King's Lynn and West Norfolk Strategic Flood Risk Assessment

Final Report: Level 1

November 2018

JBA Project Manager

Hannah Coogan
The Library
St Philips Courtyard
Church Hill
COLESHILL
Warwickshire
B46 3AD

Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft rev 1.0 / Sept 2017	DRAFT for comment	SFRA Steering Group
Final Draft rev 2.0 / Aug 2018	FINAL DRAFT for comment	SFRA Steering Group
Final rev 3.0 / Nov 2018	FINAL report	SFRA Steering Group

Contract

This report describes work commissioned on behalf of a consortium of local planning authorities in Norfolk:

- Broadland District Council
- Great Yarmouth Borough Council
- Borough Council of King's Lynn and West Norfolk
- Norwich City Council
- North Norfolk District Council
- South Norfolk Council
- Broads Authority

Each authority was represented as part of a steering group for the SFRA. The steering group's representative for the contract was North Norfolk's Policy Team Leader, Iain Withington. Sophie Dusting, Ffion Wilson, Freyja Scarborough and Roberta Whittaker of JBA Consulting carried out this work.

Prepared by ..... Roberta Whittaker BSc PGCert
Assistant Analyst

..... Sophie Dusting BSc MEPS
Analyst

Reviewed by ..... Alastair Dale BSc PGDip MIAHR
Technical Director

..... Hannah Coogan BSc M. CIWEM C.WEM
Technical Director

Purpose

This document has been prepared as a Final Draft Report for the Borough Council of King's Lynn and West Norfolk. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to the Client.

Acknowledgements

We would like to acknowledge the assistance of:

- All the commissioning authorities;
- The Lead Local Flood Authority (Norfolk County Council);
- Environment Agency;
- Internal Drainage Boards (Downham Market Group of IDBs, East Harling IDB, Middle Level Commissioners, Water Management Alliance, Waveney IDB);
- Anglian Water;
- Highways England; and,
- Planners at the neighbouring authorities and LLFAs

Copyright

Carbon Footprint

A printed copy of the main text in this document will result in a carbon footprint of 627g if 100% post-consumer recycled paper is used and 798g if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Executive Summary

Introduction

Norfolk Local Planning Authorities (LPAs) have a long track record of cooperation and are working together on strategic cross-boundary planning issues, through the Norfolk Strategic Framework. One of the aims of the framework is to inform the preparation of future Local Plans, through shared objectives and strategic priorities.

Strategic Flood Risk Assessments (SFRAs) form part of the evidence base of the Local Plan and can be used to inform the Sustainability Appraisal. The requirement for the preparation of SFRAs is detailed in Section 14 Paragraph 156 of the **National Planning Policy Framework (NPPF).**

A consortium of Norfolk LPAs, comprising Broadland District Council, Great Yarmouth Borough Council, the Borough Council of King's Lynn and West Norfolk, North Norfolk District Council, Norwich City Council, South Norfolk Council and the Broads Authority, have commissioned new Level 1 SFRAs to inform strategic planning decisions, the preparation of Local Plans and to inform development management decisions. These councils are local planning authorities for their respective administrative areas, with the exception of the Broads Executive Area, where the Broads Authority is the Local Planning Authority.

The Level 1 SFRAs comprise the following four reports:

- 2017 Greater Norwich Area SFRA, covering the Norwich City Council, Broadland District Council, South Norfolk Council and parts of the Broads Authority administrative areas
- 2017 North Norfolk SFRA covering the North Norfolk District Council and parts of the Broads Authority administrative areas
- 2017 Great Yarmouth SFRA covering the Great Yarmouth Borough Council and parts of the Broads Authority administrative areas
- 2018 King's Lynn and West Norfolk SFRA covering the Borough Council of King's Lynn and West Norfolk

Within this 2018 SFRA report, when reference is made to the '*combined study area*' and this is the whole area covered by the four reports listed above.

The 2018 SFRA document replaces the previous King's Lynn and West Norfolk SFRA originally published in 2008. The main purpose of the 2018 SFRA is to inform the selection of options for the Local Plan allocations and support determination of planning applications for King's Lynn and West Norfolk Borough.

SFRA objectives

The key objectives of the 2018 Strategic Flood Risk Assessment are:

- To provide up to date information and guidance on flood risk for King's Lynn and West Norfolk Borough, taking into account the latest flood risk information and the current state of national planning policy;
- To determine the variations in risk from all sources of flooding in King's Lynn and West Norfolk Borough, taking into account climate change;
- To identify the requirements for site-specific flood risk assessments;
- To consider opportunities to reduce flood risk to existing communities and developments;
- To enable the Borough Council of King's Lynn and West Norfolk to apply the Sequential Test;
- To aid the Borough Council of King's Lynn and West Norfolk in identifying when the Exception Test is required and when a more detailed Level 2 SFRA will be required, when determining strategic site allocations; and,
- To inform the Sustainability Appraisal of the Borough Council of King's Lynn and West Norfolk Local Plan, so that flood risk is taken into account when considering strategic site allocations.

SFRA outputs

This report fulfils the Level One SFRA requirement.

To meet the objectives, the following outputs have been prepared:

- Assessment of all potential sources of flooding (see Sections 5 and 6)
- Assessment of the potential impact of climate change on flood risk (see Sections 4 and 5)
- Mapping of all potential sources of flooding including climate change (see Appendix A)
- Mapping of location and extent of functional floodplain (see Appendix A)
- Mapping of "dry islands" (see Appendix A)
- Assessment of standard of protection provided by existing flood risk management infrastructure (see Section 7)
- Mapping of areas covered by Environment Agency Flood Warnings (see Section 6.10.2 and Appendix C)
- Review of opportunities to reduce flood risk to existing communities and development (see Section 10)
- Guidance for developers including requirements for site-specific flood risk assessments and general advice on the requirements and issues associated with Sustainable Drainage Systems (SuDS) (see Sections 8 and 9)
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk (see Section 3).

Summary of the SFRA

Appraisal of flood risk

- There have been a number of recorded flood incidents across the Borough, from a combination of sources. The predominant source of flooding is from tidal sources, although recent flooding has been largely from surface water. Under Section 19 of the Flood and Water Management Act, Norfolk County Council in their role as Lead Local Flood Authority, have published two reports within the Borough of King's Lynn and West Norfolk; one investigation concerning the event on 6th November and 23rd December 2012 at Sutton Road, Walpole Cross Keys and another investigation concerned the rainfall events that caused 42 properties to flood in the Borough between early June and late November 2014. Section 19 reports are available to download from Norfolk County Council's **website**. A total of 47 flood incidents along the A47 highway have been recorded since July 2008, by Highways England. Most recently, surface water flooding affected the Borough in July 2018. Historic flooding is discussed further in Section 6.1.
- Fluvial flooding is one of the primary sources of flood risk within the Borough of King's Lynn and West Norfolk. The most significant watercourse in terms of fluvial risk is the River Great Ouse; however, there are several other watercourses that pose a significant risk. Due to their low-lying elevations, many settlements across the Fens area are at risk of flooding from watercourses that are substantially influenced by high tide levels. In addition, fluvial/tidal flooding also gives rise to the risk of flooding in the event of overtopping / breach from embanked watercourses that are higher than the adjacent land. As water levels in the Fens area are heavily managed by Internal Drainage Boards (IDBs), a mechanical or structural failure of engineering installations such as land drainage pumps, sluice gates, lock gates, outfall flap valves etc. or their support infrastructure (i.e. power supplies in the case of drainage pumps) could exacerbate flooding. Fluvial flooding is discussed further in Section 6.4.
- The low-lying areas in the west and south of the Borough that belong to the Fens are highly susceptible to tidal flooding. The actual tidal flood risk within the Great Ouse catchment is generally considered to be low, due to the defences in place and the standard of protection provided. Tidally influenced water levels have the potential to rise over embankments and inundate the land behind them in the Nene catchment. The greatest risk related to tidal flooding in the Borough would be if a spring tide coincided with a major storm surge event.

Tidal flood defences are essential to preventing the inundation of the Fens and with them a significant portion of the study area. Tidal flooding is discussed further in Section 6.5.

- Coastal erosion is a predominant process along Hunstanton Cliffs causing potential threats to settlements and coastal defences. The emerging **Hunstanton Coastal Management Plan** will address these issues by defining a plan to manage the coastline at a local level. The (2010) **North Norfolk Shoreline Management Plan** (SMP) covering Hunstanton to Kelling and the (2010) **The Wash SMP** covering Gibraltar Point to Old Hunstanton describe the high level strategy and coastal polices. It should be noted that the policies described in the SMPs do not always focus on the "hold the line" approach. For example, at Hunstanton Cliffs, in the short and medium term the strategy of no active intervention will be used, allowing the cliffs to erode naturally. Section 2.9 outlines the SMP strategies in the Borough and coastal flood risk is discussed further in Section 6.6.
- Watercourses in IDB districts are managed for water level and flood risk management. There are 18 IDBs which operate in the Borough of King's Lynn and West Norfolk; the IDBs are administered by four organisations: Downham Market Group of Internal Drainage Boards, Ely Group of Internal Drainage Boards, Middle Level Commissioners and Water Management Alliance. The full list of IDBs in the Borough is contained in Section 2.12.4; the coverage of IDB districts is shown in Appendix B. The IDB policy statements on flood protection and water level management have been used to determine the general standard of flood protection provided to each IDB District:
    - Downham Market Group: The policy statements for **Downham and Stow Bardolph**, **the East of Ouse, Polver and Nar**, **the Northwold**, **the Southery and District**, the **Stoke Ferry** and **Stringside** IDBs state that the board seeks to maintain a general standard of protection for agricultural land and developed areas of 1 in 20-years and 1 in 100-years respectively. The policies acknowledge that the likely return period cannot be taken literally and should be considered as a chance of some over-spilling from the system taking place each year as being 5% and 1% respectively.
    - The Ely Group of Internal Drainage Boards: The Burnt Fen **policy statement** and the Littleport and Downham **policy statement** state that, the board seeks to maintain for agricultural land and developed areas of land, a standard of protection of 1 in 20-years and 1 in 100-years respectively The policies acknowledge that the return period cannot be taken literally and should be considered as a chance of some over spilling from the system taking place each year as being 5% and 1% respectively.
    - Middle Level Commissioners: The **Churchfield and Plawfield**, **Euximoor**, **Hundred Foot Washes**, **Hundred of Wisbech**, **Manea and Welney**, **Needham and Laddus**, **Nordelph** and **Upwell** policy statements provide varying standards of protection levels and should be referred to separately.
    - Water Management Alliance: The King's Lynn IDB **policy statement** and the Norfolk Rivers IDB **policy statement** states that the Boards will seek to maintain a general standard of protection against flooding of 1 in 10-years with 600mm of freeboard to agricultural land and 1 in 100-year with 300mm freeboard to developed areas. The policy statement acknowledges that the standards cannot be taken literally and that some over-spilling from the systems may occur during these events.
- The Risk of Flooding from Surface Water (RoFfSW) dataset shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys, with some isolated ponding located in low-lying areas. The Stage 1 **King's Lynn and West Norfolk Settlements Surface Water Management Plan** (SWMP) initially addressed several localities that had suffered surface water flooding or carry a high surface water flood risk. The Stage 2 work focused on producing surface water flood risk mapping for the four highest priority areas: King's Lynn, Downham Market, Heacham and Snettisham. The SWMP identified six critical drainage catchments in King's Lynn, two critical drainage catchments at Downham Market and a critical drainage catchment at Wimbotsham, Snettisham and Heacham. Surface water flood risk is discussed further in Section 6.7.
- Groundwater plays a role in coastal erosion, as water within the rock strata can create instabilities within coastal cliffs. The Areas Susceptible to Groundwater flooding (AStGWf) dataset shows that areas more susceptible to groundwater flooding are generally

associated with the valleys of watercourses and along coastline areas. The AStGWf dataset is shown in Appendix A. Due to the characteristics or The Wash and the underlying Chalk features there is the potential for groundwater flooding. The lowest lying areas however tend to be the Fens and are highly managed, so it is reasonable to assume that the pumping infrastructure operated by the Internal Drainage Board maintains a low water table. This reduces the probability of groundwater flooding. Groundwater flooding is discussed further in Section 6.8.

- Historical incidents of flooding are detailed by Anglian Water in their sewer flooding register. This database records incidents of flooding relating to public foul, combined or surface water sewers and identifies which properties suffered flooding. A total of 118 recorded flood incidents have been identified on the sewer flooding register for the Borough of King's Lynn and West Norfolk. Flood risk from sewers is discussed further in Section 6.9.1.
- There are no records of flooding from reservoirs impacting properties inside the study area. Flood risk from reservoirs is discussed further in Section 6.9.2 and is mapped in Appendix A.
- Currently there are 14 Flood Alert Areas and 31 Flood Warning Areas (FWAs) covering the study area. Mapping showing the coverage of the Flood Alert Areas and FWAs is provided in Appendix C.
- A high-level review was undertaken to identify the main settlements where flood risks / extents are more prominent; this is shown in Table 6-6. If a settlement is not listed in this table this does not mean that the settlement is not at flood risk. The mapping provided in Appendix A can be used as a high-level screening exercise, to identify whether a location or site has a potential risk of flooding.
- The mapping of all potential sources of flooding including climate change is provided in Appendix A.

Climate change

The NPPF and accompanying Planning Practice Guidance set out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. The Environment Agency published **updated climate change guidance** on 19 February 2016 (further updated on 3 February 2017), which supports the NPPF and must now be considered in all new developments and planning applications. UK Climate Predictions are currently being updated and are due for release in late 2018. Following this, the Environment Agency guidance will be updated.

The climate change allowances used in the Strategic Flood Risk Assessment are detailed in Sections 4 and 5. Climate change modelling for watercourses and coastal areas across the combined study area was undertaken where detailed models exist and were available and supplied at the time of preparing this SFRA. Where existing detailed models were not re-run and mapped for climate change, this is documented in Appendix D. Further details and guidance for developers is contained in Section 4 and 8. The mapping of all potential sources of flooding including climate change is provided in Appendix A.

Flood defences

There are a number of Environment Agency assets throughout King's Lynn and West Norfolk Borough. The assets comprise a mixture of embankments, dunes, bridge abutments, demountable defences, walls and Flood Storage Areas. The standard of protection provided by these assets varies, as does the condition. The flood risk analysis in Section 7 indicates that much of the Borough is heavily dependent on flood defences to protect settlements from flooding, particularly from tidal / coastal sources. For example, the 2015 breach modelling of the Great Ouse shows that significant areas of the Borough of King's Lynn and West Norfolk are at risk should the defences breach.

Further information on flood defences and schemes in the Borough is provided in Section 7. Mapping showing the location, type and condition flood defences across the Borough is provided in Appendix E; this also displays the design standard of protection offered by the defences.

Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and Flood Risk Assessments (FRAs) are documented in Section 3, along with guidance for planners and developers throughout

the report. Links are provided to various relevant guidance documents and policies published by other Risk Management Authorities, such as the LLFA and the Environment Agency.

Dry Islands

Dry islands can present specific hazards, primarily the provision of safe access and egress during a flood event. The results show that there are 564 dry islands in the Borough of King's Lynn and West Norfolk. These are mainly in the southern and western areas of the Borough and a few dry islands cross administrative boundaries into neighbouring districts.

Dry islands are discussed in Section 6.10.3; this section expands further on the assumptions used to map dry islands and further considerations. Dry islands are mapped in Appendix A.

Relevant studies

There are many relevant regional and local studies which complement the SFRA and have been considered, such as the Catchment Flood Management Plan, River Basin Management Plan, the Preliminary Flood Risk Assessment, Local Flood Risk Management Strategies and SMPs. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management. Relevant policy is discussed in Section 2 and policy considerations have been referenced throughout the report.

Policy Recommendations

The following policy recommendations are to be considered by the Borough Council of King's Lynn and West Norfolk in the development of the Local Plan.

Development and planning considerations

Sequential approach to development

It is recommended that the sequential approach is adopted for all future developments within the Borough of King's Lynn and West Norfolk.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at a site.

Sequential and Exception tests

The SFRA has identified that areas of King's Lynn and West Norfolk Borough are at high risk of flooding from tidal, coastal, fluvial and surface water sources. Therefore, proposed development sites will be required to satisfy the Sequential and, where necessary, Exception Tests in accordance with the NPPF. The Borough Council of King's Lynn and West Norfolk should use the information in the 2018 SFRA when deciding which development sites to take forward in their Local Plan.

Site-specific Flood Risk Assessments

Local Planning Authorities should steer all development to Flood Zone 1 and take a sequential approach to development. If this is not possible, 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 Sequential and Exception Tests are satisfied (for windfall sites not included in the plan evidence on the Sequential Test must be submitted in FRAs).

The Flood Zones, whilst generally accurate on a large scale, are not provided for land where the catchment of the watercourse falls below 3km^2. There are a number of small watercourses and field drains which may pose a risk to development. Therefore, whilst these smaller watercourses may not be shown as having flood risk on the flood risk mapping, it does not necessarily mean that there is no flood risk. As part of a site-specific FRA the potential flood risk and extent of flood zones should be determined for these smaller watercourses. The Risk of Flooding from Surface Water map can be a useful starting point for identifying floodplains in small catchments.

Where a site-specific FRA has produced modelling outlines which differ from the EA's Flood Map for Planning (Rivers and Sea) then the model can be submitted to the EA for an Evidence Based Review.. Where the modelling and results are deemed acceptable to the EA, amendments to the Flood Map for Planning (Rivers and Sea) may take place.

Where the watercourses are embanked, the effect of overtopping and breach must be considered and appropriately assessed.

All new development within the 1% Annual Exceedance Probability (AEP) flood extent including an allowance for climate change (for the lifetime of the development) must not normally result in a net loss of flood storage capacity. Annual Exceedance Probability is the probability (expressed as a percentage) of a flood event occurring in any given year. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage. Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should normally be provided to ensure that the total volume of the floodplain storage is not reduced.

There are a number of guidance documents which provide information on the requirements for site-specific FRAs:

- **Standing Advice on Flood Risk (Environment Agency);**
- **Flood Risk Assessment for Planning Applications (Environment Agency);** and,
- **Site-specific Flood Risk Assessment: CHECKLIST (NPPG, Defra).**

The Environment Agency has also produced a guidance document called "Flood risk assessment: Climate Change allowances" which details the application of current climate change allowances and local considerations in East Anglia. This document, alongside other flood risk guidance, is available from:**https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers**.

Developers are further advised to refer to policies DM 18 and DM 21 in the **Site Allocations and Development Management Polices Plan.** This details requirements for sites located in coastal flood risk hazard zone (Hunstanton to Dersingham) as defined in the Council's Policies Map (DM 18) as well as for sites in areas at risk of flooding (DM 21). Developers should note that changes may have been made to these policies since the publication of this document and that they should seek the most up to date guidance to refer to. Developers are also advised to consult the Councils' webpage called: **"Information for planning agents"** which provides further information on flood risk and design guidance.

Developers should consult with the Borough Council of King's Lynn and West Norfolk, Norfolk County Council, the Environment Agency, Anglian Water and, where necessary, relevant IDBs at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design. If applications cross administrative boundaries, the neighbouring LLFAs, Suffolk County Council, Cambridgeshire County Council and Lincolnshire County Council may need to be approached.

Further guidance for developers can be found in Section 8.

Surface water management and SuDS

- Developers should consult Norfolk County Council's guidance for developers: Norfolk County Council, **Lead Local Flood Authority, Statutory Consultee for Planning, Guidance Document (2017).** The guidance provides information on how SuDS proposals for new developments will be considered by the LLFA, when to consult the LLFA, how to screen applications based on local flood risk and records, LLFA standing advice (for Ordinary Watercourse consenting, major development below LLFA thresholds and minor development), the levels of information required for planning applications and technical guidance. The technical guidance is split into the following themes:
    - Local flood risk guidance
    - Drainage hierarchy
    - Infiltration testing guidance
    - Runoff rates
    - Runoff volumes
    - Climate change
    - Management and maintenance
    - Flood exceedance management
- Planners should be aware of local conditions and requirements set by either the Downham Market Group of IDBs, Ely Group of IDBs, Middle Level Commissioners or the Water

Management Alliance. Further details regarding their policies for development and SuDS can be found on their websites:

- **http://www.downhammarketidbs.org.uk**
- **http://www.elydrainageboards.co.uk**
- **https://middlelevel.gov.uk/**
- **https://www.wlma.org.uk/**

- Developers who wish to have their SuDS schemes considered for adoption by Anglian Water should refer to the **Anglian Water SuDS Adoption Manual**[1]. Anglian Water also expect national guidance (i.e. **the CIRIA C753 SuDS Manual**) to be referred to in addition to Anglian Water's guidance.
- It should be demonstrated through a Surface Water Drainage Strategy, that the proposed drainage scheme, and site layout and design, will provide an appropriate standard of protection from surface water flooding to properties and critical infrastructure from flooding from surface water both on and off site. A detailed site-specific assessment of SuDS would be needed to incorporate SuDS successfully into the development proposals. All development should adopt source control SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff. The 2015 **DEFRA non-statutory technical standards for sustainable drainage systems** should be followed, alongside the LLFA guidance note and national guidance.
- For proposed developments, geotechnical investigations should be undertaken to determine whether the ground at the site has infiltration potential. This information should be representative of on-site conditions. If the ground at the site is found to have infiltration potential, detailed infiltration testing should be undertaken in line with BRE 365 to establish representative infiltration rates. The LLFA have published information relating to infiltration tests within their **guidance document.**
- A number of Groundwater Source Protection Zones have been identified throughout King's Lynn and West Norfolk Borough (see Section 9.4.1). Where sites lie within or close to aquifers (see Section 6.2), treatment steps may be required ahead of discharge to the ground, sewers etc. Development proposals at sites across the area should assess the pollution risk to receiving waterbodies and include appropriate treatment steps ahead of any discharge to surface or groundwaters. The CIRIA C753 SuDS manual provides further guidance on this issue.
- A management and maintenance plan of sustainable drainage and surface water systems covering the lifetime of the development will be required. Consideration must also be given to the residual risks associated with the use of SuDS.

Further information on surface water and SuDS is provided in Section 9.

Council review of planning applications

The Council should consult the Environment Agency's **'Flood Risk Standing Advice (FRSA) for Local Planning Authorities'**, last updated 15 April 2015, when reviewing planning applications for proposed developments at risk of flooding. The Council will consult the relevant statutory consultees as part of the planning application assessment and they should also contact non-statutory consultees (e.g. IDBs or Anglian Water) that have an interest in the planning application.

Infrastructure and safe access

Finished floor levels and safe access and egress

Finished floor level guidance has been established through consultation with the Environment Agency.

Minimum finished floor levels for development should be above whichever is higher of the following:

- a minimum of 600mm above the 1% AEP fluvial event plus an allowance for climate change.
- a minimum of 600mm above the 0.5% AEP tidal event plus an allowance for climate change.

1 At the time of preparing this SFRA, Anglian Water's current manual is expected to be revised to take account of national guidance published after the manual and Anglian Water's position regarding health and safety matters associated with open SuDS features.

- 300mm above surrounding ground levels

A 300mm freeboard is only applicable where detailed modelling is available which is deemed to be reliable. If no detailed and reliable modelling is available, the Environment Agency may require a 600mm freeboard to be applied when setting minimum finished floor levels.

There is specific design flood level guidance relating to the application and use of the Tidal Hazard Mapping Models for the River Nene and River Great Ouse (see Section 8.2.6) which considers the impact of a breach of tidal defences. Developers are advised to consult the flood design guidance relating to the application and use of this modelling on the Council webpage called: **"Information for planning agents"**.

With regards to LLFA guidance and surface water flood risk, finished floor levels are recommended to be set to a minimum of 300mm above the 1% AEP plus an allowance for climate change flood levels (including anticipated flood levels within the drainage system). If there is an uncertainty in flood levels, the freeboard level should be increased from 300mm to 600mm. The LLFA would also expect a minimum of at least 150mm freeboard between proposed external ground levels and the property finished floor level. Further information can be found in the **LLFA guidance document**.

Safe access and egress to a locally identified refuge area will need to be demonstrated at all development sites. Ideally, waterproof construction techniques used. If safe access and egress to a locally identified refuge area cannot be achieved, the **Defra/EA Technical Report: FD2320: Flood Risk Assessment Guidance for New Development** should be referred to, to determine the hazard to people posed along the access route. This can also be used to inform a Flood Warning and Evacuation Plan for the site. Emergency vehicular access should be possible during times of flood.

Resistance and resilience measures will be required if buildings are situated in the flood risk area, and as applicable in all cases of flood risk, opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought. Further information is provided in Section 8.5 and 8.6 and in the publications **"Improving the flood performance of new buildings"** and **"Prepare your property for flooding."**

Local requirements for finished floor levels should be discussed with the LPA, LLFA and EA taking into account the individual circumstances of the application.

Dry islands

It is recommended that emergency planners at the local authorities review the outputs of the 2018 SFRA and the areas identified as being located in a dry island. A site-specific Flood Risk Assessment and / or Flood Warning and Evacuation Plan may be required if a proposed development is located within a dry island (even for sites less than 1 hectare and in Flood Zone 1).

Residual risk

Residual risk is the risk that remains after mitigation measures are considered. The residual risk includes the consideration of flood events that exceed the design thresholds of the flood risk management measures or circumstances where there is a failure of defences, e.g. flood banks collapse, reservoir failure etc. The flood risk analysis in Section 7 and Appendix E demonstrates that much of the Borough is heavily dependent on flood defences to protect settlements from flooding. The Environment Agency breach model extents covering the King's Lynn and West Norfolk Borough show that residual risk from breach is significant. This risk is especially relevant in the west of the Borough and comes from both fluvial and tidal sources. Residual risks should be considered as part of site-specific Flood Risk Assessments.

Where the watercourses are embanked, the effect of overtopping and breach must be considered and appropriately assessed. There is specific guidance relating to the application and use of the Tidal Hazard Mapping Models for the River Nene and River Great Ouse (see Section 8.2.6) which considers the impact of a breach of tidal defences. Developers are advised to consult the flood design guidance relating to the application and use of this modelling on the Council webpage called: **"Information for planning agents"**.

Further, any developments located within an area protected by flood risk management measures, where the standard of protection is not of the required standard, or where the failure of the intended level of service gives rise to unsafe conditions, should be identified and appropriate responses prepared, as necessary.

Future flood management in the Borough of King's Lynn and West Norfolk

Green Infrastructure and Water Framework Directive

Developments should demonstrate opportunities to create, enhance and link green assets. Development that may adversely affect green infrastructure assets should not be permitted.

Strategic flood risk solutions

The information provided in the SFRA should be used as a basis for investigating potential strategic flood risk solutions within the Borough of King's Lynn and West Norfolk (see Section 10 for further information). Opportunities could consist of the following:

- Future improvements and maintenance of existing flood defences;
- Catchment and floodplain restoration;
- Flood storage areas;
- Opening up culverts, weir removal, and river restoration; and
- Green infrastructure.

Cross-boundary partnership working

For successful future flood risk management, it is recommended that local planning authorities adopt a partnership working approach to flood risk management and consider the cumulative impact of development within a catchment.

Use of Strategic Flood Risk Assessment data

SFRAs are high-level strategic documents and, as such, do not go into detail on an individual site-specific basis. The 2018 SFRA has been developed using the best available information, supplied at the time of preparation, taking into account the latest flood risk information and the current state of national planning policy. This relates both to the current risk of flooding from fluvial, tidal, pluvial, groundwater, sewers and reservoirs as well as the potential impacts of future climate change. It is this data that guidance singles out as the most appropriate for forward planning.

At the time of writing, this report was developed using the best available information. However, the 2018 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. The Environment Agency regularly reviews their hydrology, hydraulic modelling and flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA. The information used in this SFRA is detailed in Appendix D.

Please note that the Environment Agency are in the process of updating the River Burn model. This model is due for completion in late 2018 and developers should request the latest information from the Environment Agency.

Level 2 SFRA

A separate Level 2 SFRA has been undertaken and is available from the Borough Council. This considers the site risk at a community level in more detail and is intended to be used to apply the Sequential and Exception Tests at planning allocation stage.

