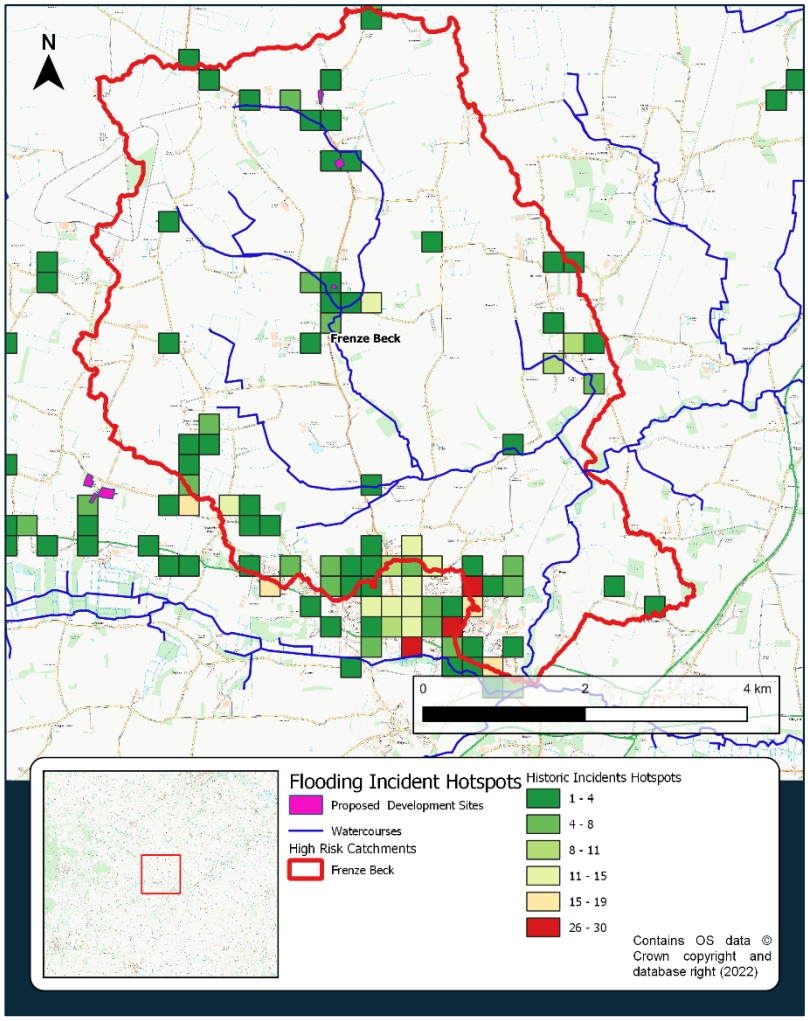

Figure 8-9: Proposed development and historic flooding hotspots within the Frenze Beck catchment

The Frenze Beck rises near Green House Farm and flows southeast and south towards its confluence with the River Waveney. The catchment comprises a number of tributaries that flow converge near the eastern catchment boundary, where the brook is joined by the Dickleburgh Stream, before flowing south towards the town of Diss and the River Waveney.

In terms of fluvial flood risk, there are a number of areas where properties are at risk and located within Flood Zone 2 and 3, particularly villages and Hamlets near channel confluences such as Shelfanger and Westbrook Green Farm. Highways within the floodplain are also at significant risk from fluvial flooding, such as the Burston Road which follows the river along the valley for approx. 800m. Some of these locations have also been identified in the flooding incidents hotspots data exemplified (**Figure 8-9**), including Shelfanger and the Burston Road.

Given the rural nature of the majority of the catchment, there are likely to be opportunities for upstream measures such as flood storage and natural flood management (NFM) techniques to be implemented to reduce the flood risk issues at confluence points and downstream in Diss.

There are very few development sites within this catchment, two in Winfarthing and one Shelfanger. Although these are and are located on high ground, and surface water risk here is contained to natural channels and the highways, all three sites are within, or directly next to flooding hotspot areas. Further investigation into these flooding events is recommended at the earliest available opportunity before development progresses. Surface water management should also be seriously considered when developing these sites. The flooding hotspot data however indicates the main areas of surface water flood risk within the catchment are around the suburbs of Diss that encroach into the south of the catchment.

Surface water flooding risk may be increased in the future if flows in the catchment were to increase as a result of further development and climate change. It is therefore particularly important that development does not increase runoff and contribute to the existing known surface water issues.

The small amount of proposed development also means there are limited opportunities for SuDS to be implemented as part of development; however, this assessment highlights these issues and the importance of ensuring that runoff does not increase in future and that careful consideration is given to proposals that affect the natural storage and flow of surface water. There remains the potential for the retrofitting of SuDS within the existing urban areas to reduce runoff.

8.4.1.8 Broome Beck

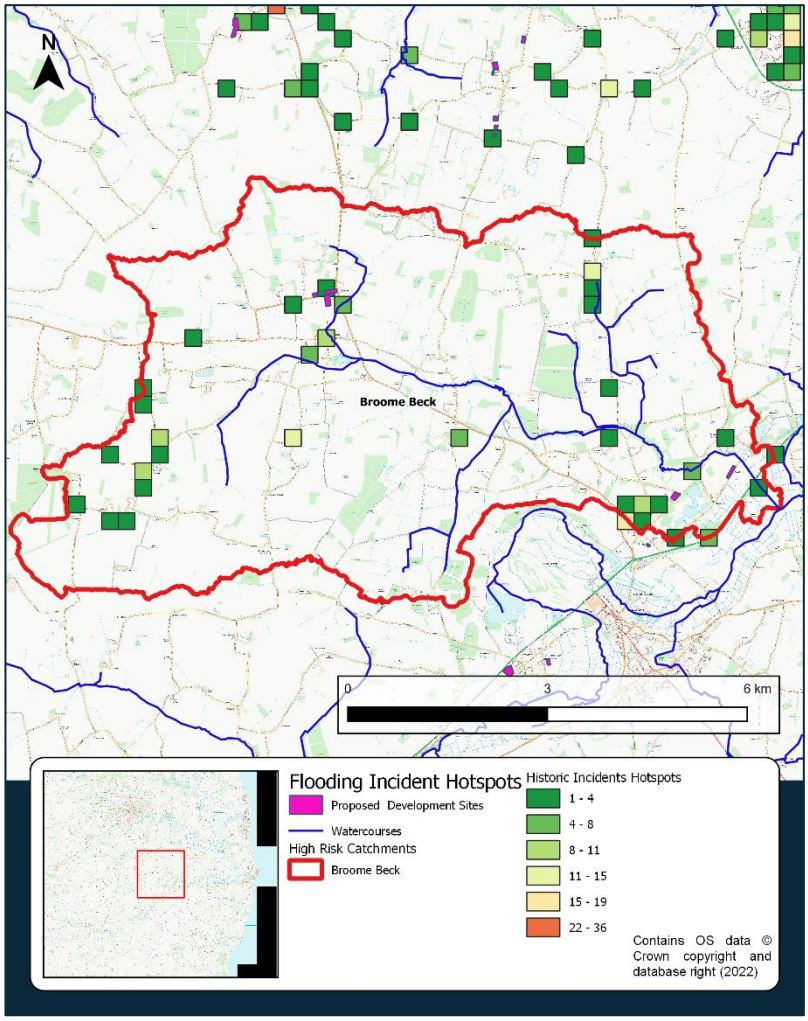

Figure 8-10: Proposed development and historic flooding hotspots within the Broome Beck catchment

The Broome Beck rises near Upgate Street and flows eastward towards its confluence with the lower section of the River Waveney (Waveney (Ellingham Mill – Burgh St. Peter)). The watercourse is joined by three tributaries that drain the hills to the northwest and southwest of the catchment, which converge near Hedenham and Belsey Bridge. From here the brook flows southeast through its lowland floodplain north of Ditchingham and Broome before draining into the Waveney.