Contents

List of Figures

List of Tables

Using this document

Hyperlinks

Hyperlinks have been provided where there are useful reference points. These are shown as **red bold text.**

Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
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
BFAP	Broadland Flood Alleviation Project
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CDA	Critical Drainage Area - A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, Main River and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
CFMP	Catchment Flood Management Plan- A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association
Cumecs	The cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second; also m^3/s.
Defra	Department for Environment, Food and Rural Affairs
Designated Feature	A form of legal protection or status reserved for certain key structures or features that are privately owned and maintained, but which make a contribution to the flood or coastal erosion risk management of people and property at a particular location.
Design flood	This is a flood event of a given annual flood probability, which is generally taken as: • fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or; • tidal flooding with a 0.5% annual probability (1 in 200 chance each year), against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.
DTM	Digital Terrain Model
EA	Environment Agency
ESWSL	An ESWSL is the level the sea is expected to reach during a storm event for a particular magnitude of flood event as a result of the combination of astronomical tides and meteorological surges.
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.
FCERM	Flood and Coastal Erosion Risk Management
FCERMGiA	Defra's Flood and Coastal Erosion Risk Management Grant in Aid
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).

Flood Risk Regulations	Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Flood 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.
FWA	Flood Warning Area
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a Main 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
FRMP	Flood Risk Management Plan
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
FWS	Flood Warning Service
GI	Green Infrastructure – a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and urban fringe
Greenfield	Undeveloped parcel of land
Ha	Hectare
IDB	Internal Drainage Board
Indicative Flood Risk Area	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG.
JBA	Jeremy Benn Associates
LFRMS	Local Food Risk Management Strategy
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
mAOD	metres Above Ordnance Datum
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
NRD	National Receptor Database
NRIM	National Reservoir Inundation Mapping
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.
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
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.
PPS25	Planning Policy Statement 25: Development and Flood Risk – superseded by the NPPF and NPPG
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	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
SMP	Shoreline Management Plan
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection.
SPD	Supplementary Planning Document
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 Consortium of Norfolk authorities Strategic Flood Risk Assessments

Norfolk Local Planning Authorities (LPAs) have a long track record of cooperation and are working together on strategic cross-boundary planning issues, through the Norfolk Strategic Framework. One of the aims of the framework is to inform the preparation of future Local Plans, through shared objectives and strategic priorities.

Strategic Flood Risk Assessments (SFRAs) form part of the evidence base of the Local Plan. A revised version of the NPPF was published on 24 July 2018 and sets out Government's planning policies for England and how these are expected to be applied. This revised Framework replaces the previous NPPF published in March 2012. The requirement for the preparation of SFRAs in Section 14 Paragraph 156 of the **National Planning Policy Framework (NPPF):**

> ***"...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, paragraph 156)

The NPPF also requires that Local Plans are based on adequate, up-to-date and relevant data and evidence; since the publication of the previous SFRAs, flood risk datasets and information has developed and planning and flood risk related policy and guidance has been updated.

A flow chart diagram illustrating **how flood risk information should be taken into account in the preparation of a Local Plan** is shown on the National Planning Practice Guidance (NPPG) website and is replicated in Figure 3-1.

A consortium of Norfolk LPAs, comprising Broadland District Council, Great Yarmouth Borough Council, the Borough Council of King's Lynn and West Norfolk, North Norfolk District Council, Norwich City Council, South Norfolk Council and the Broads Authority, have commissioned new Level 1 SFRAs to inform strategic planning decisions, the preparation of Local Plans and to inform development management decisions. These councils are local planning authorities for their respective administrative areas, with the exception of the Broads Executive Area, where the Broads Authority is the Local Planning Authority.

The new Level 1 SFRAs are split into the following four reports:

- 2017 Greater Norwich Area SFRA covering the Norwich City Council, Broadland District Council, South Norfolk Council and parts of the Broads Authority administrative areas
- 2017 North Norfolk SFRA covering the North Norfolk District Council and parts of the Broads Authority administrative areas
- 2017 Great Yarmouth SFRA covering the Great Yarmouth Borough Council and parts of the Broads Authority administrative areas
- 2018 King's Lynn and West Norfolk SFRA covering the Borough Council of King's Lynn and West Norfolk

Within this 2018 SFRA report, when reference is made to the '*combined study area*', this is the whole area covered by the four reports listed above. The combined study area is shown in Figure 1-1.

1.2 Purpose of the Strategic Flood Risk Assessment

The 2018 SFRA document replaces the previous King's Lynn and West Norfolk SFRA originally published in 2008. The main purpose of the 2018 SFRA is to inform the selection of options for the Local Plan allocations and support determination of planning applications for King's Lynn and West Norfolk Borough. The SFRA study area is shown in Figure 1-2.

The key objectives of the 2018 SFRA are:

- To provide up to date information and guidance on flood risk for King's Lynn and West Norfolk Borough, taking into account the latest flood risk information and the current state of national planning policy;
- To determine the variations in risk from all sources of flooding in King's Lynn and West Norfolk Borough, taking into account climate change;
- To identify the requirements for site-specific flood risk assessments;
- To consider opportunities to reduce flood risk to existing communities and developments;
- To enable the Borough Council of King's Lynn and West Norfolk to apply the Sequential Test;
- To aid the Borough Council of King's Lynn and West Norfolk in identifying when the Exception Test is required and when a more detailed Level 2 SFRA will be required, when determining strategic site allocations; and,
- To inform the Sustainability Appraisal of the Borough Council of King's Lynn and West Norfolk Local Plan, so that flood risk is taken into account when considering strategic site allocations.

1.3 Levels of SFRA

The NPPG advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

1. Level One: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
2. Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's 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 Level One SFRA requirements. A separate Level 2 SFRA is available for the Borough.

1.4 SFRA outputs

To meet the objectives, the following outputs have been prepared:

- Assessment of all potential sources of flooding;
- Assessment of the potential impact of climate change on flood risk;
- Mapping of all potential sources of flooding including climate change;
- Mapping of location and extent of functional floodplain;
- Mapping of "dry islands";
- Assessment of standard of protection provided by existing flood risk management infrastructure;
- Mapping of areas covered by Environment Agency Flood Warnings;
- Review of opportunities to reduce flood risk to existing communities and development;
- Guidance for developers including requirements for site-specific flood risk assessments and general advice on the requirements and issues associated with Sustainable Drainage Systems (SuDS); and,
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.

1.5 SFRA user guide

Table 1-1: User guide

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.
2. The Planning Framework and Flood Risk strategic documents	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.
3. The sequential, risk-based approach	Describes the Sequential Approach and application of Sequential and Exception Tests.
4. Climate change	Outlines climate change guidance and the implications for the Borough of King's Lynn and West Norfolk.
5. Sources of information used in preparing the SFRA	Outlines what information has been used in the preparation of the SFRA.
6. Understanding flood risk in the Borough of King's Lynn and West Norfolk	Gives an introduction to the assessment of flood risk and provides an overview of the characteristics of flooding affecting the study area. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered.
7. Fluvial and coastal defences	Assessment of residual risk from flood defences, including future protection from climate change.
8. FRA requirements and flood risk management guidance	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Provides guidance for developers and outlines conditions set by the EA and LLFAs that should be followed.
9. Surface water management and SuDS	Advice on managing surface water run-off and flooding.
10. Strategic flood risk solutions	Summary of strategic options that can be considered by commissioning authorities and their partners, to avoid, control, mitigate and / or reduce flood risk in the Borough of King's Lynn and West Norfolk.
11. Summary	Summary of SFRA findings.
12. Recommendations	Summary of recommendations.
Appendix A: **Mapping of all sources of flood risk across the Borough of King's Lynn and West Norfolk**	Interactive GeoPDF mapping of flood risk from all sources including the functional floodplain (Flood Zone 3b) and climate change mapping, to the Borough of King's Lynn and West Norfolk. Historic flood events are not mapped.
Appendix B: **Watercourses across the Borough of King's Lynn and West Norfolk and coverage of IDB districts**	Maps showing the location of watercourses in the Borough of King's Lynn and West Norfolk including Main Rivers, Ordinary Watercourses and IDB districts.
Appendix C: **Flood Alert and Flood Warning coverage across the Borough of King's Lynn and West Norfolk**	Maps showing the extent of the Environment Agency's Flood Warning Service.

Section	Contents
Appendix D: Technical Summary	A technical summary, providing supporting information on the methodology used in this SFRA. A map showing those watercourses with detailed hydraulic models across the combined study area. A table which lists all detailed hydraulic models supplied for use in this commission and covers the combined study area. This table identifies those models which have been used to inform Flood Zone 3b and the climate change extents across the combined study area; the models listed in this table are those available at the time of preparing this report and supplied for use in this commission.
Appendix E: Defences	Maps showing the location, type, condition and standard of protection offered by flood defences in King's Lynn and West Norfolk Borough.

1.6 Consultation

The following parties (external to the Borough Council of King's Lynn and West Norfolk) have been consulted during the preparation of this version of the SFRA:

- Environment Agency
- Norfolk County Council (as Lead Local Flood Authority [LLFA] and as Highways Authority)
- Anglian Water
- Highways England
- Internal Drainage Boards (IDBs)
- Neighbouring authorities and LLFAs

1.7 Use of SFRA data

1.7.1 SFRA information and updates

It is important to recognise that SFRAs are high-level strategic documents and, as such, do not go into detail on an individual site-specific basis. The SFRA has been developed using the best available information at the time of preparation, taking into account the latest flood risk data and the current state of national planning policy. This relates both to the current risk of flooding from fluvial, tidal, pluvial, groundwater, sewers and reservoirs as well as the potential impacts of future climate change. It is this data that guidance identifies as being most influential for forward planning.

The accompanying SFRA appendices comprise:

- Appendix A: Mapping of all sources of flood risk across the Borough of King's Lynn and West Norfolk
- Appendix B: Watercourses in the Borough of King's Lynn and West Norfolk and coverage of IDB districts
- Appendix C: Flood Alert and Flood Warning coverage across the Borough of King's Lynn and West Norfolk
- Appendix D: Technical Summary including a list of all detailed models used in the 2018 SFRA and a map showing the coverage of these models
- Appendix E: Mapping showing the location, type and condition flood defences across the Borough of King's Lynn and West Norfolk, as well as the design standard of protection offered by the defences

The SFRA appendices are published separately to the main SFRA report.

Appendix A is presented in interactive GeoPDFs. An accompanying User Guide is provided with the GeoPDFs which provides step-by step instructions on how to navigate to data and how to use the GeoPDFs.

The datasets shown in GeoPDFs have not been trimmed to the individual SFRA study area; there is some overlap into neighbouring authority areas. This approach was agreed with the commissioning authorities in order to highlight that flood risks cross administrative boundaries and to reinforce the need for continuous partnership working with the consortium of Norfolk LPAs and their partners. It should also be noted that some datasets were supplied showing information clipped to Norfolk County Council's administrative boundary.

The GeoPDFs can be used to perform high-level screening exercises, to identify whether a location or site has a potential risk of flooding. The GeoPDFs show flood extent information and do not show flood levels, depths, velocities or hazard to people information. If flood level, depth, velocity and hazard to people information is required, this should be addressed as part of a Level 2 SFRA and / or as part of a site-specific Flood Risk Assessment.

The GeoPDFs are subject to the limitations of the flood risk datasets, for example:

- The Flood Zones, whilst generally accurate on a large scale, are not provided for land where the catchment of the watercourse falls below 3km^2. As such, whilst a location can be shown to be outside of Flood Zones 2 and 3, this does not necessarily mean that it is not at risk of fluvial flooding, as the lack of flood extent is due to a lack of data rather than indicating there is no risk.
- In certain areas, hydraulic models are in the process of being updated at the time of preparing the 2018 SFRA. It is important that this 2018 SFRA and appendices are read in conjunction with the Technical Summary provided in Appendix D. The Technical Summary provides further information on the hydraulic modelling and mapping approaches used in the 2018 SFRA.

The SFRA is a tool for refining information on river and sea flooding risk shown on the Environment Agency flood maps. The Environment Agency's Flood Zones, on their Flood Map for Planning website, may differ to the maps in the SFRA for a short period of time. The modelled fluvial and tidal flood risk datasets shown in the 2018 SFRA and Appendix A, will be incorporated into the Environment Agency's flood maps in due course.

At the time of writing, this report was developed using the best available information. However, this 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 the commissioning local planning authorities, Norfolk County Council (including as Highways Authority), Highways England, IDBs, Anglian Water and the Environment Agency. Such information may be in the form of:

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

The Environment Agency regularly reviews their hydrology, hydraulic modelling and flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA.

The 2018 SFRA was commissioned by a consortium of Norfolk authorities and was produced in conjunction with the LLFA and Environment Agency. The assistance of these organisations and external stakeholders including IDBs, Anglian Water and planners at the neighbouring authorities and LLFAs, is acknowledged.

Figure 1-1: Combined study area

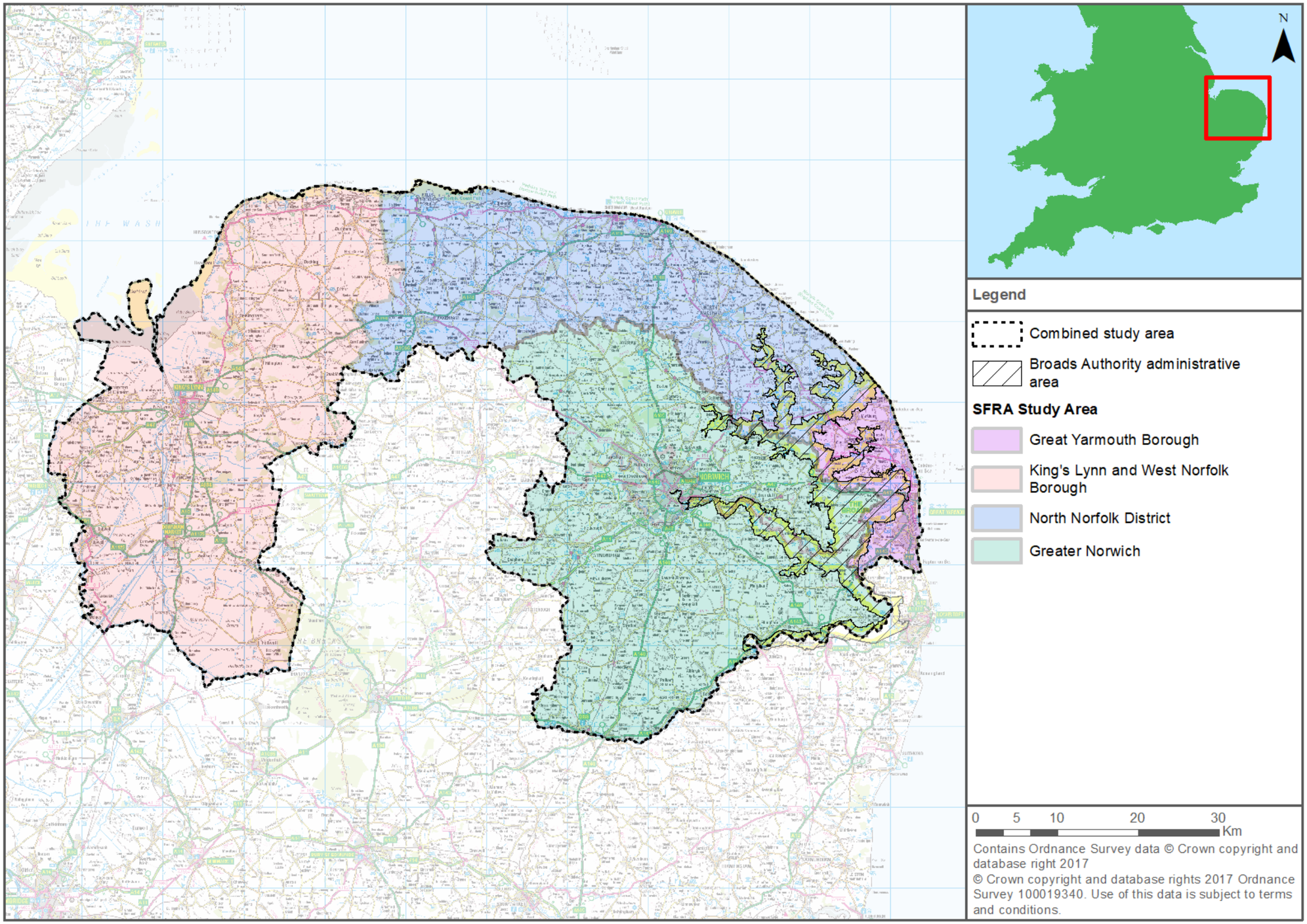
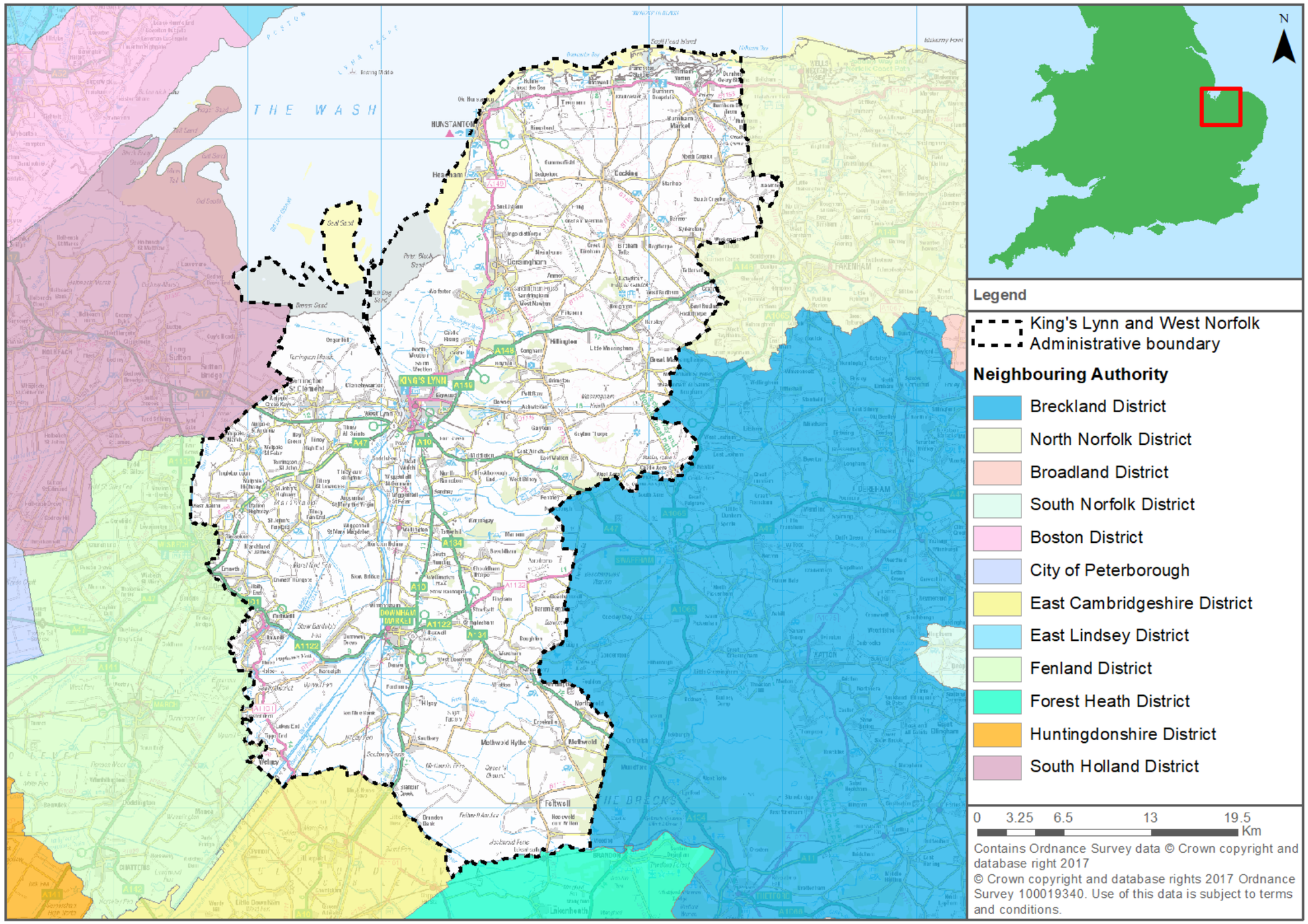


Figure 1-2: Study area



2 The Planning Framework and Flood Risk strategic documents

2.1 Introduction

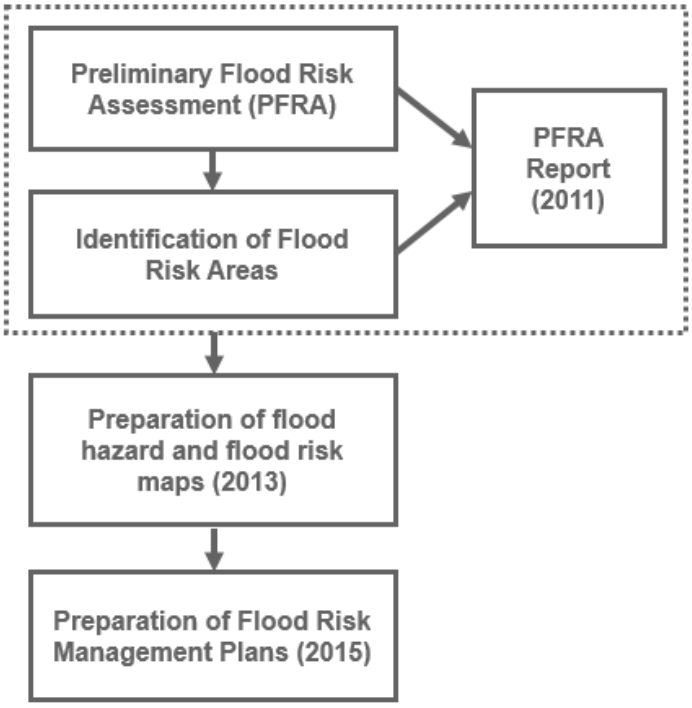
The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the SFRA provides an overview of the planning framework, flood risk policy and strategic documents and flood risk responsibilities.

2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

The Flood Risk Regulations (2009) translate the current EU Floods Directive into UK law and place responsibility upon all LLFAs to manage localised flood risk. Under the Regulations, the responsibility for flooding from rivers, the sea and reservoirs lies with the Environment Agency; however, responsibility for local and all other sources of flooding rests with LLFAs. In the instance of this SFRA, the LLFA is Norfolk County Council. Details on the responsibilities of LLFAs are provided in Section 2.12.2.

Figure 2-1 illustrates the steps taken to implement the requirements of the EU Directive in the UK via the Flood Risk Regulations.

Figure 2-1: Flood Risk Regulation Requirements



The next cycle of the Flood Risk Regulations has now begun (2015 – 2021). Norfolk County Council updated their **PFRA** in 2017. There are no Flood Risk Areas for flooding from surface water, groundwater and ordinary watercourses in this Borough. The Environment Agency are currently preparing a national PFRA for river, sea and reservoir flooding and identifying Flood Risk Areas for these sources. This will be published by December 2018.

2.2.1 Flood Risk Management Plans (FRMPs)

Under the Regulations the Environment Agency exercised an 'Exception' during the initial round of assessment and did not prepare a PFRA for risk from rivers, reservoirs and the sea. Instead they prepared and published a FRMP to meet the requirements of the Regulations. The FRMP summarises the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations. The **Anglian River Basin District Flood Risk Management Plan** (FRMP) was issued in March 2016 and covers the period of 2015 to 2021. The FRMP draws on policies and actions identified in Catchment Flood Management Plans (section 2.7)

and also incorporates information from Local Flood Risk Management Strategies (Section 2.2.3). The Plan will be updated as part of the new cycle of the Flood Risk Regulations and is due to be published in December 2021.

2.2.2 Flood and Water Management Act (FWMA), 2010

Following the 2007 floods, Sir Michael Pitt was appointed to chair an independent review into the floods. The **final report** was published in June 2008. The **Flood and Water Management Act** (2010) implements some of Sir Michael Pitt's recommendations and aims to create a simpler and more effective means of managing both flood risk and coastal erosion.

The FWMA helped to establish Lead Local Flood Authorities (LLFAs). Norfolk County Council is the LLFA for the Borough of King's Lynn and West Norfolk. Further information on the LLFA role and responsibilities are provided in Section 2.12.2.

2.2.3 Norfolk Local Flood Risk Management Strategy (LFRMS) (2015)

Norfolk County Council is responsible for developing maintaining, applying and monitoring a **Local Flood Risk Management Strategy** (LFRMS) for Norfolk, which includes the Borough of King's Lynn and West Norfolk. The Strategy is used as a means by which the LLFA co-ordinates Flood Risk Management on a day to day basis. The Strategy also sets measures to manage local flood risk i.e. flood risk from surface water, groundwater and Ordinary Watercourses.

The aim of the Norfolk LFRMS is:

To work with organisations, businesses and communities to manage flood risk and, where it is practicable, affordable and sustainable to do so, to reduce risk to life, property and livelihoods that may arise from local surface runoff, Ordinary Watercourse and groundwater flooding.

The LFRMS will seek to implement the following strategic objectives:

- **Objective 1**: Determine and communicate Local Flood Risk
- **Objective 2**: Partnership Working
- **Objective 3**: Partnership Programmes and Projects
- **Objective 4**: Riparian Responsibilities
- **Objective 5:** Flood Risk and Development
- **Objective 6**: Water Framework Directive
- **Objective 7:** Support Water and Sewerage Company infrastructure

Norfolk County Council have advised that LFRMS policies UC10 (Planning) and UC11 (Securing Sustainable Drainage (SuDS)) apply to the SFRA study area.

2.2.4 The National Flood and Coastal Erosion Risk Management Strategy for England (2011)

The **National Flood and Coastal Erosion Risk Management Strategy** for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. It was prepared by the Environment Agency with input from Defra.

The Strategy builds on existing approaches to flood and coastal risk management and promotes the use of a wide range of measures to manage risk. It describes how risk should be managed in a co-ordinated way within catchments and along the coast and balance the needs of communities, the economy and the environment.

The strategy encourages more effective risk management by enabling people, communities, business, infrastructure operators and the public sector to work together to:

- ensure a clear understanding of the risks of flooding and coastal erosion, nationally and locally, so that investment in risk management can be prioritised more effectively;
- set out clear and consistent plans for risk management so that communities and businesses can make informed decisions about the management of the remaining risk;
- manage flood and coastal erosion risks in an appropriate way, taking account of the needs of communities and the environment;
- ensure that emergency plans and responses to flood incidents are effective and that communities are able to respond effectively to flood forecasts, warnings and advice;
- help communities to recover more quickly and effectively after incidents.

The Strategy is currently being updated and will be published in 2019.

2.3 National Planning Policy and Guidance

The **National Planning Policy Framework** (NPPF) was published in July 2018, replacing the previous version published in March 2012. The NPPF sets out Government's planning policies for England and how these are expected to be applied. The Framework is based on core principles of sustainability and forms the national policy framework in England. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions.

The NPPF sets out the Government's requirements for the planning system and provides a framework within which local people and councils can produce distinctive local and neighbourhood plans to reflect the needs and properties of their communities. The NPPF must be taken into account by local planning authorities when preparing Local Plans and for applicants preparing planning submissions.

The key changes in the revised NPPF compared to the 2012 NPPF include:

- Strategic policies should also now consider the 'cumulative impacts in, or affecting, local areas susceptible to flooding' (para 156), rather than just to or from individual development sites;
- Future risk from climate change. The 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158);
- Natural Flood Management. 'Using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques)' (para 157c);
- SuDS. 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165); and
- Emergency planning. Emergency plans are required as part of an FRA that includes the inclusion of safe access and egress routes to a locally identified refuge area (para 163e).

National Planning Practice Guidance (NPPG) was published in 2014 and sets out how the NPPF should be implemented. This will be updated in due course to reflect the changes to the NPPF. **NPPG: Flood Risk and Coastal Change** advises on how planning can account for the risks associated with flooding and coastal change in plan making and the application process. It sets out Flood Zones, the appropriate land uses for each Zone, flood risk assessment requirements, including the Sequential and Exception Tests and the policy aims for developers and authorities regarding each Flood Zone. Further details on Flood Zones and associated policy is provided in Table 3-1 and throughout this report. The Sequential and Exception tests are covered in greater detail in Sections 3.2 to 3.3.