In terms of fluvial flood risk, the main areas of risk are Woodton and Broome. Site SN4020 borders Flood Zone 2 on its north-eastern boundary in Broome, and further investigation should be considered here with regards to climate change impacts. Some of these locations have also been identified in the flooding incidents hotspots data exemplified (**Figure 8-10**), including Broome, Ditchingham and Woodton.

Given the rural nature of the majority of the catchment, there are likely to be opportunities for upstream measures such as flood storage and natural flood management (NFM) techniques to be implemented to reduce the flood risk issues in Woodton and downstream in Ditchingham and Broome.

Although development sites in Woodton are located on high ground, and surface water risk here is contained to natural channels and the highways, all three sites proposed there are located within, or partially within, one flooding hotspot grid square (Sites SN0278, SN0262 and SN0268SL). Further investigation into the nature of these historic flood events is recommended prior to any development. Surface water management should also be seriously considered when developing these sites.

Risk of Flooding from Surface Water data and the flooding hotspot data however indicate the main areas of surface water flood risk within the catchment are Topcroft Street, Woodton, Thwaite St. Mary and primarily around the areas of Ditchingham that encroach into the south of the catchment.

Surface water flooding risk may be increased in the future if flows in the catchment were to increase as a result of further development and climate change. It is therefore particularly important that development does not increase runoff and contribute to the existing known surface water issues.

The small amount of proposed development also means there are limited opportunities for SuDS to be implemented as part of development; however, this assessment highlights these issues and the importance of ensuring that runoff does not increase in future and that careful consideration is given to proposals that affect the natural storage and flow of surface water. There remains the potential for the retrofitting of SuDS within the existing urban areas to reduce runoff.

8.5 Policy Recommendations

8.5.1 Broadscale Recommendations

The broadscale cumulative impact assessment for South Norfolk has highlighted that the potential for development to have a cumulative impact on flood risk is moderately low across the area. Catchments have been identified as high, medium or low risk. The assessment provides a spatial illustration of the locations in the respective catchments that are potentially sensitive to changes in the flood risk and where more detailed assessment might be appropriate to assess the potential effect of all proposed development within a catchment.

Flood risk will potentially be affected by proposed development and thus it is appropriate that provisions for incremental action and betterment in flood risk terms across all of South Norfolk is supported.

The following policy recommendations therefore apply to all catchments within the study area:

- South Norfolk Council should work closely with neighbouring local authorities to develop complementary Local Planning Policies for catchments that drain into and out of the South Norfolk authority area to other local authorities in order to minimise cross boundary issues of cumulative impacts of development.
- Developers should incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites. Proposals will be required to provide reasoned justification for not using SuDS techniques, where ground conditions and other key factors show them to be technically feasible. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the districts where practicable. Developers should refer to the **Norfolk County Council Information for Developers** for the requirements for

Suds in South Norfolk, including Technical and Development Type-specific Guidance for Developers.

- Norfolk County Council as LLFA will review Surface Water Drainage Strategies in accordance with their local requirements for major and non-major developments. These should take into account all sources of flooding to ensure that future development is resilient to flood risk and does not increase flood risk elsewhere.
- Where appropriate, that the opportunity for Natural Flood Management in rural areas, SuDS retrofit in urban areas and river restoration should be maximised. Culverting should be opposed, and day-lighting existing culverts promoted through new developments. Careful consideration should be given to proposals that affect the natural storage and flow of surface water so that the existing capacity to absorb and convey surface water runoff is not compromised.
- Runoff rates from all development sites must be limited to greenfield rates (including brownfield sites) for all sites, with a target for 30% betterment, unless it can be demonstrated that this is not practicable. Developers should refer to the **Norfolk County Council Information for Developers** for the requirements for Suds in South Norfolk, including Technical and Development Type-specific Guidance for Developers.
- All development proposals should undertake a site-specific Flood Risk Assessment. Site-specific FRAs should explore opportunities to provide wider community flood risk benefit through new developments. Measures that can be put in place to contribute to a reduction in flood risk downstream should be considered. This may be either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors, and/ or by providing a Partnership Funding contribution towards any flood alleviation schemes.
- South Norfolk Council should consider requiring developers to contribute to community flood defences outside of their red line boundary to provide wider benefit and help offset the cumulative impact of development. There are proposed and ongoing Flood Alleviation Schemes which may help to reduce fluvial risk in the town centre, and there may be opportunities for development to support the funding/delivery of these schemes.