The Sequential Test

"The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. The flood zones, as refined in the Strategic Flood Risk Assessment for the area, provide the basis for applying the Test. The aim is to steer new development to Flood Zone 1 (areas with a low probability of river or sea flooding). Where there are no reasonably available sites in Flood Zone 1, local planning authorities in their decision making should take into account the flood risk vulnerability of land uses and consider reasonably available sites in Flood Zone 2 (areas with a medium probability of river or sea flooding), applying the Exception Test if required. Only where there are no reasonably available sites in Flood Zones 1 or 2 should the suitability of sites in Flood Zone 3 (areas with a high probability of river or sea flooding) be considered, taking into account the flood risk vulnerability of land uses and applying the Exception Test if required".

(National Planning Practice Guidance, paragraph 019)

The Exception Test

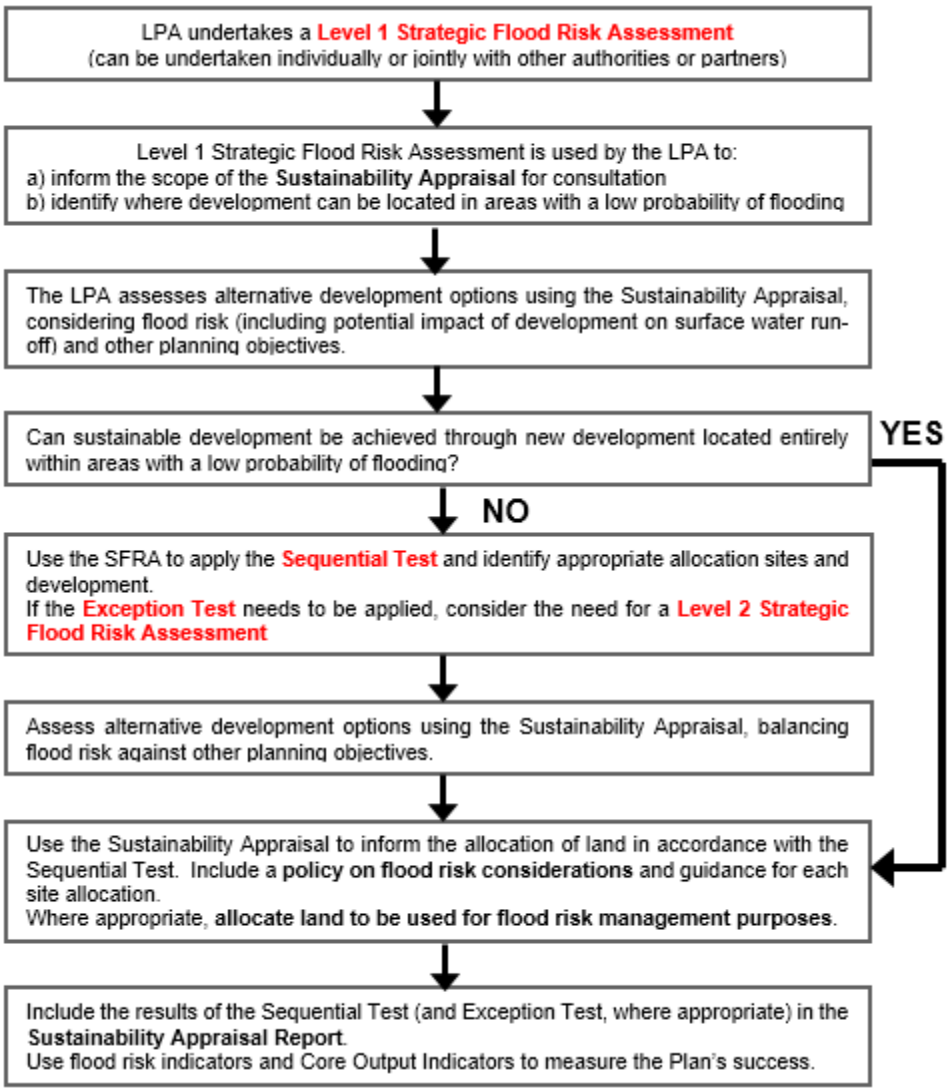
"The Exception Test, as set out in paragraph 102 of the NPPF, is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

Essentially, the two parts to the Test require proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.".

(National Planning Practice Guidance, paragraph 023)

A description of how flood risk should be taken into account in the preparation of Local Plans is outlined in Diagram 1 contained within the Planning Practice Guidance (Figure 2-2).

Figure 2-2: Flood Risk and the preparation of Local Plans†



† Diagram 1 of NPPG: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-005-20140306) March 2014

2.4 Local Policy

The King's Lynn and West Norfolk currently adopted Local Plan is formed of a number of documents including the Core Strategy (adopted 2011), Site Allocations and Development Management Plan (SADMP) and neighbourhood plans.

2.4.1 King's Lynn and West Norfolk Local Development Framework – Core Strategy (2011)

The King's Lynn and West Norfolk **Core Strategy** forms part of the Local Plan. Its aim is guide development and use of the land up to 2025, steer and shape new development and set out long term plans for the Borough. The Core Strategy identifies that whilst much of the Borough benefits from defences, flood risk remains a key issue in relation to planning and development control. The Core Strategy notes that new development therefore needs to be carefully considered where Shoreline Management Plans and the SFRAs highlight areas at risk of flooding. The Spatial Strategy was used to inform the Core Strategy and a number of policies relating to flood risk and development.

2.4.2 King's Lynn and West Norfolk Local Plan – Site Allocations and Development Management Policies Plan (2016)

The King's Lynn and West Norfolk Local Plan - Site Allocations & Development Management Policies (SADMP) Plan was adopted on 29 September 2016. The SADMP sets out the land allocations and development management policies until 31st March 2026. A summary of relevant guidance relating to flood risk and development are outlined below.

- DM18 - Coastal Flood Risk Hazard Zone (Hunstanton to Dersingham)

  The Wash Shoreline Management Plan (SMP) identified uncertainties over the future management of the defences between Hunstanton and Wolferton Creek (west of Dersingham) beyond 2025. Following the SMP, the Environment Agency and the King's Lynn and West Norfolk Borough Council introduced a Coastal Flood Risk – Planning Protocol for the area. The guidance informs those who are submitting planning applications in the area reliant on these defences, about the predicted increase in flood risk. The aim of the guidance is to prevent inappropriate development in this area. The guidance is incorporated in the Local Plan Policy as the 'Coastal Hazard Zone'. Policy DM18 specifically provides guidance for developers on development (including replacement dwellings, extensions and change of use applications) located in the 'Coastal Flood Risk Hazard Zone', as defined in the Councils Policies Map.

- DM21 - Sites in Areas of Flood Risk

  This policy provides requirements for King's Lynn and West Norfolk allocated sites in either Flood Zones 2 and 3, flood defence breach Hazard Zones or more recent Environment Agency mapping.

- Developers should note that changes may have been made to these policies since the publication of this document and that they should seek the most up to date guidance to refer to.

2.5 Planning, surface water and SuDS

The updated NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165). When considering major planning applications, LPAs should consult the LLFA on the management of surface water in order to satisfy that:

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

Norfolk County Council has published a guidance document regarding their Lead Local Flood Authority role as Statutory Consultee to Planning (2017). In this **document**, there are thresholds where the LLFA will provide bespoke advice; the thresholds are

- Residential development with greater than or equal to 100 properties.
- All developments with an area greater than or equal to 2 hectares.

The guidance document notes that these thresholds are periodically reviewed and thus these are subject to change.

In addition, the LLFA will aim to provide bespoke consultation responses for the following application types:

- *"All residential development applications where the number of units is greater than or equal to the LLFA threshold. This would include individual applications of a multi-phased development that in total would be equivalent to or greater than the LLFA threshold.*
- *All other development applications with an area greater than or equal to the LLFA threshold.*
- *Any major development applications that have a local flood risk and are on an obvious flow route or include extensive surface water or fluvial flooding on the site. Significant ponding of surface water over a large proportion of the site boundary also falls within this category.*
- *Sites adjacent to, or within, areas with records of local flooding (as evidenced and provided by the LLFA)."*

LLFA standing advice is provided in this document for major developments which fall below the LLFA thresholds and for minor development. Further information on this document can be found in Section 2.5.2. The guidance document has also been referred to through Sections 8 and 9.

2.5.1 Defra Non-Statutory Technical Standards for SuDS

On March 23 2015, the Department for Environment, Food and Rural Affairs (Defra) published the **Non-Statutory Technical Standards for SuDS**. The standards should be used in conjunction with the NPPF and NPPG. These standards cover the following

- Flood risk outside the development
- Peak flow control
- Volume control
- Flood risk within the development
- Structural integrity
- Designing for maintenance considerations
- Construction

2.5.2 Guidance on Norfolk County Council's Lead Local Flood Authority role as Statutory Consultee to Planning (2017)

This **document** was published to support the development of Norfolk County Council's (NCC's) Lead Local Flood Authority (LLFA) role as a statutory consultee to planning and to inform stakeholders in this process such as LPAs and developers. The document is split into three parts and aims to:

Part A

- Highlight recent changes in planning policy with regard to surface water drainage.
- Explain the role of the LPA in determining Sustainable Drainage Systems (SuDS) proposals on new developments.
- Outline Norfolk County Council's LLFA role as a statutory consultee to planning.

Part B

- Explain how the LLFA will fulfil this function and when it should be consulted.

Part C

- Provide guidance for developers on the information required by the LLFA from applicants to enable it to provide responses to major planning applications.

2.5.3 C753 CIRIA SuDS Manual (2015)

The **C753 CIRIA SuDS Manual** (2015) replaces and updates the previous version (C697) providing up to date guidance on planning, design, construction and maintenance of SuDS. The document is designed to help the implementation of these features into new and existing developments, whilst maximising the key benefits regarding flood risk and water quality. 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. It is recommended that developers and the Borough Council of King's Lynn and West Norfolk utilise the information within the manual to help design SuDS which are appropriate for a development.

2.5.4 Anglian Water SuDS Handbook

The **Anglian Water Handbook** provides advice to applicants when they are considering applying to Anglian Water to adopt SuDS features.

2.6 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in a particular area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

2.6.1 King's Lynn and West Norfolk settlement Surface Water Management Plan: Stage 1 (2010), Stage 2 (2012) and King's Lynn Ordinary Watercourses Study – Technical Note (2015)

Stage 1 of the **King's Lynn and West Norfolk settlement SWMP** involved assembling a steering group, data collection and engagement with local resilience groups, parishes and councillors.

The SWMP initially identified several areas which are most at risk of surface water flooding. These included:

- Burnham Market
- North Creake
- South Creake
- East Rudham
- Hunstanton
- Heacham
- Snettisham
- Dersingham
- King's Lynn
- Gayton
- Terrington St Clement
- Shouldham
- Wimbotsham
- Downham Market
- Southery
- Feltwell

Phase 2 involved identifying areas which would benefit from surface water modelling. These were identified to be King's Lynn, Downham Market, Heacham and Snettisham. Direct rainfall modelling was undertaken for these locations to indicate where surface water flooding is likely to occur. Other sources of flood risk were also considered. The predicated consequences of flooding to property, businesses and infrastructure were analysed to identify those areas at more significant risk which were categorised as Local Flood Risk Zones (LFRZs). It was recommended that based on the LFRZs, and further flood risk reporting, the Council may wish to identify Critical Drainage Areas (CDAs). CDAs are discussed further in Section 6.7. The Borough Council and partner organisations are currently considering whether the SWMPs require an update and should be contacted for the latest available information.

The Ordinary Watercourse Study Technical Note addressed the constraints of the SWMP which did not specifically cover the flood risk associated with ordinary watercourses and their interaction with surface water flooding. Critical Drainage Catchments (CDCs) were identified based on the baseline results. Twelve CDCs were identified in the Kings Lynn area. Actions were identified to reduce flood risk within the CDCs which are:

- 'As part of highways improvement programme include an additional construction task of installing additional gullies or alternative drainage systems to reduce standing water depth and duration.

- Include at least one 'at source' SuDS measure to all proposed developments across the catchment. Kings Lynn Ordinary Watercourses Study October 2015 Commercial in Confidence 22
- Proposed 'brownfield' redevelopments are required to reduce post-development runoff rates for events up to and including the 1 in 100 year return period event with an allowance for climate change. (Refer to Action Plan in Appendix E for more information).
- Focus attention on the maintenance of gully pots in the CDCs which are considered to be high risk'.

2.7 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are a high-level strategic plan providing an overview of flood risk across each river catchment. The Environment Agency use CFMPs to work with other key-decision makers to identify and agree long-term policies for sustainable flood risk management.

There are six pre-defined national policies provided in the CFMP guidance and these are applied to specific locations through the identification of 'Policy Units'. These policies are intended to cover the full range of long-term flood risk management options that can be applied to different locations in the catchment.

The six national policies are:

1. No active intervention (including flood warning and maintenance). Continue to monitor and advise.
2. Reducing existing flood risk management actions (accepting that flood risk will increase over time).
3. Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
4. Take further action to sustain the current level of flood risk (responding to the potential increases in risk from urban development, land use change and climate change).
5. Take action to reduce flood risk (now and/or in the future).
6. Take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

2.7.1 Great Ouse CFMP (2011)

The majority of the Borough of King's Lynn and West Norfolk lies within the **Great Ouse CFMP**. The following polices apply to the Borough of King's Lynn and West Norfolk:

- **Policy 3 - Bedford Ouse Rural and Eastern Rivers.** Areas of low to moderate flood risk where existing flood risk is generally managed effectively.
- **Policy 4 – The Fens and King's Lynn/South Wootton**. Areas of low, moderate or high flood risk where existing flood risk is generally managed effectively but where further actions need to be taken, to keep pace with climate change.

2.7.2 Broadland Rivers CFMP (2009)

The study area is also partially covered by the **Broadland Rivers CFMP**. The following polices apply to the Borough of King's Lynn and West Norfolk:

- **Policy 2 – Fluvial rivers.** 'Areas of low to moderate flood risk where we can generally reduce existing flood risk management actions'.

2.7.3 North Norfolk CFMP (2009)

In addition, the study area is also partially covered by the **North Norfolk CFMP**. The following polices apply to the Borough of King's Lynn and West Norfolk:

- **Policy 2 – Rural areas and North Norfolk Coast.** 'Areas of low to moderate flood risk where we can generally reduce existing flood risk management actions'.

2.7.4 River Nene CFMP (2009)

The study area is also partially covered by the **River Nene CFMP**. The following policies apply to the Borough of King's Lynn and West Norfolk:

- **Policy 4 – The Fens.** Areas of low, moderate or high flood risk where existing flood risk is generally managed effectively but where further actions need to be taken, to keep pace with climate change.

The CFMPs provide specific 'actions' for flood risk management for each sub area. The 2018 SFRA will help support the above policies in the CFMPs by aiding the Borough Council of King's Lynn and West Norfolk, to make informed decisions about the location of future development, as well as identifying where future flood risk management measures may be required.

2.8 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assess the pressure facing the water environment in River Basin Districts. The Borough of King's Lynn and West Norfolk falls within the Anglian River Basin District.

The updated 2015 **Anglian RBMP** identified a number of pressures on the water environment and significant water management issues.

The RBMP describes how development and land-use planning needs to consider a number of issues relevant to the RBMP including sustainable drainage systems, green and blue infrastructure, sewage treatment options (tertiary phosphate treatments), water efficiency measures, infrastructure and development locations and the reduction of nutrients from diffuse pollution. The RBMP provides a summary of measures to protect and improve the water environment in the river basin district. One action relevant to flood risk is the need to renaturalise heavily modified watercourses, to restore natural floodplains, remove obstructions and slow down the rate of flow. Further information on renaturalisation is provided in Section 10.3.4.

2.9 Shoreline Management Plans

Shoreline Management Plans (SMP) form part of Defra's strategy for flood and coastal defence. They provide a large-scale assessment of risks associated with coastal evolution and present the policy framework to address these risks in a sustainable manner. The SMP policies defined by Defra are:

- **Hold the line** – maintain or upgrade the level of protection provided by defences.
- **Advance the line** – build new defences seaward of the existing defence line.
- **Managed realignment** – allowing retreat of the shoreline, with management to control or limit the movement.
- **No active intervention** – a decision not to invest in providing or maintaining defences.

The Borough of King's Lynn and West Norfolk coastline is covered by:

SMP 4: Gibraltar Point to Old Hunstanton (2010) and **SMP 5: Hunstanton to Kelling Hard (2010).** The policies within the SMPs are summarised below:

- **Gibraltar Point to Wolferton Creek** – The short-term policy is to hold the line. In the long term the ideal policy is to hold the line however uncertainties in relation to the consequences of climate change and sea level rise mean this may not be practicable. In which case an alternative would be localised landward realignment.
- **Wolferton Creek to South Hunstanton** – The short-term policy is to hold the line. In the long term a mixture of measures will be utilised to manage the risk including holding the line, managed realignment, incident management and land use adaptation.
- **Hunstanton Town** – As continued protection against erosion of the Hunstanton seafront is needed to support the town's role as a regional centre and tourist destination the long-term policy here is to hold the line.
- **Hunstanton Cliffs –** In the short and medium term the strategy of no active intervention will be used allowing the cliffs to erode naturally. Meanwhile, in the long term as a lighthouse and other historic or recreational features come to be threatened, hold the line options may be explored.

- **Old Hunstanton dunes** – The long-term plan is to allow the dunes to evolve naturally but if their flood defence function reduces, work to restore it.
- **Holme dunes -** The long-term plan is to allow the dunes to evolve naturally but if their flood defence function reduces, work to restore it.
- **Thornham sea bank** – The long-term plan it to hold the line unless increased knowledge results in a preference to realign and move the defensive line further inland.
- **Thornham** – The long-term plan is to take no active intervention other than to sustain the sea path.
- **Thornham to Titchwell –** The long-term plan is for no active intervention and to continue to allow the frontage to develop naturally.
- **Titchwell RSPB reserve** – The long-term plan is to continue to allow the private owner to maintain the defences.
- **Titchwell village** - The long-term plan is for no active intervention and to continue to allow the frontage to develop naturally.
- **Reclaimed grazing marsh at Brancaster** – Although the current strategy is to hold the line the long-term strategy may be to either hold the line or managed realignment depending on the results of monitoring and research.
- **Royal West Norfolk golf club** – The long-term plan is to continue to allow the private owner to maintain the defences while leaving the currently undefended dunes undefended.
- **Brancaster and Brancaster Staithe** - The long-term plan is to continue to allow private owners to maintain their defences.
- **Reclaimed areas behind Scolt Head Island and Deepdale and Norton marshes** – The long-term plan is a preference for holding the existing line unless increased knowledge indicates realignment to be a better option.
- **River Burn outfall** – The long-term plan is to hold the line by maintaining the defences in their current positions.
- **Overy marshes** – Although the current strategy is to hold the line the long-term strategy may be to either hold the line or managed realignment prioritising the protection of properties and infrastructure depending on the results of monitoring and research.
- **Brunham Overy Staithe** - The long-term plan is to hold the line by maintaining the defences in their current positions.
- **Holkham dunes –** The long-term plan is to allow the dunes to evolve naturally but if their flood defence function reduces, work to restore it (including maintaining the existing groynes and revetment).

2.10 Water Cycle Studies

Climate Change is predicted to present unprecedented new challenges, such as more frequent and extreme rainfall events and rising global temperatures, which are expected to exert greater pressure on the existing infrastructure. Planning for water management therefore has to take these potential challenges into account. A large number of new homes for instance may cause the existing water management infrastructure to be overwhelmed which would result in adverse effects on the environment, both locally and in wider catchments.

Water Cycle Studies assist Local Authorities to select and develop sustainable development allocations so that there is minimal impact on the environment, water quality, water resources, and infrastructure and flood risk. This can be achieved in areas where there may be conflict between any proposed development and the requirements of the environment through the recommendation of potential sustainable solutions.

2.10.1 Outline Water Cycle Study (2009) and Final Water Cycle Study (2011)

The Borough Council of King's Lynn and West Norfolk carried out an **Outline Water Cycle Study in 2009 and a Final Water Cycle Study in 2011**. The Water Cycle Study examined how much growth can be accommodated within the existing infrastructure and potential environmental constraints that may restrict growth and infrastructure solutions. It also explored opportunities to enhance green infrastructure through the development of water infrastructure.

The purpose of the Water Cycle Study was to identify if there were any water related issues that present significant obstacles to the success of development, and where and when these issues may occur.

2.11 Riparian ownership

A riparian owner is the person who owns the land on which, or adjacent to, a watercourse flows through. The law presumes, in the absence of any other evidence, that the land adjoining the watercourse includes the watercourse to its mid-point; therefore, there may be more than one riparian owner of a watercourse.

Anyone with a watercourse in or adjacent to their land has rights and responsibilities as a riparian owner. The Environment Agency, local authority and other risk management authorities have permissive powers to work on watercourses under their jurisdiction, however, they are not required to do so.

Under land drainage law, watercourses cannot be obstructed and the riparian owner must accept water flowing onto their land.

Further information on the rights and responsibilities of riparian owners can be found on:

- Norfolk County Council **website**
- The Environment Agency **website**

2.12 Roles and responsibilities of Risk Management Authorities

The roles and responsibilities of Risk Management Authorities (RMAs) in the Borough of King's Lynn and West Norfolk are summarised below.

2.12.1 Borough Council of King's Lynn and West Norfolk

The LPA should take a sequential approach to development in accordance with **Table 2: Flood risk vulnerability classification** in the NPPF. As a LPA, the Borough Council of King's Lynn and West Norfolk assess, consult on and determine whether or not development proposals are acceptable, so that flooding and other, similar, risks are effectively managed.

The council will consult relevant statutory consultees as part of planning application assessments and may, in some cases, also contact non-statutory consultees, such as IDBs and Anglian Water, that have an interest in the planning application.

2.12.2 Norfolk County Council

As a LLFA Norfolk County Council's responsibilities include:

- A Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor a LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Flood Investigations: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations). A Section 19 Investigation may be carried out due to the following types of flooding in Norfolk:
    - Any risk to life or serious injury
    - One or more properties flooded internally; and/or one or more properties rendered inoperable or their functions severely compromised due to the access to the premises being impassable
    - Any section of a national category 3 road or above made impassable due to flooding; and/or flooding to priority 1 and 2 gritting routes.

  Section 19 reports are available to download from Norfolk County Council's **website**.
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.
- Designation of Features: LLFAs may exercise powers to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.

- Consenting: When appropriate, LLFAs will perform consenting of works on Ordinary Watercourses. Standing advice on Ordinary Watercourse consenting is provided in Norfolk County Council's **guidance document** on the Lead Local Flood Authority role as Statutory Consultee to Planning (2017).
- Schemes: LLFAs have permissive powers to undertake works to alleviate surface water flooding. They can also lead on Ordinary Watercourse and Groundwater schemes on request from the District Council.

Norfolk County Council is also the Local Highway Authority and manages highway drainage, carrying out maintenance and improvement works on an on-going basis, as necessary, to maintain existing standards of flood protection for highways, making appropriate allowances for climate change. It also has the responsibility to ensure highway projects do not increase flood risk.

2.12.3 Environment Agency

The Environment Agency is responsible for protecting and enhancing the environment as a whole and contributing to the government's aim of achieving sustainable development in England and Wales. The Environment Agency has powers to work on Main Rivers to manage flood risk. These powers are permissive, which means they are not a duty, and they allow the Environment Agency to carry out flood and coastal risk management work and to regulate the actions of other flood risk management authorities on Main Rivers and the coast. The Environment Agency are also statutory consultees on all planning applications in Flood Zones 2 and 3 and hold hydraulic models to map main river flood risk.

The EA also has powers to regulate works to Main Rivers and sea defences. Under the Environmental Permitting Regulations (England and Wales) 2016, an environmental permit may be required for flood risk activities for work in, under, over or within 8 metres of any fluvial Main River, flood defence structure or culvert, and within 16m of any tidal Main River, flood defence structure or culvert. A permit for works on the floodplain may also be required, beyond the 8/ 16m distance for work that is likely to divert or obstruct floodwaters, damage any river control works or affect drainage. Application forms and further information can be found on the government's website: **https://www.gov.uk/guidance/flood-risk-activities-environmental-permits.**

The Environment Agency also has a strategic overview role across all types of flooding as well as other types of water management matters.

2.12.4 Internal Drainage Boards (IDBs)

IDBs are local public authorities that manage water levels. They are an integral part of managing flood risk and land drainage within areas of special drainage need in England and Wales. The IDBs which operate within the Borough of King's Lynn and West Norfolk are shown in Table 2-1.

Table 2-1: IDBs which operate in the Borough of King's Lynn and West Norfolk

IDB Administrator	IDB Names
Downham Market Group of Internal Drainage Boards	East of Ouse Polver and Nar
	Northwold
	Southery and District
	Stringside
	Stoke Ferry
	Downham and Stow Bardolph
Ely Group of Internal Drainage Boards	Littleport and Downham
	Burnt Fen
Middle Level Commissioners	Euximoor
	Churchfield and Plawfield
	Upwell
	Needham and Laddus
	Hundred of Wisbech
	Nordelph
	Hundred Foot Washes
	Manea and Welney
Water Management Alliance	Norfolk Rivers IDB
	King's Lynn IDB

Roles and responsibilities for IDBs include the following:

- IDBs have permissive powers to undertake work to provide water level management within their Internal Drainage District. They undertake works to reduce flood risk to people and property and manage water levels for local needs, this includes the maintenance of rivers, drainage channels, outfalls and pumping stations
- They input into the planning system by facilitating the drainage of new and existing developments within their districts and advising on planning applications. However, they are not a statutory consultee to the planning process
- In some cases, a development meeting the following criteria may be required to submit an FRA to the IDB to support any consent applications:
    - Development within or adjacent to a drain/watercourse, and/or flood defence structure within the area of an IDB
    - Development within the channel of any Ordinary Watercourse within an IDB area
    - Where direct discharge of surface water or treated effluent is proposed into an IDB catchment
    - Any development proposal affecting more than one watercourse in an IDB's area and having possible strategic implications
    - Development in an IDB that is an area of known flood risk
    - Development within the maintenance access strips provided under the IDB's bylaws
    - Any other application that may have material drainage implications
- Some IDBs have other duties, powers and responsibilities under specific legislation

2.12.5 Water and wastewater providers

Anglian Water is the sewerage undertaker for the Borough of King's Lynn and West Norfolk. Water and sewerage companies including Anglian Water are responsible for managing the risks of flooding from surface water and foul or combined sewer systems.

Anglian Water provides a pre-planning service to provide a feasible water and/or drainage solution for planning application purposes. There is no requirement to request pre-planning report, however Anglian Water encourage developers to make use of our services before submitting a planning application where the site is of a significant scale. Further information can be found on the Anglian Water **website**.

Anglian Water also supply potable water to the Borough of King's Lynn and West Norfolk. Consent, prior to commencing work, is required from the relevant provider if installing water systems, or altering existing systems, is intended.

2.13 When to consult other organisations

Table 2-2 outlines which organisations should be consulted on Planning Applications with regards to development and flood risk.

Table 2-2: Organisations that may be consulted on development and flood risk

Key Authority	When to consult
Borough Council of King's Lynn and West Norfolk	Pre-application consultation is recommended to identify the range of issues that may affect the site and, following on from the Sequential and, if necessary, Exception Test, determine whether the site is suitable for its intended use. Should be consulted where an awarded watercourse runs within or adjacent to proposed development consultation
Environment Agency	Should be **consulted** on development, other than minor or as defined in the Environment Agency's Flood Risk Standing Advice document within Flood Zone 2 or 3, or in Flood Zone 1 where critical drainage problems have been notified to the LPA. Consultation will also be required for any development projects within 20m of a Main River or flood defence.
Norfolk County Council (LLFA)	Where the proposed work will either affect or use an Ordinary Watercourse or require consent permission, outside of an IDB area. The LLFA should be consulted on surface water drainage proposals for all major developments
Anglian Water	Anglian Water's **pre-planning service** should be used to identify feasible water and drainage solutions where a connection(s) to the water supply and public sewerage network is required. The reports provided can provided as supporting information as part of planning applications to be submitted to the LPA. Anglian Water would wish to comment on major planning applications in the area (10 or more dwellings) or 0.5 ha or more for employment where it proposed to connect to the public sewerage network.
Downham Market Group of Internal Drainage Boards (East of Ouse, Polver and Nar, Northwold, Southery and District, and, Stringside, Stoke Ferry and Downham and Stow Bardolph IDBs)	Where proposed development is in, or in close proximity to, an IDB district

Key Authority	When to consult
Ely Group of Internal Drainage Boards (Littleport and Downham and Burnt Fen IDBs)	
Middle Level Commissioners (Euximoor, Churchfield and Plawfield, Upwell, Needham and Laddus, Hundred of Wisbech, Nordelph, Hundred Foot Washes and Manea and Welney IDBs)	
Water Management Alliance (Norfolk Rivers and King's Lynn IDBs)	

3 The sequential, risk-based approach

3.1 The sequential, risk-based approach

This approach is designed to ensure areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk, with the aim of keeping development outside of medium and high flood risk areas (Flood Zones 2 and 3) and other sources of flooding, where possible.

The sequential approach can be applied both between and within Flood Zones.

When drawing up a Local Plan, it is often the case that it is not possible for all new development to be allocated on land that is not at risk from flooding. In these circumstances, the Flood Zone maps (that show the extent of inundation assuming that there are no defences) are too simplistic and a greater understanding of the scale and nature of the flood risks is required.

3.1.1 Flood Zones

Table 1 of NPPG Flood Risk and Coastal Change identifies the following Flood Zones. These apply to both Main River and Ordinary Watercourses. Flood risk vulnerability and Flood Zone compatibility is set out in **Table 3** of the NPPG. Table 3-1 summarises this information and also provides information on when an FRA would be required.

Table 3-1: Flood Zone descriptions

Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) are appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year. Developers and the local authorities should seek to reduce the overall level of flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify, in their SFRA, areas of functional floodplain, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. They must also be safe for users and not increase flood risk elsewhere. Essential Infrastructure will only be permitted if it passes the Exception Test.
		All developments in this zone require an FRA.

Further definition of Zone 3b:

This Flood Zone comprises land where water has to flow or be stored in times of flood (the functional floodplain). The mapping in the SFRA identifies this Flood Zone as land which would flood with a 5% chance in each and every year (a 1 in 20-year annual exceedance probability), where modelling exists for both river and sea flooding. Where the 5% AEP model outputs are not available, the 4% AEP (a 1 in 25-year annual probability) results were used as an alternative. In Appendix A, Flood Zone 3b is identified in the Flood Zone mapping.

In the absence of detailed hydraulic model information, a precautionary approach has been adopted with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. In the Appendix A mapping of all sources of flood risk, this precautionary approach is represented as a separate layer and is termed 'indicative extent of Flood Zone 3b'. If a proposed development is shown to be in Flood Zone 3, further investigation should be undertaken as part of a detailed site-specific Flood Risk Assessment to define and confirm the extent of Flood Zone 3b. This may require detailed hydraulic modelling.

The presence of defences is considered when mapping Flood Zone 3b, but if these defences are overtopped during a flood with a 5% chance in each and every year then the mapping will show that the Flood Zone affects land behind defences. Under climate change conditions, this effect can result in the extent of the Flood Zone increasing substantially and in such circumstances, decisions on land allocation or planning applications should review and take account of the implications of this effect and whether such land should be regarded as functional floodplain.

In circumstances where existing development or infrastructure is shown in Flood Zone 3b, where the flooding is a consequence of overtopping of existing defences or where the flooding is a consequence of sea water levels, additional consideration should be given to whether the specific location is appropriate for designation as 'Functional' with respect to the storage or flow of water in time of flood.

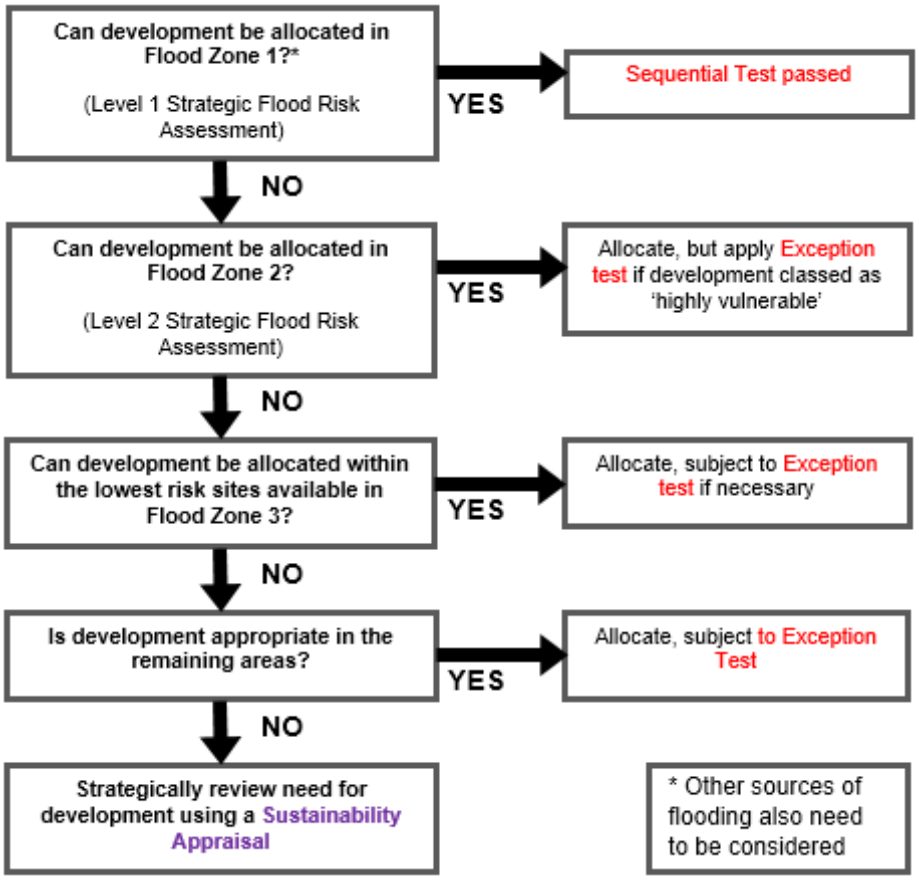
3.2 Applying the Sequential Test and Exception Test in the preparation for a local plan

When preparing a Local Plan, the LPA should demonstrate it has considered a range of site allocations, using SFRAs to apply the Sequential and Exception Tests where necessary.

The Sequential Test should be applied to the whole LPA area to increase the likelihood of allocating development in areas not at risk of flooding. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPG for Flood Risk and Coastal Change describes how the **Sequential Test should be applied in the preparation of a Local Plan** (Figure 3-1).

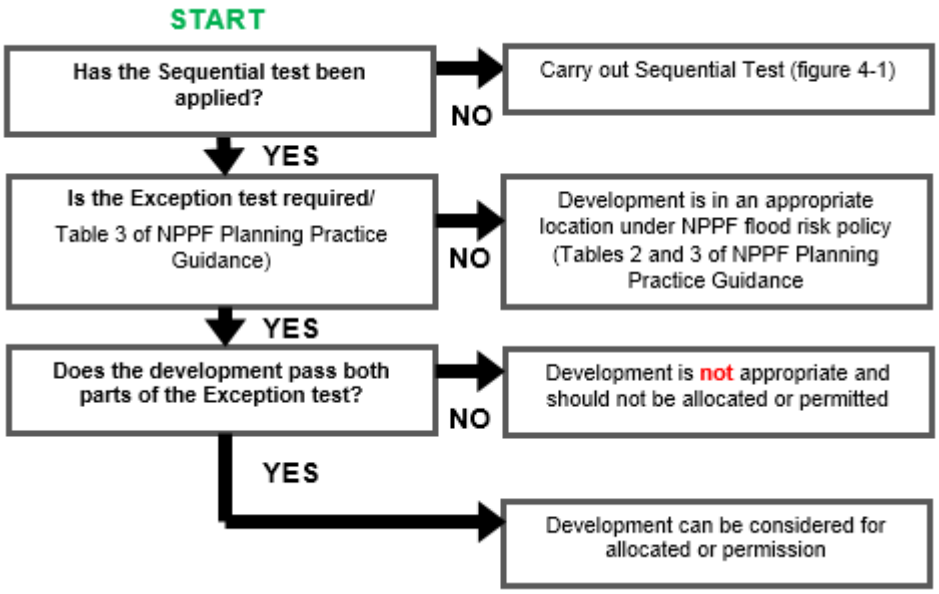
It is noted that the risk of flooding is high in the Borough and hence a Level 2 SFRA has been prepared. There is further and more specific guidance on the Sequential Test in the Level 2 SFRA that Planners should refer to.

Figure 3-1: Applying the Sequential Test in the preparation of a Local Plan



The Exception Test should only be applied following the application of the Sequential Test and as set out in Table 3 of the NPPG Flood Risk and Coastal Change. The NPPG describes **how the Exception Test should be applied in the preparation of a Local Plan** (Figure 3-2).

Figure 3-2: Applying the Exception Test in the preparation of a Local Plan



3.3 Applying the Sequential Test and Exception Test to individual planning applications

3.3.1 Sequential Test

Local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear, in other cases it may be identified by other Local Plan policies. A pragmatic approach should be taken when applying the Sequential Test.

The Borough Council of King's Lynn and West Norfolk, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied, and will need to be satisfied that the proposed development would be safe and not lead to increased flood risk elsewhere.

The Sequential Test does not need to be applied for individual developments under the following circumstances:

- The site has been identified in development plans through the Sequential Test.
- Applications for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site).

It is normally reasonable to presume and state that individual sites that lie in Flood Zone 1 satisfy the requirements of the Sequential Test; however, consideration should be given to risks from all sources, future flood risk and areas with critical drainage problems.

It is noted that the risk of flooding is high in the Borough and hence a Level 2 SFRA has been prepared. There is further and more specific guidance on the Sequential Test in the Level 2 SFRA that Developers should refer to.

3.3.2 Exception Test

If, following application of the Sequential Test it is not possible for the development to be located in areas with a lower probability of flooding, the Exception Test must then be applied if deemed appropriate (see **NPPF Table 3: Flood risk vulnerability and flood zone 'compatibility'**). The aim of the Exception Test is to ensure that more vulnerable uses, such as residential development can be implemented safely and are not located in areas where the hazards and consequences of flooding are inappropriate. For the Test to be satisfied, the following two elements have to be accepted for development to be allocated or permitted:

1. The development would provide wider sustainability benefits to the community that outweigh the flood risk

   LPAs will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied, and give advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the LPA should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused.

2. The development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall

   A site allocation stage, a Level 2 SFRA can be used to inform the test. For the Borough of Kings Lynn and West Norfolk, this is available as a separate document.

   At Planning Permission stage, a site-specific Flood Risk Assessment should demonstrate that the site will be safe and the people will not be exposed to hazardous flooding from any source. The following should be considered:

   - The design of any flood defence infrastructure.
   - Access and egress.
   - Operation and maintenance of defences.
   - Design of the development to manage and reduce flood risk wherever possible
   - Resident awareness.
   - Flood warning and evacuation procedures.

- Any funding arrangements required for implementing measures.

The **NPPG** provides detailed information on how the Test can be applied and a **table** that outlines when the Exception Test is required.

3.4 Actual flood risk

If it has not been possible for all future development to be situated in Flood Zone 1, or areas at lowest flood risk, taking into account all sources of flooding, then a more detailed assessment is needed to understand the implications of locating proposed development in Flood Zones 2 or 3. This is accomplished by considering information on the "actual risk" of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:

- residential development should be protected against flooding with an annual probability of river flooding of 1% (1 in 100-year chance of flooding) in any year; and
- residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% (1 in 200-year chance of flooding) in any year.

The assessment of the actual risk should take the following issues into account:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for the Flood Risk Management Strategy to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the development. Over time the effects of climate change may reduce the standard of protection afforded by defences, due to increased river flows and levels and sea level rise, and so commitment is needed to invest in the maintenance and upgrade of defences if the present day levels of protection are to be maintained and where necessary land secured that is required for affordable future flood risk management measures.
- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset and rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where a) the consequences of flooding need to be mitigated or b) where it is proposed to place lower vulnerability development in areas of flood risk.

3.5 Impact of additional development on flood risk

The 2018 NPPF states that "*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*."

When allocating land for development, consideration must be given to the potential cumulative impact of development on flood risk. The increase in impermeable surfaces and resulting increase in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place. Additionally, the increase in runoff may result in more flow entering watercourses, increasing the risk of fluvial flooding downstream.

Consideration must also be given to the potential cumulative impact of the loss of floodplain as a result of development. The effect of the loss of floodplain storage should be assessed, at both the development and elsewhere within the catchment and, if required, the scale and scope of appropriate mitigation should be identified.

Whilst the increase in runoff, or loss in floodplain storage, from individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe without appropriate mitigation measures.

The cumulative impact of development should also be considered at the planning application and development design stages and the appropriate mitigation measures undertaken, within an appropriate FRA, to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk.

4 Climate change

4.1 Climate change and the NPPF

The NPPF and accompanying National Planning Practice Guidance (NPPG) sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. Paragraph 156 of the NPPF, shown in Section 1.1, makes specific reference to considering the impacts of climate change as part of Local Plans. The NPPF update states that the 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158)'. Further, the NPPF and NPPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account.

The Environment Agency has published guidance to local planning authorities in the application of appropriate climate change allowances when considering climate change effects (**Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities**). This guidance adopts a risk-based approach to the selection of appropriate allowances based on the consequences of flooding, as described by the flood risk vulnerability of the proposed development (see Section 4.3.1). For proposed development that is highly vulnerable to flooding, it is recommended that the upper end allowance be used when considering climate change (i.e. 100-year +65% flow); conversely, for development that is 'water compatible' then the central allowance can be used (i.e. 100-year +25% flow). When assessing the potential effects of climate change in the land allocation process, consideration is given to the vulnerability of proposed development and the potential effect on the Flood Zone on the basis of the application of the appropriate climate change allowance.

Assessing the impacts of climate change and mapping climate change extents is a key objective and outcome of the 2018 SFRA (see Section 1.2 and 1.4). When defining the scope of this commission, the Environment Agency and LLFA recommended that the climate change allowances used in this assessment (see Section 5.2.3), be in line with the revised guidance (discussed in Section 5.2.3). These allowances reflect those which are most commonly used by developers and will assist in future development matters as part of the local planning process.

4.2 Revised climate change guidance

The Environment Agency published **updated climate change guidance** on 19 February 2016 (and updated on 3 February 2017), which supports the NPPF and must now be considered in all new developments and planning applications. The document contains guidance on how climate change should be taken into account when considering development, specifically how allowances for climate change should be included with FRAs.

The UK Climate Impacts Programme are due to publish new allowances for climate change in late 2018. The Environment Agency will, in due course, use this information to update their climate change guidance for planners.

4.3 Climate change allowances

4.3.1 Peak river flows

Climate change is expected to increase the frequency, extent and impact of flooding, reflected in peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Rising river levels may also increase flood risk.

The peak river flow allowances provided in the guidance show the anticipated changes to peak flow per river basin district. Once the river basin district has been identified, guidance on uplift in peak

flows are provided for three allowance categories, Central, Higher Central and Upper End which are based on the 50th, 70th and 90th percentiles respectively and reflect the differing levels of uncertainty associated with the respective estimates (i.e. 50th percentile: more certainty in the outcome; 90th percentile: less certainty in the predicted outcome). The allowance category to be used is based on the vulnerability classification of the proposed development and the Flood Zones within which it is to be located.

These allowances are provided in the form of figures for the total potential change anticipated, for three climate change periods:

- The '2020s' (2015 to 2039)
- The '2050s' (2040 to 2069)
- The '2080s' (2070 to 2115)

The time-period used in the assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development. Further information on what is considered to be the lifetime of development is provided in the **NPPG**.

The Borough of King's Lynn and West Norfolk falls within the Anglian River Basin District. The allowances for the Anglian River Basin District are provided in Table 4-1. The climate change allowances used in the hydraulic modelling undertaken as part of the 2018 SFRA are detailed in Sections 4.9.1 and 5. Please note that as part of UKCP18 climate change allowances are likely to be amended.

Table 4-1: Peak river flow allowances for the Anglian river basin district

Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	25%	35%	65%
Higher central	15%	20%	35%
Central	10%	15%	25%

4.3.2 High++ allowances

High++ allowances only apply in assessments for developments that are very sensitive to flood risk, for example large scale energy generating infrastructure, and that have lifetimes beyond the end of the century. H++ estimates represent the upper limit of plausible climate projections and would not normally be expected for schemes or plans to be designed to or incorporate resilience for the H++ estimate. Further information is provided in the Environment Agency publication, **Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities.**

4.3.3 Which peak river flow allowance to use?

The Flood Zone and flood risk vulnerability classification should be considered when deciding which allowances apply to the development or the plan. Vulnerability classifications are found in the **NPPG**. The guidance states the following:

Flood Zone 2

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure		✓	✓
Highly vulnerable		✓	✓
More vulnerable	✓	✓	
Less vulnerable	✓		
Water compatible	None		

Flood Zone 3a

Vulnerability classification	Central	Higher Central	Upper end

Essential infrastructure			✓
Highly vulnerable	Development not permitted		
More vulnerable		✓	✓
Less vulnerable	✓	✓	
Water compatible	✓		

Flood Zone 3b

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure			✓
Highly vulnerable	Development not permitted		
More vulnerable			
Less vulnerable			
Water compatible	✓		

4.4 Peak rainfall intensity allowance

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This increased rainfall intensity will affect drainage systems, resulting in increased risk of surface water flooding, due to the increased volume of water entering the systems. The table below shows anticipated changes in extreme rainfall intensity in small and urban catchments. These allowances should be used for small catchments and urban drainage sites. For catchments, larger than 5km^2, the guidance suggests the peak river flow allowances should be used.

For Flood Risk Assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Table 4-2: Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

4.5 Sea level allowances

Climate change is predicted to cause sea level rise and increase the rate of coastal risk erosion. The table below shows anticipated sea level rise for each time-period (termed 'epoch'), with cumulative sea level rise in brackets. Guidance on how to calculate the sea level rise (i.e. the cumulative total sea level rise expected over the lifetime of a development), is provided on the government **website**.

Table 4-3: Sea level allowance for each epoch in millimetres (mm) per year, with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

Area of England	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115	Cumulative rise 1990 to 2115 / metres (m)
East	4 (140mm)	8.5 (255mm)	12 (360mm)	15 (450mm)	1.21m

In addition to increased sea levels, wave heights may change due to increased water depths. The severity, duration and frequency of storms may also change. Allowances for wind speed and wave heights have also been **published**, alongside the sensitivity allowances to be used.

4.6 Using climate change allowances

To help decide which allowances to use to inform the flood levels that the flood risk management strategy will be based on for a development or development plan allocation, the following should be considered:

- 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)
- vulnerability of the proposed development types or land use allocations to flooding
- 'built in' resilience measures used, for example, raised floor levels
- capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach

The Environment Agency has produced a guidance document called "Flood risk assessment: Climate Change allowances" which details the application of the allowances and local considerations in East Anglia. This document is available from: **https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers**

When defining the scope of this commission, the Environment Agency recommended that the below allowances were used in this assessment, to assist with forward planning across the combined study area:

- 25% (Central) climate change allowance for the defended 0.1% AEP event
- 35% (Higher Central) and 65% (Upper End) climate change allowance for the defended 1% AEP event

The epoch selected, i.e. the total potential change anticipated for the '2080s' (2070 to 2115), generally reflects the anticipated lifetime for residential development (i.e. 100 years), as stated in **Paragraph 026 of the NPPG**.

4.7 Norfolk County Council guidance

Norfolk County Council has outlined their expectations in using climate change allowances in their guidance document called: **Norfolk County Council, Lead Local Flood Authority, Statutory Consultee for Planning, Guidance Document (2017)**. The document highlights that peak river flow climate change allowances should be considered for Ordinary Watercourses as well as Main Rivers. In addition, the new allowances should be used to update any detailed design at reserved matters or discharge of conditions planning applications following an outline planning approval where any previous allowances may originally have been applied.

4.8 Groundwater

The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has a large influence on winter flood flows, is more uncertain. 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. The effect of climate change on groundwater levels for sites in areas where groundwater is known to be an issue should be considered at the planning application stage.

4.9 The impact of climate change in the Borough of King's Lynn and West Norfolk

The **UK Climate Projections 2009** (UKCP09) predict the following climatic changes in the East England

- Increased summer temperatures of 2.9°C by 2050
- Increased winter temperatures of 2.5°C by 2050
- Reduced summer rainfall of 18% by 2050
- Increased winter rainfall of 16% by 2050.

Please note that as part of UKCP18 climate change allowances are likely to be amended.

Tomorrow's Norfolk, Today's Challenge: A Climate Change Strategy for Norfolk aims to provide the vision and drive for Norfolk to tackle the issue of climate change. It states that Norfolk is particularly vulnerable to climate change as it is a county which is low-lying with a lengthy coastline, it has a large agricultural sector and a growing population. Climate change in the county is expected to result in

- Greater flood risk, both coastal and fluvial
- Water scarcity and drought
- Accelerated coastal erosion.

One of the high-level goals of the strategy is *"to improve Norfolk's resilience to the changing climate, including reduction of the socio-economic and environmental risks associated with flooding and coastal erosion (adaptation)."* The strategy sets out a number of priorities for local authorities and their partners to manage the risks of climate change.

The **Norfolk Coast Area of Outstanding Natural Beauty (AONB) Climate Change Adaption Strategy (2017)** provides a framework for action in adapting to the effects of climate change in the Norfolk Coast AONB which extends into the Borough of King's Lynn and West Norfolk. It recognises that in the long term it will not be possible to maintain the area in its current state, but aims to identify ways in which the natural beauty of the area can be maintained. Workshops identified three main effects of climate change on the area as:

- Global sea level rise
- Change in the local climate regime
- Increased concentration of atmospheric carbon dioxide.

Climate UK prepared a report titled '**A Summary of Climate Change Risk for the East of England**.' The report, similar to that of 'Tomorrow's Norfolk, Today's Challenge' above, identified increased water scarcity, flooding and sea level risk as the three areas of greatest concern for the East of England.

Natural England published a report titled '**Climate Change – Lowland Fens.'** this report covers the likely environment changes caused by, and impacts from climate change in lowland fens. The report describes the Fens as being highly sensitive to changes in the quality and quantity of water supply, factors that are likely to be altered by the effects of climate change.

An increase in extreme rainfall events and consequently flooding and inundation of the Fens' floodplain could potentially have the following impacts:

- *"A shift in species composition to favour those species able to cope with long-term inundation.*
- *Increased nutrient input, leading to benefits for those species able to utilise enhanced levels, and the potential loss of nutrient-poor fens.*
- *Increasing difficulty of management, leading to potential abandonment.*
- *Increased peat slippage and erosion in sloping valley head mires."*[2]

4.9.1 SFRA climate change modelling

Fluvial

In the 2018 SFRA, climate change modelling for the watercourses in the combined study area, including the Borough of King's Lynn and West Norfolk, was undertaken using the new climate change guidance (see Section 4.2). Where appropriate, existing Environment Agency hydraulic models were run for the following allowances:

- 25% (Central) climate change allowance for the defended 0.1% AEP event
- 35% (Higher Central) and 65% (Upper End) climate change allowance for the defended 1% AEP event

The climate change allowances reflect the allowances most commonly used by developers i.e. for residential development classified as 'More Vulnerable' under **Table 2 of the NPPG**. The epoch selected, i.e. the total potential change anticipated for the '2080s' (2070 to 2115), generally reflects

2 Peter Wakely, Natural England (n.d. post-2013 based on references) accessed via https://www.fensforthefuture.org.uk/admin/resources/downloads/ne-access-to-evidence-climate-change-lowland-fens.pdf

the anticipated lifetime for residential development (i.e. 100 years), as stated in **Paragraph 026 of the NPPG**.

Where no hydraulic models exist, no climate change modelling was undertaken. At such locations, developers should prepare detailed hydraulic models as part of a site-specific Flood Risk Assessment and account for climate change in the assessment. Section 8.2.3 provides further guidance on this.

Where alternative approaches have been used to map the extents associated with the climate change scenarios (i.e. where Flood Zone 2 was used as a substitute for the 100-year with 65% climate change extent), developers may be required to further investigate the flood risk as part of a site-specific Flood Risk Assessment. Appendix D identifies where surrogate extents were used in the mapping.

Tidal (sea)

Climate change modelling of the Norfolk coastline was supplied by the Environment Agency for use in the combined SFRA assessments. The Norfolk coastal climate change modelling was undertaken in line with the revised climate change guidance and was agreed as part of a separate commission to the 2018 SFRA. The Norfolk coastal climate change modelling followed the guidance relating to sea level increases shown in Table 4-3, and used the defended scenario. In the wave models, a 5% allowance for increases in wind speed for the 2050s epoch and a 10% allowance for increases in wave height for the 2115 epoch, were used.

Surface Water

Climate change modelling for surface water was undertaken based on the new climate change guidance (see Section 4.4). The Risk of Flooding from Surface Water model (see Section 5.3) was rerun for the 1% AEP event plus a 40% (Upper End) increase for climate change.

Mapping

Climate change mapping covering the Borough of King's Lynn and West Norfolk is provided in Appendix A. Further information on the climate change approach and methodology can be found in Section 5 and in the Technical Summary provided in Appendix D.

Summary of climate change impacts

Modelling indicates that many of the fluvial watercourses, including the River Burn and River Nar are relatively insensitive to the effects of climate change; the impacts of climate change are not shown to increase flood extents significantly along these watercourses. Whilst flood extents may not increase significantly, climate change has the potential to increase flood levels, depths, velocities and hazard to people classification.

When considering tidal flood risk and taking into account rising sea levels, sea defences are likely to put under increased pressure in future. Higher sea levels will be seen more frequently and the severity of major floods is likely to increase.

In general, the 100-year with climate change surface water scenario results show similar overland flow routes to the 1,000-year surface water scenario and follows topographical flow paths of existing watercourses or dry valleys, with some isolated ponding located in low-lying areas. In general, the 1,000-year surface water extent is larger than the 100-year with climate change surface water scenario across the Borough of King's Lynn and West Norfolk.

4.9.2 Adapting to climate change

The NPPG sections on climate change contain information and guidance for how to identify suitable mitigation and adaptation measures 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
- 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.

5 Sources of information used in preparing the SFRA

5.1 Hydraulic models used in this SFRA

The Environment Agency supplied detailed hydraulic models for use in the SFRAs for the combined study area. Appendix D lists and displays the coverage of all the supplied detailed hydraulic models and contains information on:

- the date of the model;
- the name of the model;
- whether the model outputs have been used to inform Flood Zone 3b;
- for the 2017 hydraulic models, whether the outputs have been used to update Flood Zones 3a and 2 or whether these are based on the Environment Agency's Flood Map for Planning; and,
- whether the model outputs have been used to inform the climate change mapping.

It is important that the 2018 SFRA and mapping appendices are read in conjunction with the Technical Summary provided in Appendix D. The Technical Summary provides further information on the hydraulic modelling and mapping approaches used in the 2018 SFRA.

5.1.1 New modelling outputs

The SFRAs for the combined study area contains updated hydraulic modelling for a number of watercourses and the coast. As part of a separate commission to the SFRA, the Environment Agency have prepared updated modelling of the Anglian coastline. It should be noted that this modelling represents the tidal flood risk only; the modelling contains no fluvial inflows and does not represent the interaction between the fluvial and tidal flood risks. The outputs of these two models were supplied from the Environment Agency for use in the 2018 SFRA; the Wash model and the Wells-next-Sea model. The Wells model partially extents into the Borough and the Wash model covers a significant proportion of the Borough. The Environment Agency have caveated this data as draft with the following statement:

'*As SFRAs are not updated regularly we agreed that they could use draft outputs as we wanted to ensure that the SFRA's were not out of date as soon as they were published. However although this information was shared with our external partners to assist them with the creation of their SFRAs the data remains unavailable for external practice until model completion. This is because we need to complete all necessary reviews. The project aims to be completed by summer 2018 and will be available for external practice then*'.

Additionally as part of a separate commission to the SFRA, the Environment Agency are in the process of updating the River Burn model. This model is due for completion in late 2018.