Catchment-specific recommendations are made for high-risk catchments below.

8.5.2 Recommendations for high-risk catchments

From analysing the results produced above, high-level recommendations for flood storage and betterment have been proposed for sites in each of the high-risk catchments. These recommendations should be considered by developers as part of a site-specific assessment, but more detailed modelling must be undertaken by the developer to ascertain the true storage needs and potential at each site at the planning application stage. Particular attention should be paid to the effect of all proposed development in a plan at the location of existing sensitive receptors and included as appropriate I the assessments performed for the respective sites in the plan (but this also applies to "windfall" sites within these catchments.

Developers should also include a construction surface water management plan to support the Construction Drainage Phasing Plan. This should provide information to the Environment Agency, LLFA and the LPA regarding the

proposed management approach during the construction phase to address surface water management during storm events.

For developments in high risk catchments, the LLFA and LPA should consult with Local Non-For-Profit organisations such as wildlife trusts, rivers trusts and catchment partnerships (**Broadland Catchment Partnership**) to understand ongoing and upcoming projects where NFM, flood storage and attenuation, and environmental betterment may be possible alongside developments and aid in reducing flood risk.

8.5.2.1 Tas (Head to Tasburgh)

Sites proposed for development within, or partially within this catchment:

- SN0537, SN0538REV, SN0539, SN2126, SN1057, SN0602, SN0459, SN4048SL, SN2118
- As the catchment drains into the Tas (Tasburgh to R. Yare), where further development is proposed, and into Norwich, LPAs should work closely with the Environment Agency and LLFA to identify any areas of land that should be safeguarded for any future flood alleviation schemes and natural flood management features.
- There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration as well as contributing to the wider provision of green infrastructure.

8.5.2.2 Starston Brook

Sites proposed for development within, or partially within this catchment:

- SN1024, SN1052REV, SN0319, SN0418, SN1027, SN2103, SN0318, SN2036
- The LLFA should work closely with the Environment Agency to identify any areas of land that should be safeguarded for any future flood alleviation and natural flood management features in the upper catchment.
- There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration as well as contributing to the wider provision of green infrastructure.

8.5.2.3 Waveney (u/s Frenze Beck)

Sites proposed for development within, or partially within this catchment:

- SN3019SL, SN4036, SN4037
- As the catchment drains through Diss, LPAs should work closely with the Environment Agency and LLFA to identify any areas of land that should be safeguarded for any future flood alleviation schemes and natural flood management features.
- The LLFA should work closely with the Environment Agency to identify any areas of land that should be safeguarded for any future flood alleviation and natural flood management features in the upper catchment.
- There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration as well as contributing to the wider provision of green infrastructure.

8.5.2.4 Yare (u/s confluence with Tiffey – Lower)

Sites proposed for development within, or partially within this catchment:

- SN0018SL, SN2110, SN4051, SN0055, SN0174, SN0196

- The LLFA should work closely with the Environment Agency to identify any areas of land that should be safeguarded for any future flood alleviation and natural flood management features in the upper catchment.
- There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration as well as contributing to the wider provision of green infrastructure.

8.5.2.5 Tiffey (u/s Wymondham STW)

Sites proposed for development within, or partially within this catchment:

- SN0444, SN0567 & SN2082, SN0242 & SN0017SL, SN0577REVA & REVB
- As the catchment drains through Wymondham and toward Norwich, LPAs should work closely with the Environment Agency and LLFA to identify any areas of land that should be safeguarded for any future flood alleviation schemes and natural flood management features.
- The LLFA should work closely with the Environment Agency to identify any areas of land that should be safeguarded for any future flood alleviation and natural flood management features in the upper catchment.
- There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration as well as contributing to the wider provision of green infrastructure.