5.2 Fluvial and tidal modelling

Flood Zones 2, 3a and 3b, as shown in Appendix A, have been compiled for the study area as part of the 2018 SFRA.

Please note that the Flood Zones, whilst generally accurate on a large scale, are not provided for land where the catchment of the watercourse falls below 3km^2. There are a number of small watercourse and field drains which may pose a risk to development (e.g. some ordinary watercourses and / or drains managed by Internal Drainage Boards). Therefore, whilst these smaller watercourses may not be shown as having flood risk on the flood risk mapping, it does not necessarily mean that there is no flood risk. As part of a site-specific FRA the potential flood risk and extent of flood zones should be determined for these smaller watercourses.

Flood Zones 2 and 3a are taken from the Environment Agency's Flood Map for Planning (Rivers and Sea). Where new model results are available:

- the undefended 100-year fluvial results have been spliced into Flood Zone 3a and the undefended 1,000-year fluvial results have been spliced into Flood Zone 2.
- the combined maximum extent of the undefended and defended 200-year tidal results have been spliced into Flood Zone 3a and the combined maximum extent of the undefended and defended 1000-year tidal results have been spliced into Flood Zone 2.

This is so that the SFRA Flood Zones represent the most up-to-date information. The Environment Agency's Flood Zones on their Flood Map for Planning website may therefore differ to the maps in the SFRA for a short period of time. The modelled fluvial and tidal flood risk datasets, shown in the 2018 SFRA and Appendix A, will be incorporated into the Environment Agency's Flood Map in due course.

5.2.1 Flood Zone 3b (functional floodplain)

Flood Zone 3b comprises land where water has to flow or be stored in times of flood (the functional floodplain). The mapping in the SFRA identifies this Flood Zone as land which would flood with a 5% chance in each and every year (a 1 in 20-year annual exceedance probability [AEP]), where detailed modelling exists for both river and sea flooding. Where the 5% AEP outputs are not available, the 4% AEP (a 1 in 25-year annual probability) results were used as an alternative. The project scope provided by the commissioning authorities identified that the functional floodplain was to be mapped using the 1 in 20-year event extent. The presence of defences is considered when mapping Flood Zone 3b. In Appendix A, Flood Zone 3b is identified in the Flood Zone mapping.

In the absence of detailed hydraulic model information, a precautionary approach has been adopted with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a (i.e. termed 'indicative extent of Flood Zone 3b'). In Appendix A, if the Flood Zone 3b is indicative, this is highlighted in the GeoPDF mapping layers.

If a proposed development is shown to be in indicative Flood Zone 3b, further investigation should be undertaken as part of a detailed site-specific Flood Risk Assessment to define and confirm the extent of Flood Zone 3b. This may require detailed hydraulic modelling.

The presence of defences is considered when mapping Flood Zone 3b, but if these defences are overtopped during a flood with a 5% chance in each and every year, the mapping will show that the Zone affects land behind defences. Under climate change conditions, this effect can result in the extent of the Zone increasing substantially and in such circumstances, decisions on land allocation or planning applications should review and take account of the implications of this effect and whether such land should be regarded as functional floodplain.

In circumstances where existing development or infrastructure is shown in Flood Zone 3b, where the flooding is a consequence of overtopping of existing defences or where the flooding is a consequence of sea water levels, additional consideration should be given to whether the specific location is appropriate for designation as 'Functional', with respect to the storage or flow of water in time of flood.

5.2.2 Internal Drainage Boards

The Borough of King's Lynn and West Norfolk is partially covered by 18 Internal Drainage Boards (IDBs) which are administered by the Downham Market Group of Internal Drainage Boards, Ely Group of Internal Drainage Boards, Middle Level Commissioners and Water Management Alliance (see Table 2-1).

The IDB policy statements of flood protection and water level management have been used to determine the general standard of flood protection provided to each IDB district; this is discussed in Section 6.3.3. However, developers in IDB districts should, where appropriate, undertake a detailed assessment to determine the Flood Zone coverage including the extent of Flood Zone 3b, through detailed hydraulic modelling and consultation with the relevant IDB.

5.2.3 Climate change

Updated modelling was used, as outlined in Chapter 4 and Appendix D.

5.3 Surface water

Mapping of surface water flood risk in the Borough of King's Lynn and West Norfolk has been taken from the Risk of Flooding from Surface Water (RoFfSW) published online by the Environment Agency. These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.

The RoFfSW is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low-lying areas. They provide a map

which displays different levels of surface water flood risk depending on the annual probability of the land in question being inundated by surface water (Table 5-1).

Table 5-1: RoFfSW risk categories

Category	Definition
High	Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year (annual probability of flooding 3.3%)
Medium	Flooding occurring as a result of rainfall of between 1 in 100 (1%) and 1 in 30 (3.3%) chance in any given year.
Low	Flooding occurring as a result of rainfall of between 1 in 1,000 (0.1%) and 1 in 100 (1%) chance in any given year.
Very Low	Flooding occurring as a result of rainfall with less than 1 in 1,000 (0.1%) chance in any given year.

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 considered to more accurately illustrate the flood risk at a site-specific scale. Such an assessment will use the RoFfSW in partnership with other sources of local flooding information, such as the modelling undertaken as part of the SWMPs, to confirm the presence of a surface water risk at that particular location.

5.4 Groundwater

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.

5.5 Sewers

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 (on a 4-5 post code digit basis).

5.6 Reservoirs

The risk of inundation because of reservoir breach or failure of reservoirs within the area has been mapped using the outlines produced as part of the National Inundation Reservoir Mapping (NIRIM) study.

5.7 Suite of maps

All of the mapping can be found in the appendices to this SFRA and is presented in the following structure:

- Appendix A: Mapping of all sources of flood risk across the Borough of King's Lynn and West Norfolk (excluding historic flood extents).
- Appendix B: Watercourses in the Borough of King's Lynn and West Norfolk and coverage of IDB districts
- Appendix C: Flood Alert and Flood Warning coverage across the Borough of King's Lynn and West Norfolk

- Appendix D: Technical Summary including a list of all detailed models used in the 2018 SFRA and a map showing the coverage of these models
- Appendix E: Mapping showing the location, type and condition flood defences across the Borough of King's Lynn and West Norfolk, as well as the design standard of protection offered by the defences

It is important that the Technical Summary provided in Appendix D is read in conjunction with using or referring to the SFRA mapping appendices. The Technical Summary provides further information on the hydraulic modelling and mapping approaches used in this SFRA.

5.8 Other relevant flood risk information

Users of this SFRA should also refer to other relevant information on flood risk where available and appropriate. This information includes:

- **Great Ouse Catchment Flood Management Plan (2011), Broadland Rivers Catchment Flood Management Plan (2009), North Norfolk Rivers Catchment Flood Management Plan (2009)** and the **River Nene Catchment Flood Management Plan (2009)**

  Provides information on the catchment-wide strategy for flood risk management. It should be ensured that any flood risk management measures are consistent with the strategy.
- **Norfolk Local Flood Risk Management Strategy (2015)**

  Provides information on local flooding issues and the plan for managing risk. It should be ensured that development and any flood risk management measures are consistent with the Plan.
- **North Norfolk (2010) Shoreline Management Plan** and **The Wash Shoreline Management Plan (2010)**

  Provide large-scale assessment of risks associated with coastal evolution and presents the policy framework to address these risks in a sustainable manner. It should be ensured that any coastline development and flood risk management measures are consistent with the plan.
- **Borough of King's Lynn and West Norfolk Outline Water Cycle Study (2009)** and **Final Phase 2 Water Cycle Study (2011)**

  Developers and planners should use the Water Cycle Study as a starting point when considering any water supply, sewerage or water quality constraints on a development.
- **King's Lynn and West Norfolk Settlements Surface Water Management Plan (2012) and the King's Lynn Ordinary Watercourses Study – Technical Note (2015)**

  Provides information on surface water flooding issues for King's Lynn and West Norfolk and the plan for managing risk including the flood risk associated with ordinary watercourses and their interaction with surface water flooding. It should be ensured that any surface water management measures are consistent with the Plan.
- **Anglian Flood Risk Management Plan (2016)**

  Provides information on the catchment-wide strategy for flood risk management. It should be ensured that any flood risk management measures are consistent with the strategy.

6 Understanding flood risk in the Borough of King's Lynn and West Norfolk

6.1 Historic flooding

The Borough of King's Lynn and West Norfolk has a history of documented flood events with the main source being from tidal sources.

The historic information described below has been taken from:

- The 2008 King's Lynn and West Norfolk SFRA;
- Norfolk County Council's 2015 Local Flood Risk Management Strategy;
- The Gibraltar Point to Old Hunstanton SMP (2010) and Hunstanton to Kelling Hard SMP (2010);
- The Environment Agency's Historic Flood Map and Record Flood Outlines datasets;
- An internet search; and,
- LLFA Section 19 reports.

The following historical flood events have been recorded in the Borough of King's Lynn and West Norfolk:

- On 28th November 1897 high tides and a tidal surge affected the north Norfolk coast
- In 1947 there was widespread flooding across the Great Ouse catchment, mainly to farmland.
- In 1949 a high tide and tidal surge affected Brancaster, with properties flooded. The sea breached defences and turned the area in to saltmarsh.
- The East Coast of the UK was hit by a storm surge on the 31st January/1st February 1953. As a result, the Borough of King's Lynn and West Norfolk experienced major flooding. The Environment Agency recorded flooding in King's Lynn and West Norfolk from Holkham Bay along the coast to Old Hunstanton and from Hunstanton to Babingley. It is reported that 100 people drowned.
- In January 1978, the Environment Agency recorded flooding in King's Lynn and along the Snettisham Scalp and Stubborn Sand coastline, caused by a tidal event. It is reported that most of Hunstanton Pier and hundreds of caravans at Snettisham and Huntstanton were over turned[3].
- On 12th November 1993, the Environment Agency report that the River Nar breached, causing flooding between Lynn Road and New Road.
- In 1996 a tidal event affected Holme-next-the-Sea, with two or three metres of dune lost at The Firs frontage.
- From 14th-15th December 2003 a surge tide of up to 1.75m and gale force winds affected Holme-next-the Sea and Brancaster. Sea defences were overtopped and damaged, and there was beach loss in Norfolk.
- From the 17th-21st March 2007 surge tides with strong winds caused road flooding at Brancaster.
- During a storm surge on the 9th November 2007, the Environment Agency's tide recorder at King's Lynn (Freebridge) recorded a peak water level of 4.66m AOD between 0500 hours and 0515 hours. The tide level at Freebridge was above 4.4m AOD from 0430 hours to 0600 hours. No incidents of flooding were recorded in the Borough of King's Lynn and West Norfolk.
- As a result of a combination of a high spring tide and low atmospheric pressure, the north Norfolk coastline suffered a tidal surge on the 5th/6th December 2013. Water levels in some areas were higher than those experienced in the Great Flood of 1953 and whilst, owing to pre-planning and forewarnings, there was no loss of life or injury, significant damage was caused to both sea defences and property in towns and villages along the north Norfolk

3 http://www.edp24.co.uk/news/weather/photo-galleries-from-the-archives-how-the-floods-of-1953-1978-and-2007-affected-the-region-1-3081153

coastline. 152 houses and businesses were flooded and/or damaged as a direct result of the tidal surge, with over 200 households evacuated in Norfolk[4]. The Environment Agency recorded tidal flooding from Holkham Bay along the coast to Thornham due to the over topping of defences. Flooding was also reported by the Environment Agency in the west of Holme-next-the-Sea due to the channel capacity being exceeded with no raised defences in the area.

- Localised sewer flooding problems have been recorded at
  - **King's Lynn**: Bagge Road, Hockham Street, Mayflower Avenue, Oldmedow Road and Turbus Road.
  - **Downham Market**: Maltings Lane, Oakview Drive, Paradise Road, Peverall Road and Railway Road.

Under Section 19 of the Flood and Water Management Act, Norfolk County Council in their role as LLFA, have published Section 19 reports covering the following communities and flood events. Where possible, the likely source of the flood event, as noted in these reports, has been listed.

- On the 6th November and 23rd December 2012, a residential property was flooded internally at Sutton Road, Walpole Cross Keys. The flooding was reported to have been caused by a combination of:
  - snow and extreme rainfall events in the previous months
  - exceptionally high groundwater levels
  - poorly maintained watercourse to the south of the settlement
  - a blocked/damaged culvert downstream of the watercourse
  - damaged highways drain chamber cover in the driveway
  - exacerbated surface water discharges.
- Between early June and late November 2014, a series of rainfall events caused 42 properties to flood internally within the Borough of King's Lynn and West Norfolk.
- On the 27th July 2018 a large rainfall event caused internal property flooding in Hunstanton and North Wootton.

Section 19 reports are available to download from Norfolk County Council's **website**.

Highways England have provided details of historic floods which have occurred along the A47, since July 2008. 47 flooding incidents have been recorded along the A47 since July 2008; the flooding is described as either affecting one or more lanes of the carriageway, entry slips roads, and roundabouts. A number of incidents were caused by infrastructure issues such as a collapsed drain, blocked gulleys, blocked manhole chambers burst water pipe or poor drainage.

Historic flood information can be used for:

- Model calibration: This involves checking the model results align with historic flood information.
- The basis of Environment Agency Flood Zone 2 extents: In certain locations, the Flood Zone 2 extents can be based on the Environment Agency's Historic Flood Map rather than hydraulic modelling data.
- A driver for preparing a site-specific Flood Risk Assessment for a site: If the site is known to be affected by historic flood events, a site-specific Flood Risk Assessment may be required to investigate the risk further.

6.2 Topography, geology and soils

6.2.1 Topography

The topography of the Borough of King's Lynn and West Norfolk can be seen in Figure 6-1. Relatively flat terrain characterises much of the west of the study area; this area is covered by the Fens and most of the area is below sea level. The north east and east of the Borough are characterised by relatively steep valleys, with smaller hills located in the south east. The highest elevation in the study area, at approximately 93.80m AOD, is to the west of Great Massingham. The lowest elevation in the study area, at approximately -4.2m AOD, is to the south of Southery.

4 https://www2.north-norfolk.gov.uk/files/Coastal_Update_Issue_7_-_February_14_2.pdf

6.2.2 Geology and soils

The geology of the catchment can be an important influencing factor on the way that water runs off the ground surface. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy.

Figure 6-2 shows the bedrock (solid permeable) formations in King's Lynn and West Norfolk and Figure 6-3 shows the superficial (permeable, unconsolidated (loose) deposits. These are classified as the following:

- Principal: layers of rock or drift deposits with high permeability which, therefore, provide a high level of water storage
- Secondary A: rock layers or drift deposits capable of supporting water supplies at a local level and, in some cases, forming an important source of base flow to rivers
- Secondary B: lower permeability layers of rock or drift deposits which may store and yield limited amounts of groundwater
- Secondary undifferentiated: rock types where it is not possible to attribute either category a or b
- Unproductive Strata: rock layers and drift deposits with low permeability and therefore have negligible significance for water supply or river base flow.

The bedrock strata beneath the Borough is broadly classified as 'Unproductive' in the west of the study area; this is associated with mudstone, sandstone and siltstone. In the east of the study area, the bedrock strata is classified as Principal aquifer(s) and is associated with chalk. In the north of the Borough there is a small area of Secondary A and Secondary B aquifers, associated with mudstone, siltstone and sandstone.

The superficial deposits in the study area comprise generally of unproductive deposits in the west of the Borough (associated with clay, sand and silt alluvium deposits); to the east of the Borough there is a patchwork of Secondary (undifferentiated) and Secondary A (associated with diamicton and sand and gravel respectively) deposits. The mapping also shows no deposits recorded in parts of the east of the Borough.

Figure 6-1: Topography of the Borough of King's Lynn and West Norfolk

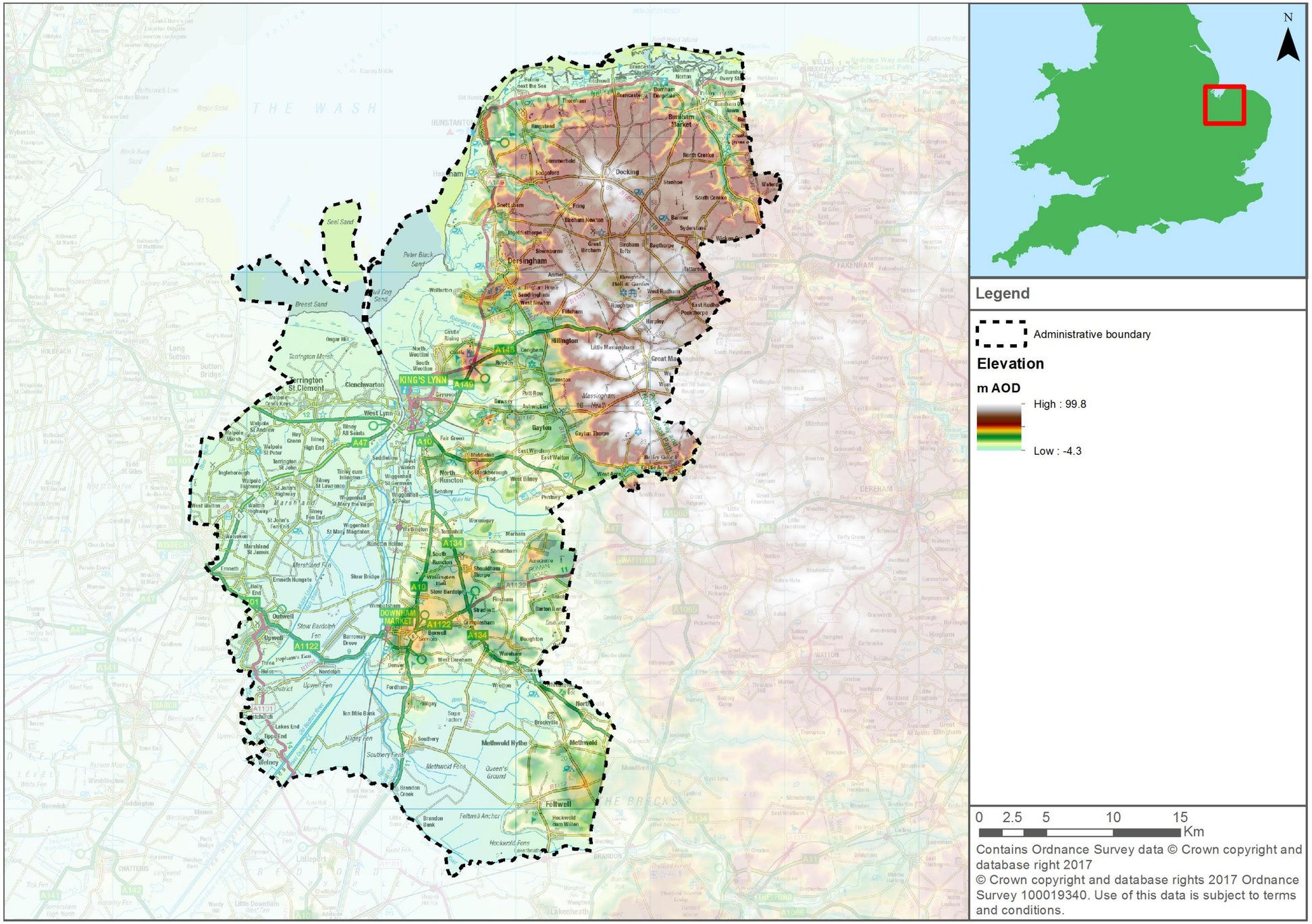


Figure 6-2: Bedrock aquifer classification in the Borough of King's Lynn and West Norfolk

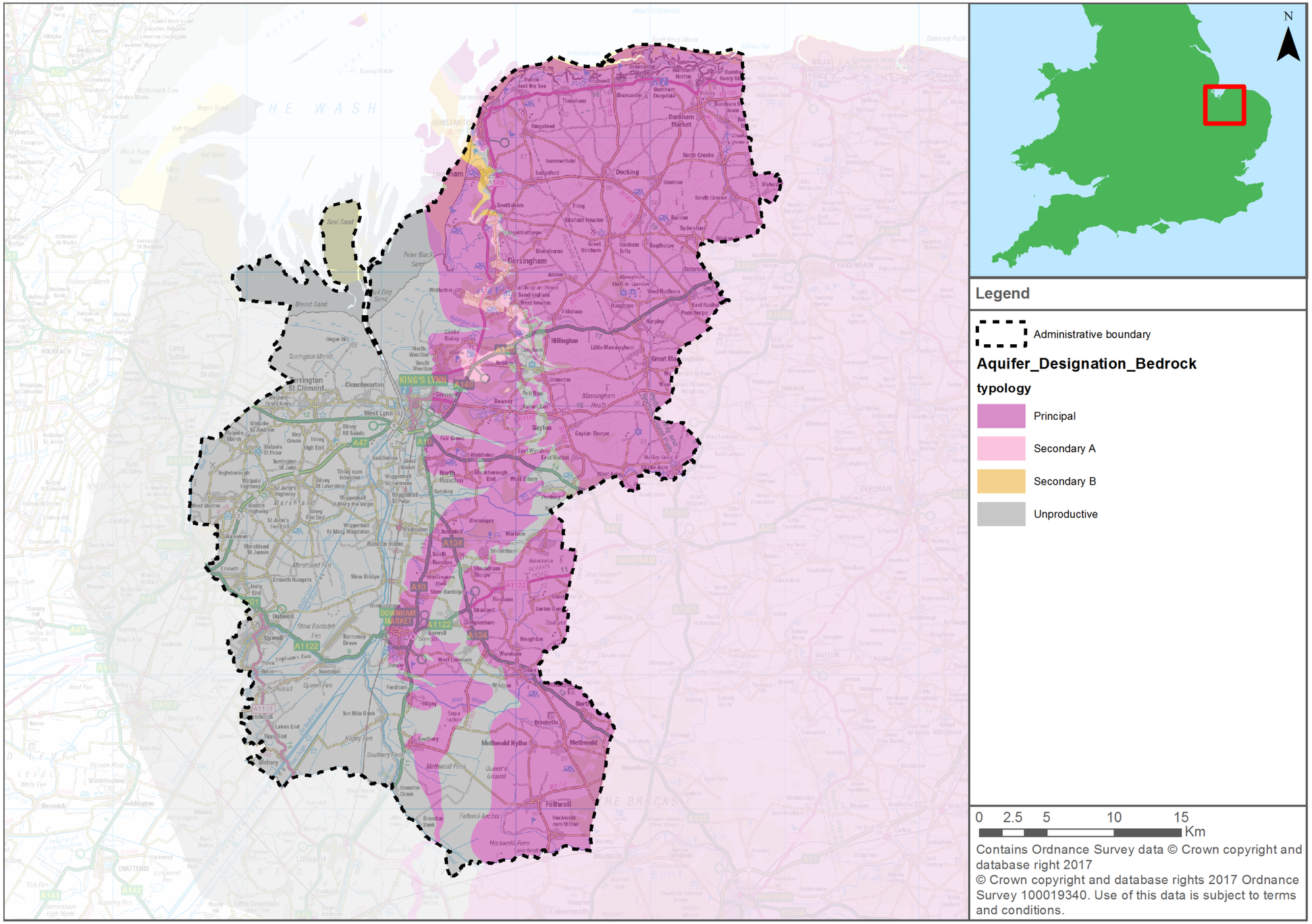
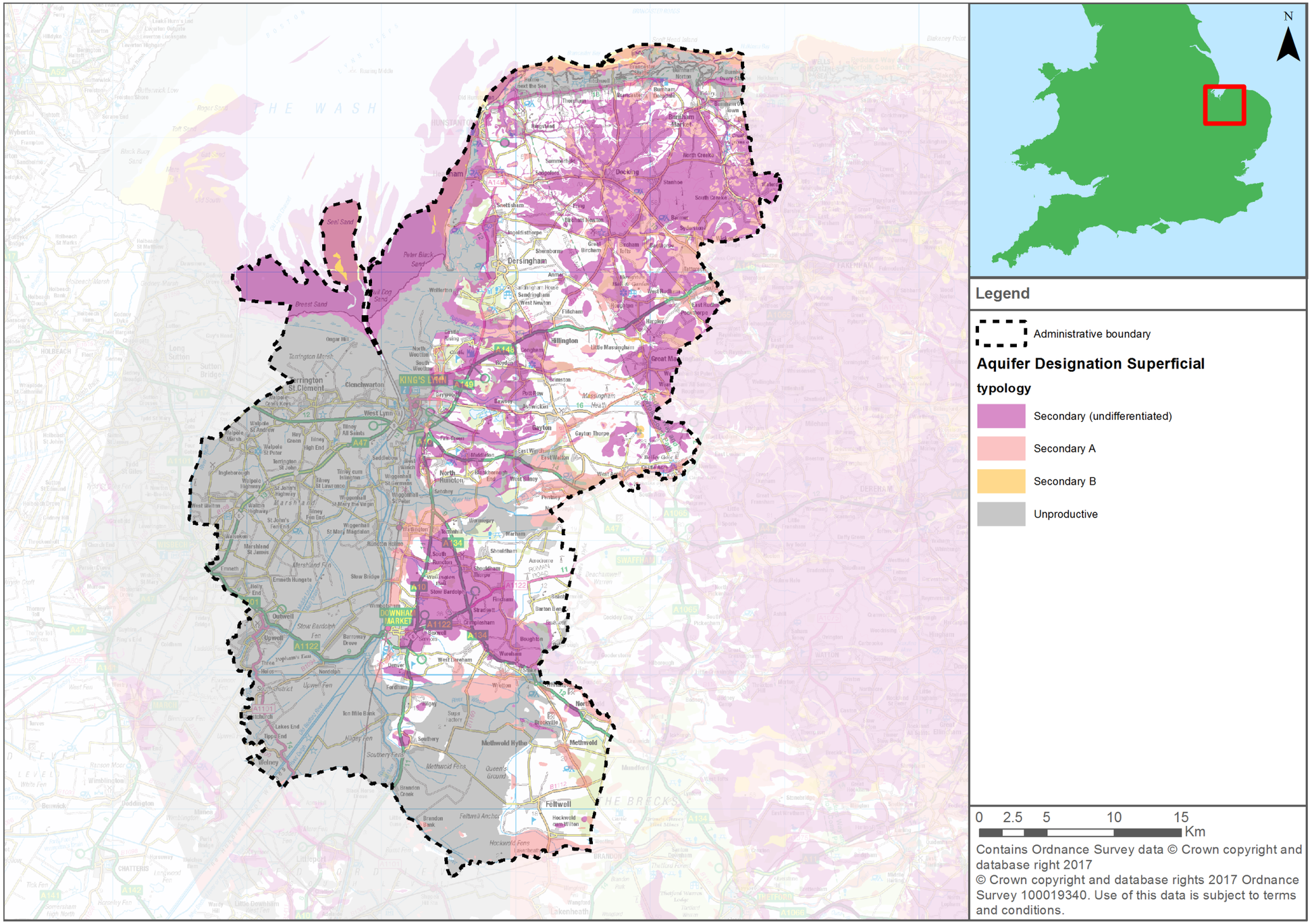


Figure 6-3: Superficial aquifer classification in the Borough of King's Lynn and West Norfolk



6.3 Watercourses in the Borough of King's Lynn and West Norfolk

There are numerous watercourses flowing through the study area. These include Main River, ordinary watercourses and the IDB watercourses. Appendix B shows the location of Main Rivers and Ordinary Watercourses in the Borough of King's Lynn and West Norfolk and the coverage of IDB districts.

6.3.1 Main Rivers

These tend to be larger streams and rivers, though some of them are smaller watercourses of local significance. The Environment Agency has permissive powers to carry out maintenance, improvement or construction work on Main Rivers to manage flood risk. Consultation with the Environment Agency will be required for any development projects within 20m of a Main River or flood defence.

6.3.2 Ordinary Watercourses

These are all watercourses not designated as Main River, and including some IDB watercourses. The local authority or IDB has permissive powers to maintain them, but the responsibility lies with the riparian owner.

6.3.3 Internal Drainage Board watercourses and drains

Numerous smaller watercourses and drains are managed by IDBs within the Borough of King's Lynn and West Norfolk. There are 18 IDBs which operate in the Borough of King's Lynn and West Norfolk; the IDBs are administered by four organisations: Downham Market Group of Internal Drainage Boards, Ely Group of Internal Drainage Boards, Middle Level Commissioners and Water Management Alliance. The coverage of the IDBs is displayed in Appendix B and details of the IDBs are detailed in Table 6-1.