8.5.2.6 Chet

Sites proposed for development within, or partially within this catchment:

- SN0400, SN0529SL, SN0412REV, SN0432REVA, SN0432REVB, SN0405, SN2148, SN0406SL, SN0587SL, SN0588SL, SN0433, SN2119
- As the catchment drains through Loddon, LPAs should work closely with the Environment Agency and LLFA to identify any areas of land that should be safeguarded for any future flood alleviation schemes and natural flood management features.
- The LLFA should work closely with the Environment Agency to identify any areas of land that should be safeguarded for any future flood alleviation and natural flood management features in the upper catchment.
- There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration as well as contributing to the wider provision of green infrastructure.

8.5.2.7 Frenze Beck

Sites proposed for development within, or partially within this catchment:

- SN4050, SN4055, SN0399BSL
- As the catchment drains through Diss, LPAs should work closely with the Environment Agency and LLFA to identify any areas of land that should be safeguarded for any future flood alleviation schemes and natural flood management features.
- The LLFA should work closely with the Environment Agency to identify any areas of land that should be safeguarded for any future flood alleviation and natural flood management features in the upper catchment.

- There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration as well as contributing to the wider provision of green infrastructure.

8.5.2.8 Broome Beck

Sites proposed for development within, or partially within this catchment:

- SN0262, SN0268SL, SN0278, SN4020, SN0345
- The LLFA should work closely with the Environment Agency to identify any areas of land that should be safeguarded for any future flood alleviation and natural flood management features in the upper catchment.
- There is the potential for development in this catchment to contribute towards works to reduce flood risk and enable regeneration as well as contributing to the wider provision of green infrastructure.

9 Summary of Level 2 assessment and recommendations

9.1 Assessment methods

As part of the Level 2 SFRA, 24 detailed site summary tables have been produced for the Level 2 sites assessed.

The summary tables set out the flood risk to each site, including Food Zone coverage, maps of extent, depth, and velocity of flooding as well as hazard mapping for the 100-year defended event, where available. Climate change mapping has also been produced to indicate the impact which different climate change allowances may have on the site (where models are available) or using Flood Zone 2 as an indication of climate change. Each table also sets out the NPPF requirements for the site as well as guidance for site-specific FRAs.

A broadscale assessment of suitable SuDS options has been provided giving an indication where there may be constraints to certain sets of SuDS techniques. This assessment is indicative and more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. It may be possible that those SuDS techniques highlighted as possibly not being suitable can be designed to overcome identified constraints. Where deemed required, culvert blockages were also presented to assess residual risk to sites.

Interactive mapping is shown in Appendix A and should be viewed alongside the detailed site summary tables. There are outline hydraulic models available for the River Waveney, but where models are unavailable, the Environment Agency's Flood Zones and Risk of Flooding from Rivers and Sea datasets have been used. Also, where the watercourses are smaller and not represented in the Flood Zones, the Risk of Flooding from Surface Water mapping datasets have been used.

Consideration has also been given to the safety implications for development with respect to surface water flood risk. This reflects the requirement to consider the application of the Exception Test ion circumstances where flood risk cannot be avoided. The Level 2 SFRA also identifies the need to consider the implications of allocating land that could potentially be affected by reservoir flood risk.

9.2 Summary of key site issues

- The majority of sites with a detailed Level 2 summary table are at surface water risk. The degree of flood risk varies, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected within the site. The sites at most significant surface water risk are: SN5029 & SN212REVA/VCWOR2, SN2183, SN3019SL, and SN0308/VCHAL1.
- Whilst not at significant flood risk within the site boundary, several sites have potential access and egress issues as a result of fluvial and surface water flooding of the surrounding roads. For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles. Also, consideration should be given to whether the risk forms a flow path or bisects the site where access from one side to another may be compromised.
- Most sites are not at significant risk from fluvial flooding. Site-specific modelling was undertaken for 6 sites within or close to present day Flood Zones. Of these, none were at significant fluvial risk, although flooding may impede access/egress. Site SN4078/VCGIL1 is at significant risk of tidal flooding from the River Waveney. There are

limitations to the modelling used (See Appendix B.) and it is recommended that these issues are investigated further should these sites be bought forward.

- Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions.
- Fluvial and surface water climate change mapping indicates that flood extents are predicted to increase. As a result, the depths, velocities and hazard of flooding may also increase. The significance of the increase tends to depend on the topography of site and the percentage allowance used; fluvial extents would be larger than Flood Zone 3, but maximum extents are likely to be similar to Flood Zone 2. The 1 in 1,000 surface water flood extent can also be used as an indication of climate change to surface water risk. Site-specific FRAs should confirm the impact of climate change using latest guidance.
- Any sites located where there is Main River (including culverted reaches of Main River) will require an easement of 8m either side of the watercourse from the top of the bank. This may introduce constraints regarding what development will be possible and consideration will also need to be for access and maintenance at locations where there are culverts. Developers will be required to apply for appropriate permits so the activity being carried out over easements does not increase flood risk.
- A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS option would be best.
- In respect of the cumulative impact assessment, there are a number of development sites proposed that have the potential to provide a betterment to existing communities downstream within the catchment and, if suitable storage facilities are implemented have the potential to complement existing flood alleviation schemes within their respective catchments. However, all of these developments also have the potential to increase flood risk offsite if both National and Local SuDS Standards are not applied.
- Developers proposing windfall sites in the high-risk Cumulative Impact Assessment catchments should demonstrate through a site-specific FRA how SuDS and surface water mitigation techniques will ensure that development does not increase flood risk elsewhere and seeks to reduce flood risk to existing communities. The catchment-based Cumulative Impact Assessment has been updated using the latest available data for the Level 2 SFRA and supersedes the catchment-based assessment in the Level 1 SFRA.

9.2.1 Considering the Exception Test for the proposed sites in South Norfolk

In principle, it is possible for the majority of sites assessed in the Level 2 SFRA to satisfy the flood risk element of the Exception Test, for example by:

- siting development away from the highest areas of risk into Flood Zone 1 (in the majority of sites assessed, the risk is along a site boundary, so steering away from this is advised),

- considering safe access/ egress in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path),
- using areas in Flood Zone 2 for the least vulnerable parts of the development in accordance with Table 2 in the NPPF. Residential development should not be permitted in Flood Zone 3 and no development at all should be permitted in Flood Zone 3b (aside from essential infrastructure, such as a bridge crossing the lowest points of a site),
- testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is raised to permit development on one area, compensatory flood storage will be required in another),
- considering space for green infrastructure in the areas of highest flood risk where this is appropriate.

In some areas of South Norfolk, more detailed fluvial modelling has been carried out in recent years, providing a more accurate representation of the Flood Zones within the District. The catchments modelled are the River Waveney, the River Wensum and the River Yare.

Consideration should be given to the surface water risk within South Norfolk as this must also be addressed by the Exception Test. Care should be taken with use of the national surface water mapping as it does not account for culverts, structures, channel hydraulics or sewer capacity, and therefore can provide an overestimate risk and therefore the confidence in this dataset is reduced. It is recommended that developers investigate surface water risk in more detail at the planning application stage and may need to consider undertaking integrated modelling.

If larger sites are split in future into smaller land parcels for development, and some of those parcels are in areas of flood risk, the Exception Test may need to be re-applied by the Developer at the planning application stage.