Table 6-1: IDB details within King's Lynn and West Norfolk

IDB Name	Administrator	Coverage	Standard of protection	Policy statement and guidance documents
Burnt Fen	Ely Group of Internal Drainage Boards	The Burnt Fen IDB occupies 175 Ha in the south of King's Lynn and West Norfolk. Burnt Fen extends to the south and west of the King's Lynn and West Norfolk authoritative boundary	Agricultural land – 1 in 20-years Developed areas of land - 1 in 100-years This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 5% and 1% respectively.	**Burnt Fen Policy Statement**
Littleport and Downham	Ely Group of Internal Drainage Boards	The Little Port and Downham IDB covers 2986 Ha in the south of the King's Lynn and West Norfolk Administrative area and extends to the south-west.	Agricultural land – 1 in 20-years Developed areas of land - 1 in 100-years This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 5% and 1% respectively.	**Littleport and Downham Policy Statement**
Churchfield and Plawfield	Middle Level Commissioners	The Churchfield & Plawfield IDB covers 642 Ha in the Upwell area	General standard of 1 in 35-50 years in conjunction with the works of the Middle Level Commissioners in providing protection from the Middle Level system of the 1 in 100-year event. This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the District system taking place each year as being 2-3%.	**Churchfield and Plawfield Policy Statement**
Euximoor	Middle Level Commissioners	The Euximoor IDB covers 3.5 Ha in the south-west of the King's Lynn and West Norfolk administration area. The majority of the IDB extends to the west.	General standard of 1 in 35-50 years in conjunction with the works of the Middle Level Commissioners in providing protection from the Middle Level system of the 1 in 100-year event. This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the District system taking place each year as being 2-3%.	**Euximoor Policy Statement**
Hundred Foot Washes	Middle Level Commissioners	The Hundred Foot Washes lies in the south-west of the King's Lynn and West Norfolk administrative boundary. The IDB occupies 614 Ha between the River Delph and the Old Bedford River and extends beyond the administrative boundary to the south-west.	The Board's District is a designated Washland and Flood Storage area. It is therefore designed to flood whenever the designated levels at Earith Sluice are exceeded.	**Hundred Foot Washes Policy Statement**
Hundred of Wisbech	Middle Level Commissioners	The Hundred of Wisbech IDB covers 5 Ha in the far west of the King's Lynn and West Norfolk authoritative area. The IDB extents to the west.	General standard of 1 in 35-50 years in conjunction with the works of the Environment Agency in providing tidal main river defences of 1 in 200 years. This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the District system taking place each year as being 0.5%.	**Hundred of Wisbech Policy Statement**
Manea and Welney	Middle Level Commissioners	The Manea and Welney IDB occupies 460 Ha in the far south-west of the King's Lynn and West Norfolk authoritative area and extends to the south-west.	General standard of 1 in 20-35 years. This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 3-5%. This is in conjunction with the works of the Environment Agency in providing protection from their system of 1 in 100 years.	**Manea and Welney Policy Statement**
Needham and Laddus	Middle Level Commissioners	The Needham and Laddus IDB occupies 422 Ha in the west of King's Lynn and West Norfolk authoritative area. The IDB extends to the west.	General standard of 1 in 35-50 years in conjunction with the works of the Middle Level Commissioners in providing protection from the Middle Level system of the 1 in 100-year event. This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the District system taking place each year as being 2-3%.	**Needham and Laddus Policy Statement**
Nordelph	Middle Level Commissioners	The Nordelp IDB covers 455 Ha in the west of the King's Lynn and West Norfolk authoritative area.	General standard of 1 in 35-50 years in conjunction with the works of the Middle Level Commissioners in providing protection from the Middle Level system of the 1 in 100-year event. This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the District system taking place each year as being 2-3%.	**Nordelph Policy Statement**
Upwell	Middle Level Commissioners	The Upwell IDB is situated in the south-west of King's Lynn and West Norfolk authoritative area and extends to the south-west. The IDB covers 3517 Ha.	General standard of 1 in 35-50 years in conjunction with the works of the Middle Level Commissioners in providing protection from the Middle Level system of the 1 in 100-year event. This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the District system taking place each year as being 2-3%.	**Upwell Policy Statement**

IDB Name	Administrator	Coverage	Standard of protection	Policy statement and guidance documents
Downham and Stow Bardolph	Downham Market Group of Internal Drainage Boards	The Downham & Stow Bardolph IDB covers 3156 Ha in the south-west of the King's Lynn and West Norfolk authoritative area, to the west of Downham Market.	General standard of protection for agricultural land – 1 in 20-years General standard of protection for developed areas of land – 1 in 100-years This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 5% and 1% respectively.	**Downham & Stow Bardolph Policy Statement**
East of Ouse, Polver and Nar	Downham Market Group of Internal Drainage Boards	The majority of the East of Ouse, Polver & Nar is situated within the centre of King's Lynn and West Norfolk authoritative area occupying 6397 Ha and extends slightly to the west.	General standard of protection for agricultural land – 1 in 20-years General standard of protection for developed areas of land – 1 in 100-years This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 5% and 1% respectively.	**East of Ouse, Polver & Nar Policy Statement**
Northwold	Downham Market Group of Internal Drainage Boards	The Northwold IDB is situated in the south-west of the King's Lynn and West Norfolk administrative area. The IBS occupies 460 Ha.	General standard of protection for agricultural land – 1 in 20-years General standard of protection for developed areas of land – 1 in 100-years This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 5% and 1% respectively.	**Northwold Policy Statement**
Southery and District	Downham Market Group of Internal Drainage Boards	The Southery and District IDB lies in the south of the King's Lynn and West Norfolk authoritative area and covers 10181 Ha. The IDB	General standard of protection for agricultural land – 1 in 20-years General standard of protection for developed areas of land – 1 in 100-years This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 5% and 1% respectively.	**Southery and District Policy Statement**
Stoke Ferry	Downham Market Group of Internal Drainage Boards	The Stoke Ferry IDB occupies 2661 Ha in the south of the King's Lynn and West Norfolk authoritative area.	General standard of protection for agricultural land – 1 in 20-years General standard of protection for developed areas of land – 1 in 100-years This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 5% and 1% respectively.	**Stoke Ferry Policy Statement**
Stringside	Downham Market Group of Internal Drainage Boards	The majority of the Stringside IDB is situated in the east of King's Lynn and West Norfolk administrative area and covers 995 Ha.	General standard of protection for agricultural land – 1 in 20-years General standard of protection for developed areas of land – 1 in 100-years This likely return period cannot be taken literally and should be considered as a chance of some overspilling from the system taking place each year as being 5% and 1% respectively.	**Stringside Policy Statement**
King's Lynn	Water Management Alliance	The King's Lynn IDB covers 33075 Ha in the north of King's Lynn and West Norfolk authoritative area.	General standard of protection for agricultural land – 1 in 10-year with 600mm freeboard General standard of protection for developed areas – 1 in 100-years with 300mm freeboard. This target return period cannot be taken literally and should be considered as the probability of the freeboard being reduce or some overspiling from the system taking place each year, being 10% and 1% respectively.	**King's Lynn Policy Statement**
Norfolk Rivers	Water Management Alliance	The Norfolk Rivers IDB covers four locations within King's Lynn and West Norfolk administrative area, with a total area of 1103 Ha. The four areas covered are Holme-next-the-Sea, Burnham Norton, Coxford and West Acre. The IDBs in the east extend to the east.	General standard of protection for agricultural land – 1 in 10-year with 600mm freeboard General standard of protection for developed areas – 1 in 100-years with 300mm freeboard. This target return period cannot be taken literally and should be considered as the probability of the freeboard being reduce or some overspiling from the system taking place each year, being 10% and 1% respectively.	**Norfolk Rivers Policy Statement**

6.4 Fluvial flood risk

Fluvial flooding is one of the primary sources of flood risk within the Borough of King's Lynn and West Norfolk. The most significant watercourse in terms of fluvial risk is the River Great Ouse; however, there are several other watercourses that pose a significant risk. These include (but are not limited to):

- River Great Ouse
- River Little Ouse
- River Nene
- River Wissey
- Old and New Bedford Rivers
- River Burn
- River Nar
- Pierpoint Drain
- Heacham River
- Babingley River
- Gaywood River

However, flooding across the Borough is predominantly from a combination of fluvial and tidal flooding as a consequence of high tide levels affecting river flood levels.

The flood risk from many of the smaller, Ordinary Watercourses throughout the Borough however is not particularly well understood.[5]

Due to their low-lying elevations, many settlements across the Fens are at risk of tidal flooding, fluvial flooding or both in the event of overtopping / breach from embanked watercourses that are higher than the adjacent land. Should an embanked watercourse (i.e. the Great Ouse) start overtopping fluvial flooding has the potential to inundate a significant area of adjacent low-lying land. The view is overtopping in most scenarios could result in 'disruptive' but manageable flooding. However, should a failure / breach of the defences occur flooding could be severe and likely present a danger to life.[6]

The Fens area is heavily managed by IDBs. Accordingly, a mechanical or structural failure of engineering installations such as land drainage pumps, sluice gates, lock gates, outfall flap valves etc. or their support infrastructure (i.e. power supplies in the case of drainage pumps) could exacerbate flooding.

A summary of fluvial flood risk to settlements in the Borough of King's Lynn and West Norfolk (as well as other sources of flooding), is detailed in Table 6-6.

6.5 Tidal flood risk

Tidal flood risk is assessed based on Extreme Still Water Sea Levels (ESWSL), plus an allowance for the interaction of wind and waves. An ESWSL is the level the sea is expected to reach during a storm event for a particular magnitude of flood event as a result of the combination of astronomical tides and meteorological surges. It is conventional to assess the magnitude of these events by referring to 'still' water, and then to make additional allowances for the effect of waves, wind and swell. The astronomical tide levels are primarily generated by the gravitational effects of the sun and the moon. Surge events are the result of meteorological conditions where low atmospheric pressure causes the sea level to be increased to a higher level than during more average or high atmospheric pressure conditions. The wave heights and swells are influenced by the strength, direction and persistence of the wind and the profile of the nearshore.

Tidal flooding is caused by extreme tide levels exceeding ground and/or defence levels. Tidal flooding often also occurs by wave overtopping of defences. Flood Zones 1, 2 and 3 delineate areas at low risk, medium risk and high risk respectively from both tidal and fluvial flooding. Flood Zones do not take into account the effects of flood defences and as such provide a worst-case

5 Norfolk County Council (2015) Norfolk Local Flood Risk Management Strategy
6 King's Lynn and West Norfolk Borough Council (2008) King's Lynn and West Norfolk Strategic Flood Risk Assessment

assessment of flood risk. Flood Zone 3 and 2 represent the area that would be flooded in the 0.5% AEP and 0.1% AEP tidal event in the absence of defences, respectively. Consideration of how climate change may influence the predicted Flood Zones in the future is indicated within the mapping of Appendix A.

The low-lying areas in the west and south of the Borough that belong to the Fens are highly susceptible to tidal flooding. The **2009 River Great Ouse CFMP** notes that the actual tidal flood risk though within the Great Ouse catchment is generally considered to be low, due to the defences in place and their standards of protection. However, should a breach or failure of an embankment occur flooding has the potential to be extensive. Further, the Nene catchment includes some areas along the western edge of the study area; here tidal waters have the potential to rise over embankments and inundate the land behind them.[7]

The previous 2008 SFRA for the Borough of King's Lynn and West Norfolk states that the greatest risk related to tidal flooding would be if a spring tide coincided with a major storm surge. This could produce water levels up to 2.0m above peak spring tide in a 1 in 100-year event and greater in lower return periods. Areas where tidal flooding would have the greatest impact include along the Wash Banks and North Sea coastline, as well as up the Great Ouse and River Nene Estuaries. Tidal Flood defences are essential to preventing the inundation of the Fens (see section 7 for more information).

Tidal locking is also likely to be an issue as high tidal levels may prevent watercourses such as the Great Ouse and other North Norfolk catchment watercourses (i.e. the River Burn) from discharging effectively, raising levels in the lower reaches of the watercourse.[8]

A summary of tidal flood risk to settlements in the Borough of King's Lynn and West Norfolk (as well as other sources of flooding), is detailed in Table 6-6.

Fluvial and tidal Flood Zones, for the Borough of King's Lynn and West Norfolk can be found in Appendix A.

6.6 Coastal flood risk

If the coast is eroding, then the potential effect is that tidal flood and erosion defences near to the sea will be lost and flood risk may increase. To maintain an appropriate standard of safety from flooding it is sometimes necessary to implement works to slow down or stop the rate of coastal erosion and so maintain the integrity of the coastal defences. The (2010) **North Norfolk Shoreline Management Plan** (SMP) covering Hunstanton to Kelling and the (2010) **The Wash SMP** covering Gibraltar Point to Old Hunstanton describe the high level strategy and coastal polices. It should be noted that the policies described in the SMPs do not always focus on the "hold the line" approach. For example, at Hunstanton Cliffs, the short and medium term the strategy of no active intervention will be used allowing the cliffs to erode naturally. Meanwhile, in the long term as a lighthouse and other historic or recreational features come to be threatened, hold the line options may be explored. Section 2.9 outlines the SMP strategies in the Borough. The emerging Hunstanton Coastal Management Plan will look at options for reducing the rate of erosion of the cliffs, as well as options for the promenade sea defences and groynes.

Coastal erosion is a predominant process along Hunstanton Cliffs causing potential threats to settlements and coastal defences. The emerging **Hunstanton Coastal Management Plan** will address these issues by defining a plan to manage the coastline at a local level. Should these defences be compromised there could be the additional risk of inundation to properties behind in areas susceptible to coastal flooding. Coastal flooding can also often occur by wave overtopping of defences. Groundwater also plays a role in coastal erosion, as water within the rock strata can create instabilities within coastal cliffs.

6.7 Surface water flood risk

Flooding from surface water runoff (or 'pluvial' flooding) is usually caused by intense rainfall that may only last a few hours, occurring often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding.

7 Environment Agency (2009) River Nene Catchment Flood Management Plan
8 Environment Agency (2010) North Norfolk Catchment Flood Management Plan

The Risk of Flooding from Surface Water (RoFfSW) dataset shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low-lying areas. The RoFfSW mapping for the Borough of King's Lynn and West Norfolk can be found in Appendix A.

The **2009 Great Ouse CFMP** identifies surface water flooding as being a particular problem in King's Lynn and South Wootton.

The **2012 King's Lynn and West Norfolk Settlements Surface Water Management Plan** identified critical drainage catchments in the following locations:

- King's Lynn
  - Green Lane, South Wootton
  - Wootton Drift
  - Swan Lane, Gaywood
  - Fairstead
  - King's Lynn Centre
  - A47 Saddlebow Roundabout
- Downham Market
  - Railway Station and Electrical Sub-Station
  - High Street
- Wimbotsham
- Snettisham
- Heacham (at Marram Way)

A Section 19 Flood Investigation Report found that a significant number properties in the south of the study area flooded between June and November 2014 either due to them being located where rainfall naturally gathers at low points or due to them being situated lower than the adjacent road resulting in surface water flowing in the direction of the property. A further Flood Investigation Report also found that poorly maintained drainage in the vicinity of Sutton Road, Walpole Cross Keys was responsible for flooding in November and December 2012. Section 19 reports are available to download from Norfolk County Council's **website**.

A summary of surface water flood risk to settlements in the Borough of King's Lynn and West Norfolk (as well as other sources of flooding), is provided in Table 6-6.

6.8 Groundwater flood risk

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. Under the Flood and Water Management Act (2010), LLFAs have powers to undertake risk management functions in relation to groundwater flood risk. 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 groundwater levels 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.

As part of the SFRA deliverables, mapping of the Borough of King's Lynn and West Norfolk has been provided showing the Areas Susceptible to Groundwater Flooding (AStGWf). This information is provided in Appendix A. The AStGWf is a strategic-scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the LLFAs to determine whether they may be at risk of flooding from groundwater. This data 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, nor does it take account of the chance of flooding from groundwater rebound (rising groundwater levels resulting from a reduction in abstraction rates from groundwater). 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 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. It should be noted that although an area may be designated as susceptible to groundwater flooding, this does not mean that groundwater flooding will definitely be a problem within these areas, rather it provides an indication of potential risk.

The AStGWf dataset shows that areas more susceptible to groundwater flooding are generally associated with the valleys of watercourses and along coastline areas. The AStGWf dataset is shown in Appendix A.

Due to the characteristics of The Wash and the underlying Chalk features there exists a potential for groundwater flooding. For example, the River Burn is a chalk stream and the section upstream of Burnham Thorpe and the Goose Beck tributary at Burnham Market can dry out as they are groundwater fed. Conversely when groundwater levels are high, flows will increase.

The lowest lying areas tend to be the Fens and are highly managed so it is reasonable to assume the pumping infrastructure operated by the IDB maintains a low water table. This would be reducing the probability of groundwater flooding. Nevertheless, there remains a residual risk of groundwater flooding due either a failure of the pumps of an exceedance of pump capacity.[9]

Meanwhile due to the presence of historic industrial sites across King's Lynn there is a heightened risk of groundwater pollution in some areas. This may place some limitations on surface water drainage mechanisms available for certain sites.[10]

A summary of groundwater water flood risk to settlements in the Borough of King's Lynn and West Norfolk (as well as other sources of flooding), is detailed in Table 6-6.

6.9 Flooding from artificial sources

6.9.1 Flooding from sewers

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system. Infiltration or entry of soil or groundwater into the sewer system via faults within the fabric of the sewerage system, is another cause of sewer flooding. Infiltration is often related to shallow groundwater, and may cause high flows for prolonged periods of time.

Since 1980, the Sewers for Adoption guidelines have meant that most new surface water sewers have been designed to have capacity for a 1 in 30-year rainfall event (3.3% AEP), although until recently this did not apply to smaller private systems. This means that, even where sewers are built to current specification, they are likely to be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding. Existing sewers can also become overloaded as new development adds to the discharge to their catchment, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

The **2012 King's Lynn and West Norfolk Surface Water Management Plan** identifies a total of 11 Critical Drainage Catchments within the settlements of which six are located within the urban area of King's Lynn (see Section 6.7).

The 2008 SFRA meanwhile reported that Anglian Water Services were aware of localised sewer flooding in the following locations:

- King's Lynn
    - Bagge Road
    - Hockham Street
    - Mayflower Avenue

9 Norfolk County Council (2015) Norfolk Local Flood Risk Management Strategy
10 Norfolk County Council (2015) Norfolk Local Flood Risk Management Strategy.

- Oldmedow Road
- Turbus Road

- Downham Market
  - Maltings Lane
  - Oakview Drive
  - Paradise Road
  - Peverall Road
  - Railway Road

Historical incidents of flooding are detailed by Anglian Water in their sewer flooding register. This database records incidents of flooding relating to public foul, combined or surface water sewers and identifies which properties suffered flooding. For confidentiality reasons, this data has been supplied on a postcode basis. The information from the sewer flooding register is shown in Table 6-2. Anglian Water's Pre-development Team is able to advise applicants of whether there is a record of sewer flooding within the vicinity of the proposed development which would need to be considered as part of a site specific Flood Risk Assessment and/or Drainage Strategy.

The sewer flooding register indicates a total of 118 recorded flood incidents in the Borough of King's Lynn and West Norfolk. The more frequently flooded postcodes are: PE32 1 (24 incidents), PE31 7 (13 incidents), PE30 4 (11 incidents) and PE38 9 (11 incidents). It is important to recognise the sewer flooding register does not contain information about properties and areas at risk of sewer flooding caused by operational issues such as blockages. Also, the register represents a snap shot in time and will get outdated with properties being added to the register following rainfall events, whilst risk will be reduced in some locations by capital investment to increase the capacity of the network. In addition, incidences of sewer flooding will not be relevant to all developments within the postcode areas identified as this will be dependent upon the proposed connection point(s) for new developments. As such the sewer flooding flood risk register is not a comprehensive 'at risk register'.

Table 6-2: Sewer flooding register for the Borough of King's Lynn and West Norfolk

Location	Postcode	Recorded flood incidents
Wisbech	**PE14 0**	2
Walton Highway/ West Walton	**PE14 7**	5
Emneth	**PE14 8**	7
King's Lynn	**PE30 1**	1
King's Lynn	**PE30 2**	6
King's Lynn	**PE30 3**	8
King's Lynn	**PE30 4**	11
King's Lynn	**PE30 5**	5
Ingoldisthorpe	**PE31 6**	1
Heacham	**PE31 7**	13
Burnham Deepdale/ Brancaster Straithe	**PE31 8**	2
Pott Row/ Grimston/ Middleton/ Roydon/ Gayton	**PE32 1**	24
Watlington/ West Winch	**PE33 0**	4

Wiggenhall St. Germans/ Wigenhall St. Mary Magdalen/ Magdalen	**PE34 3**	10
Terrington St. Clement/ Clenchwarton	**PE34 4**	4
Hunstanton	**PE36 5**	2
Hunstanton	**PE36 6**	1
Downham Market	**PE38 0**	1
Downham Market	**PE38 9**	11
	Total 118	
	Note: Based on information supplied on 26/06/2017	

6.9.2 Flooding from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low. Recent changes to legislation under the Flood and Water Management Act require the Environment Agency to designate the risk of flooding from these reservoirs. The Environment Agency is currently progressing a 'Risk Designation' process so that the risk is formally determined.

The risk of inundation to the King's Lynn and West Norfolk area as a result of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation Reservoir Mapping (NIRIM) study. There are 48 reservoirs which present a risk to the Borough of King's Lynn and West Norfolk of which, 13 reservoirs are located outside of the study area whose inundation mapping is shown to affect the Borough. Details of the reservoirs are provided in Table 6-3. Maps of the flood extent can be found on the Government's **Long term flood risk information website**.

The Government's maps represent a credible worst-case scenario. In these circumstances, it is the time to inundation, the depth of inundation, the duration of flooding and the velocity of flood flows that will be most influential.

Table 6-3: Reservoirs with potential risk to the Borough of King's Lynn and West Norfolk

Reservoir	Location (grid reference)	Reservoir owner
Butchers Hill Winter Storage Reservoir	553298, 291365	J Gilbert and Son (Littleport) Ltd
River Nar Flood Storage Area	566933, 313424	Environment Agency
New Barn Reservoir	561120, 295106	Waldersey Farms Ltd
Golder Hill	569046, 323606	Rae
Wissington No.3 (Wildes Pond)	566731, 297752	British Sugar Plc
Wissington No.2 Pond (Storage Lagoon)	565854, 298648	British Sugar Plc
Wissington No.1 (Duck) Pond	565824, 298255	British Sugar Plc
Chalk Breck	575720, 308024	D.H. Sanderson and Son Ltd
Ouse Washes FSA	545831, 284570	Environment Agency
Redmere	564910, 286578	River Fen Farms Ltd
Rosedene Reservoir No 1	567872, 295359	G.S. Shropshire and Sons Ltd
Warren Gun Breck	579748, 302559	Knights Farms Ltd
Pioneer and Severalls Farm Reservoir	567373, 297417	G.S. Shropshire and Sons Ltd

Reservoir	Location (grid reference)	Reservoir owner
Stow Bardolph No. 1 (ID106)	563639, 305598	Stow Estate Trust
Caldecote Farm	576063, 304101	Heygate Farm (Swaffham) Ltd
Warren Lodge Farm	575581, 294005	EW Porter and Son
Warren Farm Beachamwell	577660, 306430	Heygate Farm (Swaffham) Ltd
Manor Farm Reservoir (West Bilney)	571945, 314596	O.W. Wortley and Sons Ltd
Feltwell Anchor Reservoir	565291, 290111	G C Field and Sons
Further Fen Farm Reservoir	560815, 294841	A.L. Legge and Son
Lakenheath	567624, 285651	Royal Society for the Protection of Birds
Highmoor Drove	576354, 298356	J.W. Spencer Farms Ltd
Stradsett Lake	566951, 306045	Stradsett Estate Trustees
Battles East	573797, 310415	Queensquare Farming Limited
Cley Breck North	576985, 303674	O.W. Wortley and Sons
Middle Farm Winter Storage	566229, 289517	Shrubhill Farms Limited
Narford Lake	575650, 313839	Fountaine
Magpie Farm	573617, 314593	Davison and Co (Barford) Ltd
Grange Farm Reservoir	572624, 291944	EW Porter and Son
Fourteen Acre Field	580321, 307440	Heygate Farm (Swaffham) Ltd
Manor Farm Reservoir, Middleton	565705, 317806	Fair Green Farms
Spring Lodge Methwold	575420, 294657	O.W. Wortley and Sons
Reaches Farm	573494, 298257	O.W. Wortley and Sons
Half Moon Reservoir	564101, 286995	River Fen Farms Ltd
Stony Hills	569780, 338166	GW Harold and Partners
Lyng Farm Reservoir (Thornham)	574233, 340460	Thornham Farms (Norfolk) Ltd
Lyng Quarry (Farm) (ID107)	574180, 341730	Thornham Farms (Norfolk) Ltd
Village Farm reservoir	579234, 327029	Cholmondeley Estates
Brickyard Reservoir	586206, 342631	Holkham Farming Company Ltd
Denver Black Bank FSR	559118, 301530	Environment Agency
Soigne Reservoir	577503, 318089	Heronhill water LLP
Dodds 2 Reservoir	575446, 320048	Heronhill water LLP
Redmere No2	565307, 286125	River Fen Farms Ltd
Denver Silt Fen	559038, 300822	Environment Agency
Denver Middle Drove	559852, 302353	Environment Agency
Piggeries Field Ikburgh	580304, 296363	J.W. Spencer Farms Ltd
Hilgay Wetland	564968, 297433	Norfolk Wildlife Trust
Docking Reservoir	574880, 335814	Robinsons Farm Ltd.

Reservoir flooding is very different from other forms of flooding. It may happen with little or no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate, but it is less likely than flooding from rivers or surface water. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage.

- Developers should seek to contact the reservoir owner to obtain information which may include:

- reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
- operation: discharge rates / maximum discharge;
- discharge during emergency drawdown; and
- inspection / maintenance regime.

- Developers should 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 lay-out?
  - 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 relevant authorities regarding emergency plans in case of reservoir breach

In addition to the risk of inundation those considering development in areas affected by breach events should also assess the potential hydraulic forces imposed by the rapid flood event and check that the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

The NPPG states that, where relevant, the LPAs should take advice from reservoir undertakers. LPAs should discuss their proposed site allocations with reservoir undertakers to[11]:

- avoid an intensification of development within areas at risk from reservoir failure, and;
- ensure that reservoir undertakers can assess the cost implications of any reservoir safety improvements required due to changes in land use downstream of their assets.

6.10 Flood warning and emergency planning

6.10.1 Emergency planning

Emergency planning is one option to help manage flood related incidents. From a flood risk perspective, emergency planning can be broadly split into three phases: before, during and after a flood. The measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding.

In development planning, a number of emergency planning activities are already **integrated** in national building control and planning policies e.g. the NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. However; safety is a key consideration for any new development and includes residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes to a locally identified refuge area and evacuation procedures. One of the key changes in the 2018 NPPF is related to emergency planning. Emergency plans are required as part of an FRA that includes the inclusion of safe access and egress routes to a locally identified refuge area (para 163e).

The NPPF Planning Practice Guidance outlines how developers can ensure safe access and egress to and from development to a locally identified refuge area to demonstrate that development satisfies the second part of the Exception Test. As part of an FRA, the developer should review the acceptability of the proposed access in consultation with the LPA (where appropriate) and the Environment Agency.

There are circumstances where a flood warning and evacuation plan[12] is required and / or advised:

- It is a **requirement under the NPPF** that a flood warning and evacuation plan is prepared for sites at risk of flooding used for holiday or short-let caravans and camping and are important at any site that has transient occupants (e.g. hostels and hotels) and for essential ancillary sleeping or residential accommodation for staff required by uses

11 NPPG, Paragraph: 006 Reference ID: 7-006-20140306, Revision date: 06 03 2014

12 Flood warning and evacuation plans may also be referred to as an emergency flood plan or flood response plan.

in this category [water-compatible development], subject to a specific warning and evacuation plan.

- The **Environment Agency and DEFRA's standing advice** for undertaking flood risk assessments for planning applications states that details of emergency escape plans will be required for any parts of the building that are below the estimated flood level.

It is recommended that Emergency Planners at the Borough Council of King's Lynn and West Norfolk and / or Norfolk County Council (where appropriate) are consulted prior to the production of any emergency flood plan.

In addition to the **flood warning and evacuation plan considerations listed in the NPPF / PPG**, it is advisable that developers also acknowledge the following:

- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach.
- Proposed new development that places additional burden on the existing response capacity of the Councils will not normally be appropriate.
- Developers should encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.
- The vulnerability of site occupants.
- Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop emergency plans.

The **Norfolk Prepared**, Local Resilience Forum website covering King's Lynn and West Norfolk provides practical advice for residents, communities and businesses on preparing for emergencies (not exclusive to flooding). The LRF website provides a map of **communities with registered emergency plans** and contains emergency plan templates for residents and communities. The agencies which form the Norfolk Local Resilience Forum have also prepared a number of multi-agency emergency plans to support the flood response; these can be downloaded from their **website**.

Further emergency planning information links:

- **2004 Civil Contingencies Act**
- **DEFRA (2014) National Flood Emergency Framework for England**
- **Sign up for Flood Warnings with the Environment Agency**
- **National Flood Forum**
- **GOV.UK Make a Flood Plan guidance and templates**
- **FloodRe**
- **Local Resilience Forum website covering the Borough of King's Lynn and West Norfolk**

6.10.2 Flood warnings

Flood warnings can be derived and, along with evacuation plans, can inform emergency flood plans or flood response plans. The Environment Agency is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as Main Rivers) and coastal flooding in England. Flood Warnings are supplied via the Flood Warnings Service (FWS), to homes and business within Flood Zones 2 and 3.

There are currently 14 Flood Alert Areas (FAAs) and 31 Flood Warning Areas (FWAs) covering significant parts of the King's Lynn and West Norfolk area. These are shown in Appendix A. A list of the FAAs in the study area is shown in Table 6-4 and a list of the FWAs in the study area is shown in Table 6-5.

Table 6-4: Flood Alert Areas within the Borough of King's Lynn and West Norfolk

Flood Alert Code	Flood Alert Name	Watercourse	Coverage
052WAFBWC	Middle Level in the Fens	Great Ouse	Middle Level in the Fens
052WAFELY	Ely Ouse	Great Ouse and Lodes	Great Ouse and the Cambridgeshire Lodes
052WAFHFW	Hundred Foot Washes	Old Bedford River, New Bedford River, Hundred Foot Drain, River Delph	Hundred Foot Washes, also known as the Ouse Washes, including the causeways at Earith, Sutton Gault and Welney
052WAFLOT	Little Ouse River and River Thet in Suffolk and Norfolk	Little Ouse and River Thet	Little Ouse River from Rickinghall to Hockwold, including The Black Bourn, and River Thet from Attleborough to Thetford
052WAFWNR	North West Norfolk Rivers	Heacham, Ingol and Babingley Brook	River Heacham, River Ingol and Babingley Brook in Norfolk
052WATCST	Coast from Hunstanton to north of King's Lynn	The North Sea	Hunstanton, Heacham, Snettisham, Ingoldisthorpe, Dersingham and Wolferton areas
052WATKLN	King's Lynn, West Lynn and The Wash frontage	The Tidal River and Great Ouse	King's Lynn, West Lynn, Clenchwarton, Terrington St Clement, Walpole Cross Keys and Tilney All Saints areas
052WATTIDALRV	Tidal river from Denver to south of King's Lynn	Tidal River Great Ouse	Eau Brink, Saddle Bow, the Wiggenhalls, Tilney St Lawrence, West Walton, Walpole St Peter, Walpole Highway, Watlington, Nordelph, Barroway Drive and Salters Lode.
054WACDV2A	The north Norfolk coast from Old Hunstanton, to and including Cley	North Sea	The north Norfolk coast at Old Hunstanton, Brancaster, Burnham, Holkham, Wells, Blakeney and Cley
054WAFNF1D	The River Burn from South Creake, to and including, Burnham Thorpe	Burn	The River Burn from South Creake, to and including, Burnham Thorpe
054WAFNF4A	The River Wensum upstream of Hempton, including the River Tat	Wensum, Tat	The River Wensum upstream of Hempton, including the River Tat
055WAT602WTEb	Areas near the tidal River Welland, tidal River Nene, and The Wash	River Welland, River Nene, The Wash	Areas near the tidal River Welland, tidal River Nene, and The Wash frontage from Fossdyke Wash to Terrington Marsh
052WAFWISSEY	River Wissey in Norfolk	River Wissey	River Wissey from Bradenham to Denver including Watton Brook
052WAFNAR	River Nar in Norfolk	River Nar	River Nar from Litcham to South Lynn

Table 6-5: Flood Warning Areas within the Borough of King's Lynn and West Norfolk

Flood Warning Code	Flood Warning Name	Watercourse	Coverage
052FWFGO7BL	Old Bedford Counter Drain Flood Defence	Old Bedford	Welney, Nordelph, Upwell, Christchurch, Manea, Outwell
052FWFMLC01	Middle Level Commissioner Area	Middle Level Drains	Ramsey to Upwell covering the Middle Level
052FWTCST_BRKL S	Coast from north of King's Lynn to Snettisham	The North Sea	North Wootton, Wolferton, Dersingham, Ingoldisthorpe and Snettisham.
052FWTCSTHUN	Precautionary Evacuation Notice area at Hunstanton	North Sea	locations along South Beach Road, Seagate Road and the sea front
052FWTCSTHSF	Precautionary Evacuation Notice area at Heacham seafront	North Sea	Properties along the sea front at Heacham
052FWTCSTHEACH	West Norfolk Coast at Heacham	North Sea	Caravan Parks, Jubilee Road, Marram Way, Forest Drive, Leaside, Folgate Road, Fengate, Sandringham Road, along with the Manor Farm area, and Beach Farm.
052FWTCSTSSF	Precautionary Evacuation Notice area at Snettisham seafront	North Sea	properties in front of the flood defences, along the sea front at Snettisham
052FWTCSTSNETT	West Norfolk Coast at Snettisham	North Sea	Properties and caravan parks along Beach Road
052FWTTRVWH	Tidal River Great Ouse at the Wiggenhalls	River Great Ouse	Saddlebow, Wiggenhall St Germans, Wiggenhall St Peter and Wiggenhall St Mary Magdalen
052FWTKLNKL1	King's Lynn river frontage and South Lynn	River Great Ouse	Areas close to the River Great Ouse at King's Lynn, from the Relief Channel to Riverside Industrial Estate
052FWTKLNKL2	Urban area of King's Lynn	River Great Ouse	Areas of King's Lynn including Highgate, North End, North Lynn, Hardwick and parts of Fairstead, Gaywood and South Wootton
052FWTKLNWL	Tidal River Great Ouse at West Lynn	River Great Ouse	West Lynn
052FWTTRV_BRW1	Wash frontage at Admiralty Point including Tidal River Great Ouse west bank breach to Eau Brink	North Sea	Admiralty Point, Terrington St Clement, Clenchwarton, Tilney All Saints, Tilney High End, Walpole Cross Keys and Eau Brink
052FWTTRV_BRW2	Tidal River Great Ouse west bank breach from the Wiggenhalls to Outwell	River Great Ouse	Wiggenhall St Mary The Virgin, Tilney St Lawrence, Tilney cum Islington, Tilney Fen End, St Johns Fen End, Marshland St James and Outwell.
052FWTTRV_BRW3	East of Wisbech along the A47 to	River Great Ouse	Terrington St Clement, Walpole St Andrew,

	Terrington St John and surrounding areas		Walpole St Peter, Terrington St John, Walpole Highway, West Walton, Walton Highway, Wisbech, Emneth, Walsoken, Marshland St James and St Johns Fen End
052FWTTRV_BRW 4	Tidal River Great Ouse west bank breach from Stowbridge to Nordelph	River Great Ouse	Stowbridge, St. Johns Fen End, Marshland St James, Barrow Drove, Outwell, Nordelph, Salters Lode and Downham Market
054FWCDV2A1	The north Norfolk coast from Old Hunstanton to Staithe Lane, including Holme-next-the-Sea	North Sea	The north Norfolk coast at Old Hunstanton including the golf course, Holme-next-the-sea and Staithe Lane
054FWCDV2A2	The north Norfolk coast at Thornham, from Staithe Lane to the Titchwell Nature Reserve	North Sea	The north Norfolk coast at Thornham, from Staithe Lane to the Titchwell Nature Reserve
054FWCDV2A3	The north Norfolk coast at Brancaster, from Titchwell Marsh Nature Reserve to Brancaster Marsh	North Sea	The north Norfolk coast at Brancaster, from Titchwell Marsh Nature Reserve to Brancaster Marsh
054FWCDV2A4	The north Norfolk coast at Brancaster Staithe	North Sea	The north Norfolk coast at Brancaster Staithe
054FWCDV2A5	The north Norfolk coast at Burnham	North Sea	The north Norfolk coast at Burnham Deepdale, Burnham Norton, Burham Over and Burnham Market
054FWCDV2A6	The north Norfolk coast from Burnham Overy Staithe and Holkham	North Sea	The north Norfolk coast at Burnham Overy Staithe and Holkham, including Holkham Nature Reserve
054FWFNF1D	The River Burn from South Creake, to and including Burnham Thorpe	Burn	The River Burn from South Creake, to and including Burnham Thorpe
055FWTNENE1B	Tidal River Nene in Wisbech	River Nene	Tidal River Nene in Wisbech
055FWTNENE2C	Wash Frontage and the right bank of the Tidal Nene from Walton Dam to Admiralty Point	Tidal Nene, The Wash	Wash Frontage and the right bank of the Tidal Nene from Walton Dam to Admiralty Point, including Walpole Marsh, Walpole Cross Keys, Bellmount and Wingland Marsh
052FWFLOTTH	Little Ouse River and River Thet from Thetford to Hockwold	Little Ouse River, River Thet	Primrose Close, The Meadows, Castle Lane, Mill Lane, Old Bury Road, Bridge Street, Riverside Walk, Canon's Close, Coney Close and Coventry Way in Thetford, Teal Walk, High Street and Riverside Way in Brandon, and Church Lane in Hockwold
052FWFWIMH	River Wissey from Mundford to Hilgay	River Wissey	Swaffham Road, Malsters Close, and The Lammas in Mundford, Bridge Road and Great Man's Way in Stoke Ferry, and Bridge Street in Hilgay

052FWFNANS	River Nar from Narborough to Saddlebow	River Nar	Main Road in Narborough, Spring Lane in Marham, Lynn Road, Garage Lane and St. Germans Road in Setchey, Mill Road in Wiggenhall St. Germans, and Low Road, High Road and Saddlebow Road in Saddlebow
052FWTTRV_BRE1	Tidal River Great Ouse east bank breach at Downham Market	River Great Ouse	Bridge Road and Horse Fair Close
052FWTTRV_BRE2	Tidal River Great Ouse east bank breach from Watlington to south King's Lynn	River Great Ouse	Stow Bridge, Watlington, Setchey, West Winch, Saddlebow and Wiggenhall St Germans
052FWFHFW_BRE2	Hundred Foot Washes Flood Defences east bank breach from Coveney to Denver	River Great Ouse	Littleport, Hilgay, Downham, Welney, Coveney, Southery, Fordham, Denver and Witcham

6.10.3 Dry Islands

In this SFRA, dry islands are defined as an area of 0.5 hectares or greater in size, identified as being in Flood Zone 1 and completely surrounded by land which falls within Flood Zone 2 (i.e. the extreme 1 in 1,000-year extent). The 0.5 hectares threshold was selected as this reflects one of the criteria used to define "major development" (see Section 2.5). Flood Zone 2 was selected as under the NPPG, developers are required to consider the safety of the site during the extreme flood event including the potential for an evacuation before the extreme flood event.

Dry islands can present specific hazards, primarily the provision of safe access and egress during a flood event.

The results show that there are 564 dry islands in the Borough of King's Lynn and West Norfolk. These are primarily located towards the southern and western areas of the Borough and a few dry islands cross administrative boundaries into neighbouring districts.

The identification of dry islands in this SFRA have limitations:

- Dry islands account for the fluvial and tidal flood risk only, as mapped in the SFRA Flood Zone 2. No other sources of flood risk nor a breach of defences have been considered when mapping dry islands.
- A number of the dry islands are located in areas where there are IDB drains; it is not known what influence that the IDB drains will have on the extent of flood risk.
- Other areas may be considered a dry island if all access routes are compromised due to flood waters, regardless of whether the surrounding land is covered by flood waters. Identifying such areas was not practical given the strategic nature of the assessment and that this is a Level 1 SFRA.
- Dry islands are identified based on the SFRA Flood Zone 2 extent. This does not consider flood depths, velocities or flood hazard to people classification.

Mapping which shows these dry islands is contained in Appendix A.

Emergency planning implications

A site-specific Flood Risk Assessment may be required if a proposed development is located within a dry island (even for sites less than 1 hectare and in Flood Zone 1). A site-specific Flood Risk Assessment may also need to be accompanied with a Flood Warning and Evacuation Plan to detail emergency response arrangements. However, it should be noted that evacuation may not always be the most suitable response. Situations may arise where occupants cannot be evacuated or where it is safer to remain "in-situ" (e.g. if a safe evacuation cannot be safely facilitated because flooding obstructs access and egress).

The developer should consult with the Borough Council of King's Lynn and West Norfolk if their site is located on a dry island and the requirements for a site-specific FRA and emergency procedures. Further work may need to be undertaken by the developer to confirm the flood extent around the dry island, for example if the site is located in an area near an IDB drain, the coastline or in a catchment <3km^2, which are not accounted for in this analysis.

6.11 Cross Boundary Considerations

The topography of the Borough means that a number of major watercourses such as the River Great Ouse and the River Wissey flow through the study area. As such, future development, both within and outside the Borough of King's Lynn and West Norfolk can have the potential to affect flood risk to existing development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation. The Borough Council of King's Lynn and West Norfolk has boundaries with the following Local Authorities:

- North Norfolk District
- Breckland District
- Forest Heath District
- East Cambridgeshire District
- Fenland District
- South Holland District

Neighbouring authorities in Norfolk are collectively working together in this SFRA and/ or through the Norfolk Strategic Framework. Information, where available on emerging plans, has been used to assess whether there are any proposed developments that may affect flood risk in the Borough of King's Lynn and West Norfolk.

The **Great Ouse Tidal River Baseline Report, 2017**, sets out flood risk management issues in the Great Ouse Tidal River System which covers the Borough of King's Lynn and West Norfolk and East Cambridgeshire District Council's

The neighbouring authority Fenland District Council, has allocated 3000 homes in the Wisbech Fringe Area. The Wisbech Level 2 SFRA produced for Fenland District Council, 2012 offers flood risk advice for this area under Sub Area E – Central. It is recommended that the most recent local plans of neighbouring authorities are obtained to accurately assess neighbouring authority allocations as several authorities were yet to publish their site allocations at the time of this report. 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 the Borough of King's Lynn and West Norfolk.

Development control should ensure that the impact on receiving watercourses from development in the Borough of King's Lynn and West Norfolk has been sufficiently considered during the planning stages and appropriate mitigation measures put in place to ensure there is no adverse impact on flood risk or water quality.

6.12 Summary of flood risk to towns and villages in the Borough of King's Lynn and West Norfolk

Table 6-6 summarises the flood risk to towns and villages in the Borough of King's Lynn and West Norfolk. A high-level review was undertaken to identify the main settlements where flood risks / extents are more prominent. This has been informed by historic flood risk information and the flood risk datasets shown in Appendix A. It is therefore important that the information contained in this table is read in conjunction with the Technical Summary provided in Appendix D. The Technical Summary provides further information on the hydraulic modelling and mapping approaches used in this SFRA.

The settlements listed in Table 6-6 do not reflect the settlement hierarchy in the Local Authority's Local Plan.

If a settlement is not listed in Table 6-6, this does not mean that the settlement is not at flood risk. The mapping provided in Appendix A can be used as a high-level screening exercise, to identify whether a location or site has a potential risk of flooding.

Table 6-6: Summary of flood risk to towns and villages in the Borough of King's Lynn and West Norfolk

Settlement	Fluvial / tidal / coastal flood risk	Flood Defences	Surface water flood risk	Susceptibility to Groundwater flood risk				Reservoir inundation risk	Number of recorded sewer incidents on Anglian Water's Sewer Flooding Register
				<25%	>=25% <50%	>=50% <75%	>=75%		
King's Lynn	King's Lynn is at risk from tidal and fluvial flooding. The River Great Ouse flows to the west of the town whilst an extensive semi-culverted drainage network flows through the town itself. Other watercourses that flow through the town include: the River Nar, Gaywood River, West Lynn Drain, Pier Point Drain and Puny Drain as well as their tributaries. Many of these watercourses share their confluence with the River Great Ouse within proximity to King's Lynn. Flood Zones show nearly all the western half of the town to be within Flood Zone 3. Additional properties are also at risk in the eastern half of the town, usually when in close proximity to a drain or watercourse. There are defences along the banks of the River Nar and The River Great Ouse. • The River Great Ouse defences generally provide a standard of protection of 0.5% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail. • The defences along the River Nar typically have a standard of protection of 2% AEP. There is a risk of the defences being overtopped in events exceeding a 2% AEP. Interaction between the River Great Ouse and its tributary watercourses has the potential to cause flooding particularly around their confluences. High levels in the River Great Ouse meanwhile may prevent the tributaries from discharging, causing them to back up and overtop. King's Lynn has a long and well documented history of flooding from tidal and fluvial sources, particularly from storm surges.	See section 7 and Appendix E	Mapping shows surface water flood risk in King's Lynn tends to follow topographical flow paths of existing watercourses or dry valleys, and is widely dispersed across the settlement. However, the risk is largely confined to roadways and gardens in the 3.3% AEP and 1% AEP events. However, in the 0.1% AEP event flooding becomes widespread. Surface water flood risk however is particularly acute in the vicinity of Fairstead, around Spencer Road in the north,and to the south of Grimston Road. Localised sewer flooding problems have been recorded at Bagge Road, Hockham Street, Mayflower Avenue, Oldmedow Road and Turbus Road. The 2012 King's Lynn and West Norfolk Surface Water Management Plan identified critical drainage catchments in the following locations: • Green Lane, South Wootton • Wootton Drift • Swan Lane, Gaywood • Fairstead • King's Lynn Centre • A47 Saddlebow Roundabout	✓	✓	✓	✓	The settlement is not shown to be located within reservoir inundation extents.	31 incidents have been recorded with four-digit postcodes which relates to King's Lynn

Settlement	Fluvial / tidal / coastal flood risk	Flood Defences	Surface water flood risk	Susceptibility to Groundwater flood risk	Reservoir inundation risk	Number of recorded sewer incidents on Anglian Water's Sewer Flooding Register
				<25% / >=25% <50% / >=50% <75% / >=75%		
Terrington St Clement	Mapping shows flood risk to the settlement of Terrington St Clement stems from coastal / tidal sources. The entire settlement is located within Flood Zone 3. Terrington St Clement is situated within the Fens area. Several watercourses that flow through / from the settlement are Ordinary Watercourses; in some cases, these are managed by an IDB. Such watercourses may not have been accounted for in the Environment Agency Flood Zone mapping. There is the potential that the settlement could flood from one or more of these watercourses, independently to tidal or coastal flooding. There are a series of embankments along the coastline, north of Terrington St Clement which have a standard of protection of 0.67% AEP and 0.5% AEP. The defences dataset indicates that the coastline defences are not continuous. Further, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in Terrington St Clement consists predominantly of water ponding on roads, gardens and other open spaces throughout the town. A number of properties in the vicinity of South Greenare shown to be at risk of surface water flooding in the 0.1% AEP event.	AStGWf dataset displayed no data in this location – susceptibility is therefore unknown.	The settlement is not shown to be located within reservoir inundation extents.	Four incidents have been recorded in a four digit postcode area which relates to Terrington St. Clement and Clenchwarton
Clenchwarton	Mapping shows flood risk to the settlement Clenchwarton is from tidal / coastal sources. The entire settlement is located within Flood Zone 3. Clenchwarton is situated within the Fens area. Several watercourses that flow through / from the settlement are Ordinary Watercourses; in some cases, these are managed by an IDB. Such watercourses may not have been accounted for in the Environment Agency Flood Zone mapping. There is the potential that the settlement could flood from one or more of these watercourses, independently to tidal or coastal flooding. There are a series of embankments along the River Great Ouse, to the east of Clenchwarton, which have a standard of protection of 0.5% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in Clenchwarton consists predominantly of water ponding on roads, gardens and other open spaces throughout the town.	AStGWf dataset displayed no data in this location – susceptibility is therefore unknown.	The settlement is not shown to be located within reservoir inundation extents.	Four incidents have been recorded in a four digit postcode area which relates to Terrington St. Clement and Clenchwarton

Settlement	Fluvial / tidal / coastal flood risk	Flood Defences	Surface water flood risk	Susceptibility to Groundwater flood risk				Reservoir inundation risk	Number of recorded sewer incidents on Anglian Water's Sewer Flooding Register
				<25%	>=25% <50%	>=50% <75%	>=75%		
Dersingham	Mapping shows that flood risk to the settlement of Dersingham is from tidal / coastal sources. Flood Zones are largely confined to the west of the village, past the A149. However, to the north-west of the village, the Flood Zones affect properties along Valley Rise, Jubilee Drive and Alexandra Close. There are also Flood Zones towards the south of the settlement, following un-named drains and which affect a number of properties such as those along Holyrood Drive, Edinburgh Way, Windsor Drive, Lynn Road and Duck Decoy Close. There are additional unnamed watercourses located to the south and east of the settlement. In the south, several dozen properties are shown to be within the Flood Zone extents of the unnamed drain that flows east to west. Flood Zones from the unnamed watercourses in the east of the town are not shown in the Environment Agency's Flood Maps; this unnamed watercourse could present a flood risk. There are a series of embankments along the coastline, to the west of the settlement, which have a standard of protection of 0.5% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in Dersingham consists predominantly of water ponding on roads, gardens and other open spaces throughout the town. A number of properties, particularly in the vicinity of Manor Road in the south of the settlement and around Woodside Lane in the north of the town, are show to be at risk of surface water flooding in the 0.1% AEP event.	✓				The settlement is not shown to be located within reservoir inundation extents.	None
Hunstanton	Mapping shows that flood risk to the settlement of Hunstanton is from tidal / coastal sources. Flood Zones to the north and west of the town are quite narrow and confined to the sea-front, affecting a few properties along the coastline. Towards the south-west of the settlement, the Flood Zones are comparatively wider, affecting a significant part of the town. Notably, this part of the town contains a number of caravan and leisure parks. There is also an un-named watercourse located to the south of the settlement, leading from Downs Farm. Flood Zones from this un-named watercourse affect the farm but are not shown to affect properties within the main part of Hunstanton town. There are a series of flood walls along the coastline at Hunstanton, which have a standard of protection of between 1% and 0.5% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail. The mapping also indicates that behind the flood walls, there is an embankment which has a standard of protection of 2% AEP. There is a risk of the defences being overtopped in events exceeding a 2% AEP. Hunstanton has been affected by storm surges and flooding from tidal sources.	See section 7 and Appendix E	Mapping shows surface water flood risk in Hunstanton consists predominantly of water ponding on roads, gardens and other open spaces throughout the town. A number of properties, particularly in the vicinity of Southend Road and around South Beach Road are shown to be at risk of surface water flooding in the 0.1% AEP event.	✓	✓	✓		Properties in the south of the settlement are shown to be within the reservoir inundation extents of the Stony Hills and Lying Farm (Thronham) reservoirs.	Three incidents have been recorded in a four digit postcode area which relates to Hunstanton

Settlement	Fluvial / tidal / coastal flood risk	Flood Defences	Surface water flood risk	Susceptibility to Groundwater flood risk				Reservoir inundation risk	Number of recorded sewer incidents on Anglian Water's Sewer Flooding Register
				<25%	>=25% <50%	>=50% <75%	>=75%		
Heacham	Mapping shows that flood risk to the settlement of Heacham is from tidal / coastal sources. The Flood Zones are wider and affect significant areas to the west and south of the village; notably, this part of the village contains a number of caravan and leisure parks. There are also Flood Zones to the north of the village, associated with the Heacham River which affects properties north of Station Road / Lynn Road. Mapping suggests that water backs-up along the valley of the un-named watercourse to the south of the village which affects properties along Folgate Road and Fengate. However, the mapping indicates that the Flood Zones from the unnamed watercourse have not been mapped in the Environment Agency's Flood Maps; this unnamed watercourse could present a flood risk. There are a series of flood walls and embankments along the coastline at Heacham, which have a standard of protection of between 1% and 0.5% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in Heacham consists predominantly of water ponding on roads, gardens and other open spaces throughout the village. A number of properties, particularly in the vicinity of Collins Lane and around Marram Way are show to be at risk of surface water flooding in the 0.1% AEP event. The 2012 King's Lynn and West Norfolk Surface Water Management Plan identified critical drainage catchments in Heacham, at Marram Way.	✓	✓	✓	✓	Properties in the north of the settlement are shown to be within the reservoir inundation extents of the Stony Hills and Lying Farm (Thronham) reservoirs.	13 incidents have been recorded in a four digit postcode area which relates to Terrington St. Clement and Clenchwarton
Terrington St John and Tilney St Lawrence	Mapping shows flood risk to the settlements of Terrington St John and Tilney St Lawrence is from tidal sources. The settlements are mainly covered by Flood Zones 2 and 3 with a number of small dry islands within the settlement boundaries. The settlements are situated within the Fens area. Several watercourses that flow through / from the settlements are Ordinary Watercourses; in some cases, these are managed by an IDB. Such watercourses may not have been accounted for in the Environment Agency Flood Zone mapping. There is the potential that the settlements could flood from one or more of these watercourses, independently to tidal flooding. There are a series of flood walls, embankments and bridge abutments along the River Great Ouse, which have a standard of protection of 1% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in Terrington St John and Tilney St Lawrence consists predominantly of water ponding on roads, gardens and other open spaces throughout the village, even in the 0.1% AEP event.	AStGWf dataset displayed no data in this location – susceptibility is therefore unknown.				Neither of the settlements are shown to be located within reservoir inundation extents.	None

Settlement	Fluvial / tidal / coastal flood risk	Flood Defences	Surface water flood risk	Susceptibility to Groundwater flood risk				Reservoir inundation risk	Number of recorded sewer incidents on Anglian Water's Sewer Flooding Register
				<25%	>=25% <50%	>=50% <75%	>=75%		
Watlington	Mapping shows flood risk to the settlement of Watlington is from tidal / fluvial sources. The western part of the settlement is located within Flood Zone 3, affecting a number of properties. Several watercourses that flow through / from the settlement are Ordinary Watercourses; in some cases, these are managed by an IDB. Such watercourses may not have been accounted for in the Environment Agency Flood Zone mapping. There is the potential that the settlement could flood from one or more of these watercourses, independently to tidal flooding. There are a series of flood walls, embankments and bridge abutments along the River Great Ouse, which have a standard of protection of 1% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in Watlington consists predominantly of water ponding on roads, gardens and other open spaces throughout the village. Sporadic property flooding is shown beginning in the 1% AEP event. A number of properties, particularly in the vicinity of Stone Close are show to be at risk of surface water flooding in the 0.1% AEP event.	✓	✓	✓	✓	The settlement is not shown to be located within reservoir inundation extents.	Four incidents have been recorded in a four digit postcode area which relates to Watlington and West Winch
West Walton and Walton Highway	Mapping shows flood risk to the settlements of West Walton and Walton Highway is from fluvial / tidal sources. Due to their location in the Fens with low elevation the majority of the settlement is located within Flood Zones 3 and 3 with a number of dry islands within the settlement, especially in the west of the settlement. Several watercourses that flow through / from the settlement are Ordinary Watercourses; in some cases, these are managed by an IDB. Such watercourses may not have been accounted for in the Environment Agency Flood Zone mapping. There is the potential that the settlement could flood from one or more of these watercourses, independently to tidal flooding. There are a series of embankments along the River Nene, which have a standard of protection of 0.67% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in West Walton and Walton Highway consists predominantly of water ponding on roads, gardens and other open spaces throughout the village.	AStGWf dataset displayed no data in this location – susceptibility is therefore unknown.				Neither of the settlements are shown to be located within reservoir inundation extents.	Four incidents have been recorded in a four digit postcode area which relates to Watlington and West Winch
Walpole St Andrew and Walpole St Peter	Mapping shows flood risk to the settlements of Walpole St Andrew and Walpole St Peter is from fluvial / tidal sources. The majority of the settlements are located in Flood Zone 3 with some small areas of Flood Zone 2. Several watercourses that flow through / from the settlement are Ordinary Watercourses; in some cases, these are managed by an IDB. Such watercourses may not have been accounted for in the Environment Agency Flood Zone mapping. There is the potential that the settlement could flood from one or more of these watercourses, independently to tidal flooding. There are a series of embankments along the River Nene, which have a standard of protection of 0.67% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in Walpole St Andrew and Walpole St Peter consists predominantly of water ponding on roads, gardens and other open spaces throughout the village.	AStGWf dataset displayed no data in this location – susceptibility is therefore unknown.				Neither of the settlements are shown to be located within reservoir inundation extents.	None.