9.3 Planning Policy recommendations

The Planning Policy recommendations in Chapter 7.6 of the Level 1 SFRA still stand for the site allocations and any windfall development that comes forward. Recommendations in the L1 are made on:

- Developers should consider flood resilience measures for new development, including raised thresholds, self-sealing UPVC doors, non-return valves and air brick covers.
- Combine infiltration (e.g. permeable surfaces) and attenuation (e.g. balancing ponds and flood storage reservoirs) SuDS techniques to overcome constraints to the area of a site set aside for infiltration systems caused by development pressures.
- Where appropriate, opportunities for betterment should be sought where surface water flooding issues are present, which could be implemented through Supplementary Planning documents for individual settlements.
- Encourage the use of permeable surfacing in gardens and use measures to optimise drainage and reduce runoff.
- Consider opportunities for water conservation through rainwater harvesting and water butts where appropriate for new and existing development.
- Promote land management practices where appropriate to attenuate runoff and alleviate potential issues downstream.

Further site-specific recommendations have been made in the Level 2 report regarding Cumulative Impact Assessment. These are made in Chapter 7.

9.4 Guidance for windfall sites and sites not assessed in the L2

- For sites not represented in the Environment Agency's Flood Zones, or where Flood Zones do exist, but no detailed hydraulic modelling is present, it is recommended that developers construct detailed hydraulic models at these sites as part of a site-specific FRA using channel, structure and topographic survey, to confirm flood risk. Site specific flood modelling will probably need to be developed in locations where it is necessary to understand the effects of proposed development schemes on the existing flood flow paths and flood volume storage.
- If a site's extents either include or borders with a Main River (including a culverted reach of Main River), an easement of 8m is required from either bank for access and maintenance. Any future development will require a flood risk permit from any activity within 8m of a Main River.
- If an ordinary watercourse is within or immediately adjacent to the site area, consultation with the Lead Local Flood Authority should be undertaken. If alterations or discharges are proposed to the watercourse, a land drainage consent will be required.
- Where necessary, blockages of nearby culverts may need to be simulated in a hydraulic model to confirm residual risk to the site.
- Surface water risk should be considered in terms of the proportion of the site at risk in the 30-year, 100-year or 1,000-year events, whether the risk is due to isolated minor ponding or deeper pooling of water, or whether the risk is due to a wider overland flow route.
- Surface water risk and mitigation should be considered as part of a detailed site-specific Flood Risk Assessment and Surface Water Drainage Strategy.
- Access and egress should be considered at the site, but also in the vicinity of the site, for example, a site may have low surface water risk, but in the immediate locality, access/ egress to and from the site could be restricted for vehicles and/ or people.
- Sites where there is a canal within or immediately adjacent to the site area, developers should consult the Canals and Rivers Trust. Any proposed alterations to the canal or discharges must be agreed with the Canals and Rivers Trust.
- If a site is located within 250m of a landfill site, there could be amenity, dirt and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment.

9.5 Use of SFRA data and future updates

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The SFRA should be a 'living document', and as a result should be updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by South Norfolk Council, Norfolk County Council, the Highways Authority, Anglian Water and the Environment Agency. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a future flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood defence schemes, or alleviation schemes.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment. It is recommended that the SFRA is reviewed in line with the Environment Agency's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking with the above bodies for any new information.

9.5.1 Neighbourhood Plans

Flood risk should be fully addressed in the plan preparation and in bringing forward policies for the allocation of land and therefore the SFRA findings should be used in the production of Neighbourhood Plans.

Neighbourhood planners can use the information in the Level 1 and Level 2 SFRA on the sources of flood risk across South Norfolk and the flood risk mapping, to assess the risk of flooding to sites within their community. The SFRA will also be helpful for developing community level flood risk policies in high flood risk areas.

The Level 1 Greater Norwich SFRA highlights on a broad scale where flood risk from fluvial, surface water, groundwater and the effects of climate change are most likely. The maps are useful to provide a community level view of flood risk but may not identify if an individual property is at risk of flooding or model small scale changes in flood risk. Local knowledge of flood mechanisms will need to be included to complement this broadscale mapping.

Appendices

A Level 2 Assessment

A.1 Site Summary Tables

A.2 GeoPDF mapping

Instructions for using GeoPDFs

1. GeoPDFs should be opened with Adobe. They display the mapping datasets relevant to this report for each site

2. Datasets shown in the legend can be switched on and off using the tick boxes

B Modelling Technical Note

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