Settlement	Fluvial / tidal / coastal flood risk	Flood Defences	Surface water flood risk	Susceptibility to Groundwater flood risk				Reservoir inundation risk	Number of recorded sewer incidents on Anglian Water's Sewer Flooding Register
				<25%	>=25% <50%	>=50% <75%	>=75%		
Downham Market	The mapping shows that the majority of Downham Market is located in Flood Zone 1. The Flood Zones associated with the River Great Ouse are confined to the west of the settlement. This is due to the settlement being on raised ground to the east whilst the River Great Ouse proceeds to inundate a wide floodplain of low-lying ground to its west. Several watercourses that flow through / from the settlement are Ordinary Watercourses; in some cases, these are managed by an IDB. Such watercourses may not have been accounted for in the Environment Agency Flood Zone mapping. There is the potential that the settlement could flood from one or more of these watercourses, independently to tidal flooding. There are a series of flood walls, embankments and bridge abutments along the River Great Ouse, which have a standard of protection of 1% AEP. However, there remains a residual risk of flooding should the defences be overtopped or fail.	See section 7 and Appendix E	Mapping shows surface water flood risk in Downham Market consists predominantly of water ponding on roads, gardens and other open spaces throughout the town in the 3.3% AEP event. In the 1% AEP event a prominent overland flow route has developed in the south of the settlement starting to the west of London Road and flowing west towards the River Great Ouse. In the 0.1% AEP event at least three prominent overland flow routes are visible within the settlement. All flowing in an east to west direction towards the River Great Ouse and all with the potential to cause flooding to property. Localised sewer flooding problems have been recorded at Maltings Lane, Oakview Drive, Paradise Road, Peverall Road and Railway Road. The 2012 King's Lynn and West Norfolk Surface Water Management Plan identified critical drainage catchments in the following locations: • Railway Station and Electrical Sub-Station • High Street	AStGWf dataset displayed no data in this location – susceptibility is therefore unknown.				Properties in the west of the settlement are shown to be within the reservoir inundation extents of the Denver Middle Drove reservoir.	12 incidents have been recorded in a four digit postcode area which relates to Downham Market.

7 Fluvial and coastal defences

Preparation of the SFRA has included a high-level review of available information on flood defences and involved interrogation of existing evidence on defence condition and standards of protection. Details of the flood defence locations and condition were provided by the Environment Agency for the purpose of preparing this assessment, in addition to some supplementary explanation on asset performance. Defences are categorised as either raised flood defences (e.g. walls/embankments) or flood storage areas (FSAs). The Environment Agency flood defences and their locations are summarised in the following sections.

7.1 Flood defences and standard of protection

One of the principal aims of the SFRA is to outline the present risk of flooding across the Borough of King's Lynn and West Norfolk including consideration of the effect of flood risk management measures (including flood banks and defences). The modelling that informs the understanding of flood risk within the Borough of King's Lynn and West Norfolk is typically of a catchment wide nature, suitable for preparing evidence on possible site options for development. In cases where a specific site risk assessment is required, detailed studies should seek to refine the results used to provide a strategic understanding of flood risk from all sources.

Flood defences are given a rating based on a grading system for their condition. A summary of the grading system used by the Environment Agency for condition is provided in Table 7-1.

Table 7-1: Defence asset condition rating

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no effect on performance.
2	Good	Minor defects that will not reduce the overall performance of the asset.
3	Fair	Defects that could reduce the performance of the asset.
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation required.
5	Very Poor	Severe defects resulting in complete performance failure.

Developers should consider the standard of protection provided by defences and residual risk as part of a detailed FRA.

Standard of Protection

Flood defences are designed to give a specific standard of protection, reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP standard of protection means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year.

Although flood defences are designed to a standard of protection it should be noted that, over time, the actual standard of protection provided by the defence may decrease, for example due to deterioration in their condition or increases in flood risk due to climate change.

It should be noted that the Environment Agency's on-going hydraulic modelling programme may revise flood risk datasets and as a consequence, the standard of protection offered by flood defences in the area, may differ from those discussed in this report.

The condition of existing flood defences and whether they will continue to be maintained and/or improved in the future is an issue that needs to be considered as part of the risk based sequential approach and, in light of this, whether possible site options for development are appropriate and sustainable. In addition, detailed Flood Risk Assessments (FRAs) will need to thoroughly explore the condition of defences, especially where these defences are informal and demonstrate a wide variation of condition grades. It is important that all of these assets are maintained to a good condition and their function remains unimpaired.

Figure 7-1 shows the location of Environment Agency flood defences taken from the Environment Agency's Asset Information Management System (AIMS) dataset. This shows that defences are predominantly found along sections of the River Nene, the Great River Ouse and its tributaries and along coastal areas.

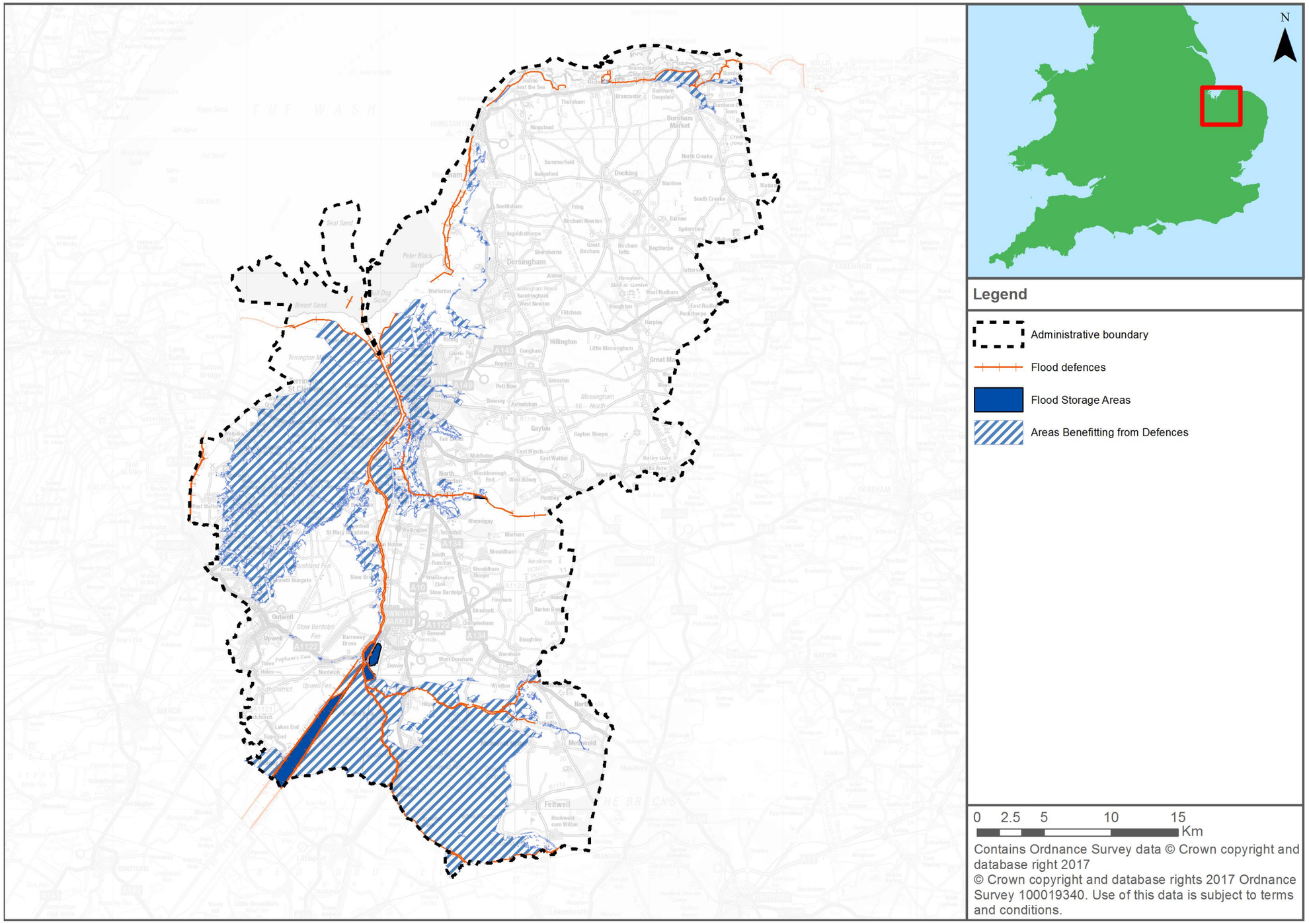
The Environment Agency dataset called "Areas Benefiting from Defences" is also shown in Figure 7-1. This dataset shows those areas that benefit from the presence of defences in a 1 in 100 (1%) chance of flooding each year from rivers; or 1 in 200 (0.5%) chance of flooding each year from the sea. Areas benefiting from defences in the Borough of King's Lynn and West Norfolk are shown in Figure 7-1. This indicates that extensive areas of the Borough benefit from defences, particularly within the Wash and Fenland areas.

Five Environment Agency Flood Storage Areas (FSAs) are located in the Borough of King's Lynn and West Norfolk, as shown in Figure 7-1:

- One FSA is located next to the River Nar
- Two FSAs are located to the east of the River Great Ouse
- Two FSAs are located between the Old Bedford River and the River Delph.

A review of key Environment Agency assets across the Borough of King's Lynn and West Norfolk, their condition and standard of protection is included in the following sections. Maps showing the type of flood defence, its condition and standard of protection is provided in Appendix E. References to the appropriate maps are provided in the text.

Figure 7-1: EA Flood Defences, Areas Benefiting from Defences and Flood Storage Areas



7.2 Fluvial and tidal food defences in the Borough of King's Lynn and West Norfolk

7.2.1 River Nene

In Appendix E, the maps KL_AE_01 and KL_AE_02 display the flood defences located along sections of the River Nene. The mapping shows that there are embankments located along the River Nene, between Walsoken and Warpole Marsh which are considered to be in either a good or fair condition. The defences offer protection against the 0.67% AEP event.

7.2.2 River Great Ouse and tributaries

There are a number of defences along the River Great Ouse and its tributaries. The defences located along the River Great Ouse and its tributaries are outlined in the following section. In Appendix E, the maps KL_AE_03 to KL_AE_10 display the flood defences along the River Great Ouse and its tributaries including the Little Ouse River, River Wissey, Old Bedford River and New Bedford River.

King's Lynn to Downham Market

The majority of the defences along the River Great Ouse and the River Nar are embankments. Several flood walls are located in King's Lynn and at the mouth of the River Great Ouse. The defences are mostly in fair condition, with a number of defences throughout the area in good condition. The standard of protection provided by the defences varies in the area from protecting against the 4% AEP event to the 0.5% AEP event.

Downham Market to Little Ouse River and River Wissey

The flood defences along the River Great Ouse through Downham Market and along the Little Ouse and River Wissey are predominately embankments. Several flood walls are located to the south of Downham Market. The majority of the defences are in fair condition, with sections of the defences along the watercourses in good or poor condition.

Most of these flood defences offer protection against the 1% AEP event. Embankments to the south of Stoke Ferry offer protection from the 5% AEP event and an embankment along Sluice Road offers protection from the 2% AEP event.

Old Bedford River and New Bedford River

Along the Old Bedford River and the New Bedford River lie embankments. The majority of defences are in fair condition, with some part of the defences along the left bank of the Old Bedford River in poor condition. Furthermore, the embankment underneath Wash Road, along New Bedford River, is also in good condition, as is the right embankment along the Old Bedford River's lower reach.

The defences along the New Bedford River offer protection from the 1% AEP event. Defences along the right bank of the Old Bedford River also offer protection against the 1% AEP event with some defences along the left bank offering protection against the 4% AEP event.

7.3 Coastal defences in King's Lynn and West Norfolk

The (2010) **North Norfolk Shoreline Management Plan** (SMP) covering Huntstanton to Kelling and the (2010) **The Wash SMP** covering Gibraltar Point to Old Hunstanton describe the high level strategy and coastal polices. More detailed strategies have been developed to address coastal erosion and flood risk, describing the approach to meeting the outcomes of the SMP, these are described in the following documents:

- **Emerging Hunstanton Coastal Management Plan**
- **Wash East Coastal Management Strategy (2015)**

The EA have provided further details about coastal assets along the coastline of the Borough.

7.3.1 Burnham Overy Straithe to Old Hunstanton

In Appendix E, the maps KL_AE_22 to KL_AE_26 display the flood defences along Burnham Overy Sraithe to Old Hunstanton.

The defences along the coastline between Burnham Overy Staithe and Old Hunstanton are primarily embankments. Dunes are located in Burnham Overy Staithe and Holme next the Sea and walls are located in Hunstanton.

The condition of the defences varies from very poor to good and the majority defend from the 10% AEP flood event. There are a number of defences in the Titchwell area where the standard of protection is not recorded.

7.3.2 Hunstanton to Wolferton

In Appendix E, the maps KL_AE_27 to KL_AE_29 display the flood defences along Hunstanton to Wolferton.

The Environment Agency maintain defences from South Hunstanton to Wolferton. The defences help to reduce the risk of flooding to 642 residential properties and around 3,500 caravans and holiday homes. During the December 2013 tidal surge, these flood defences helped reduce the impact of flooding. The defences comprise of a natural shingle ridge backed by a grassed sea bank before tapering into a single hard defence at South Hunstanton. Wave action removes the shingle which is deposited down the coast and increases the flood risk. National Flood and Coastal Erosion Risk Management Grant in Aid (FCERM GiA) is no longer available to fully fund the maintenance of the defences. Confirmation has been received from the Borough Council of King's Lynn and West Norfolk that 41% of funding is still available. A Community Interest Company (CIC) has been set up to contribute towards the remainder of the flood risk management work. In the short term the CIC plans to replenish the shingle beach annually. The long term plan is to improve defences and increase the standard of protection to further reduce the flood risk[13,14].

The Environment Agency data shows the flood defence types; this shows that the majority of defences are embankments with walls located to the south of Hunstanton. The defences are mostly considered to be in fair condition, with a wall in Heacham in good condition and an embankment to the south of Peter Black Sand in poor condition. The standard of protection offered by the defences varies; the defences protect from either the 2%, 1% or 0.5% AEP events.

In addition, confirmation has been received from the Borough Council of King's Lynn and West Norfolk that sea walls, a promenade, rear wave walls and flood gates in Hunstanton Town offer defence. The rear wave wall at the southern end of the Hunstanton frontage is maintained by the Environment Agency with the remaining defence maintained by Borough Council of King's Lynn and West Norfolk. The Hunstanton CMP is reviewing the conditions and future approach to these defences.

7.3.3 Terrington Marsh

Embankments offer defence against coastal flooding to the north of Terrington Marsh. The defences are considered to be in fair or good condition and offer protection against either the 0.5% or 0.67% AEP event.

7.4 Ely Ouse Transfer Scheme

In 1964, it was anticipated that the increase in population in the South Essex area could cause problems over the water supply in the 1970s. A scheme was promoted by the former Great Ouse and Essex River Authority to transfer surplus water from the Ely Ouse at Denver to the head waters of the Essex rivers [15], which increased flows and made extra water available to existing reservoirs in Essex.

The Ely Ouse Transfer Scheme offers multiple benefits including flood protection. In times of flood, the water level from the old and new Bedford-Ouse was higher than the waters outside the Denver sluice, coming from the Ely-Ouse and its south level tributaries. By-passing the Denver Sluice and discharging at King's Lynn, allows flood waters from the South Level rivers to discharge and flow away. A relief channel was constructed from Denver with sluice gates at each end. A cut off channel from the River Lark at Mildenhall, crossing the River Little Ouse and the River Wissey, conveys waters from all three rivers to the relief channel for discharge at King's Lynn. Should tide levels rise, the sluices at King's Lynn close, preventing discharge and containing water in the relief channel. The Ely-Ouse river channel was also widened as part of this scheme.

13 Environment Agency (2015) East Wash Community Interest Group
14 Environment Agency (2016) Norfolk community come together to protect their coast
15 National Rivers Authority, The Ely Ouse Essex Water Transfer Scheme

The Ely Ouse Transfer Scheme has reduced the flood risk along the River Great Ouse and increased the water supply to reservoirs in Essex. In dry conditions, 35% of Essex's required water resources come from the scheme[16].

7.5 Residual flood risk

Residual risk is an important consideration when assessing sites. Residual risk refers to the risks that remain in circumstances after measures have been taken to alleviate flooding (such as flood defences). It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges.
- Failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner or failure of pumping stations.

Defences in the Borough of King's Lynn and West Norfolk are shown to provide a varying standard of protection; the condition of the defences also varies. However, in the event of a breach, depending on the extent and magnitude of the breach, water could rapidly inundate areas behind defences with little warning. Although the majority of areas protected by defences are within the Environment Agency's Flood Warning Service, the service does not provide a warning in the event of a breach.

There is also the potential that the risk of defences overtopping in the future may increase due to increased flows due to climate change.

7.5.1 Breach

The extents associated with a breach of fluvial and tidal flood defences are shown in the Appendix A, interactive GeoPDF maps. The breach extents have been extracted from a number of existing hydraulic models supplied by the Environment Agency when preparing this SFRA. Details of the models used to map the breach extents are contained in Table 7-2. Due to the number of breach scenarios modelled and the number of models available, the extents from the individual breaches and models have been merged into:

- One combined extent for the tidal 200-year with climate change (2115) scenario; and,
- One combined extent for the fluvial 100-year with climate change scenario. Where breaches have not been supplied for the 100-year with climate change event the 100-year event breach has been included in the outline.

Further information can be found in Appendix D.

Table 7-2: Models used to inform breach extents shown in the Appendix A, interactive GeoPDFs

Model Details	Fluvial / Tidal	Event mapped	Breach locations (shown in Figure 7-2)
2015 Tidal Hazard Mapping (Tidal Great Ouse)	Tidal	200-year with climate change (2115) scenario	98
2013 Cut Off Channel (Eastern Rivers MP1)	Fluvial	100-year	4
2016 Fenland (Fenland Hazard Mapping)	Fluvial	100-year (8 scenarios) 100-year with climate change (26 scenarios)	34

16 Institute of Civil Engineers (2015) What are water transfers and interconnections

2017 Wells-next the Sea (Anglian Coastal Modelling)	Tidal	200-year with climate change	4
2009 Wash (Anglian Area Central Tidal Hazard Mapping)	Tidal	200-year with climate change	2
2011 Tidal Nene (Tidal Nene and Tidal Wellard Hazard Mapping)	Tidal	200-year with climate change	1

3 additional breach scenarios were also run as part of the commission for the Level 2 SFRA using the Fenland, 2016 Model at Southery to provide a complete coverage of breach outputs in this area.

It should be noted that the areas predicted should be seen as indicative of the influence of breaches, as the exact location of the breach, failure type and event at which the breach occurs all could influence the flooding from such an event. The closest breach may not necessarily produce the worst flooding. There may be a location further away that has a preferential flow path to the site. LiDAR data can be used to determine whether there is a flow path.

It should also be noted that not all possible breach scenarios have been modelled, it is possible that defences could breach in alternative locations.

Results

The breach modelling (Figure 7-3) shows that significant areas of the Borough of King's Lynn and West Norfolk are at risk should the defences breach; it demonstrates that King's Lynn and many smaller urban settlements are reliant on defences to protect against tidal (sea) flooding.

Figure 7-2: Considered Breach Locations

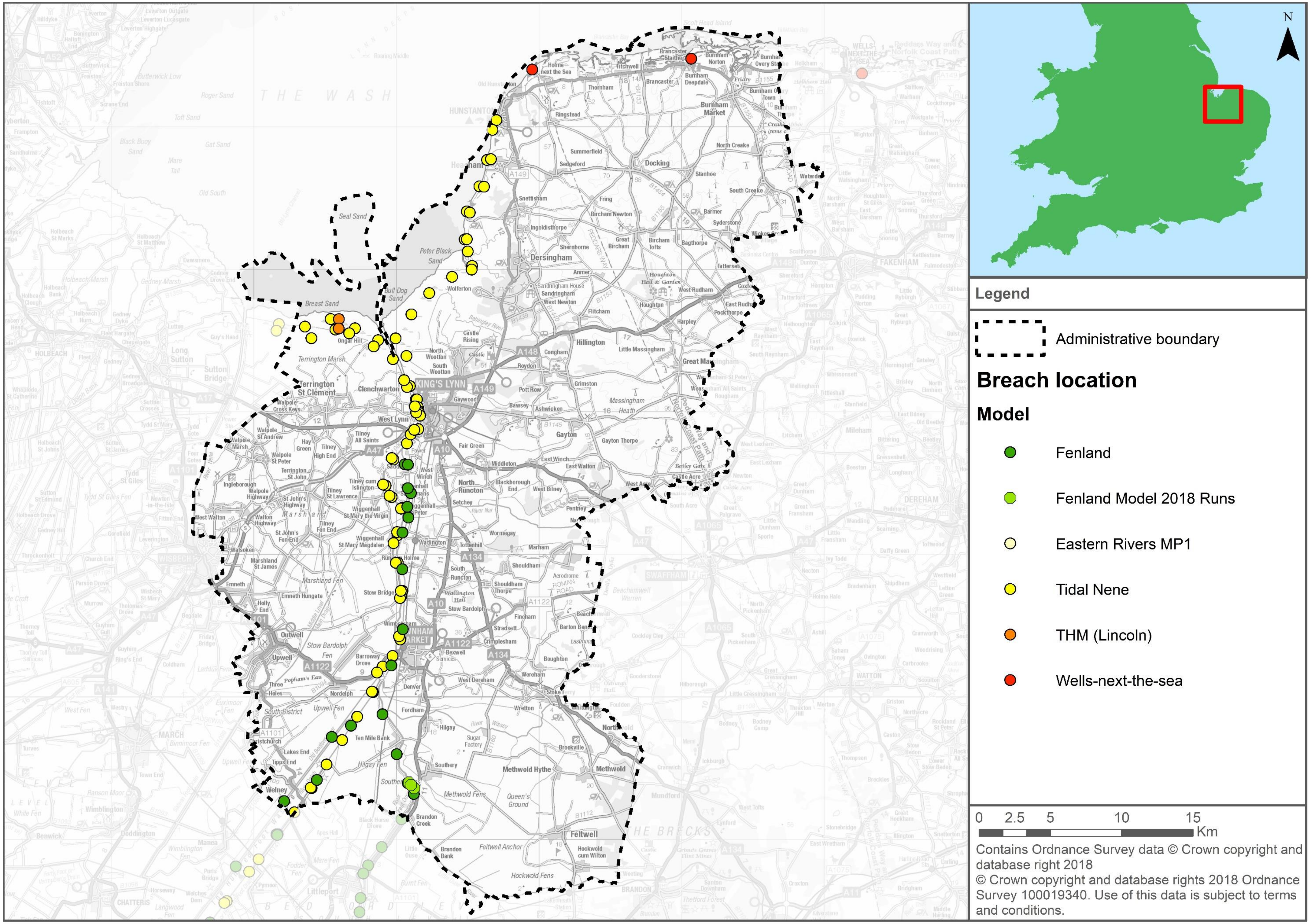
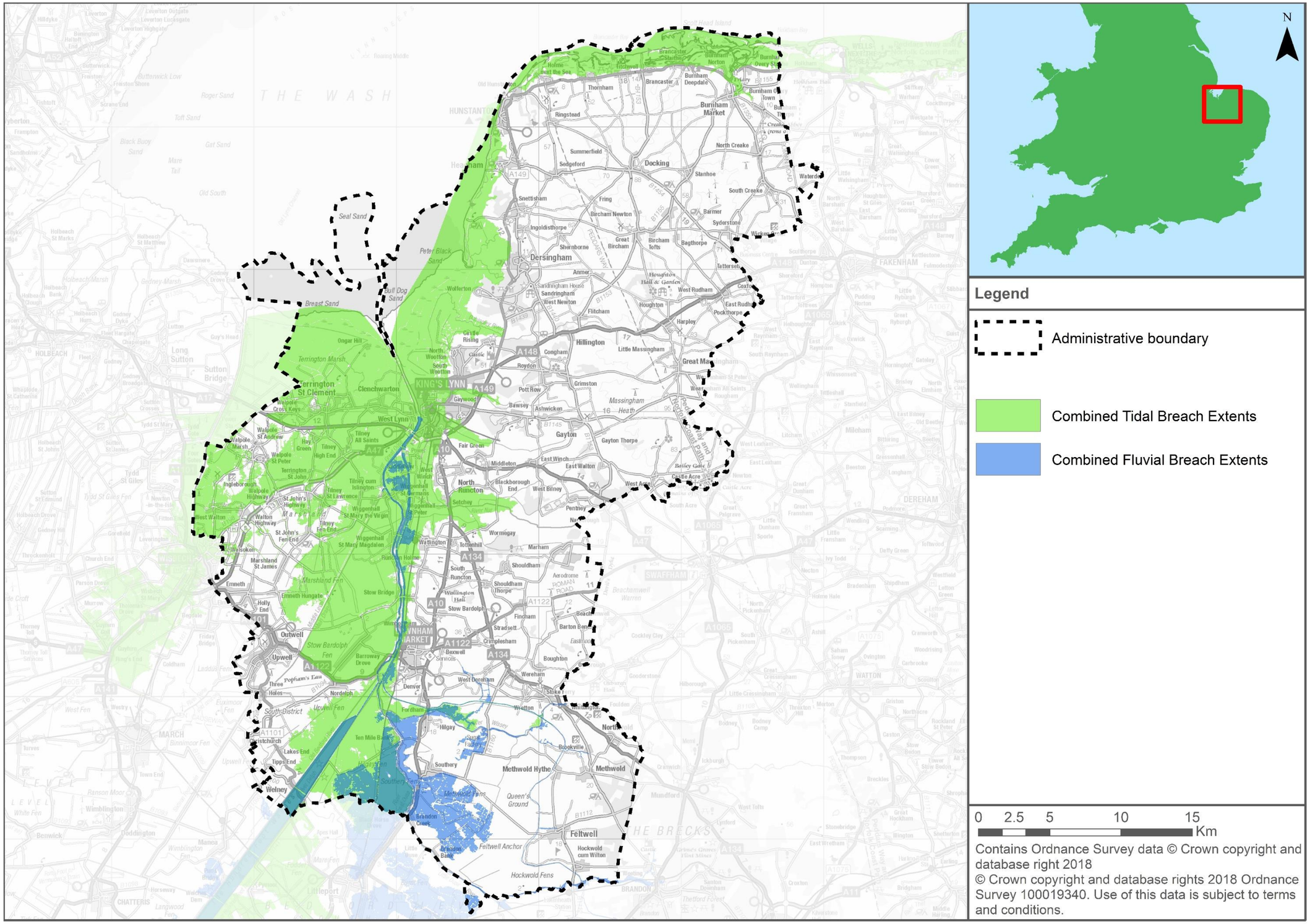


Figure 7-3: Breach Extents



7.5.2 Implications for development

The assessment of residual risk demands that attention be given to the vulnerability of the receptors and the response to managing the resultant flood emergency. In this instance, attention should be given to the characteristics of flood emergencies and the roles and responsibilities during such events. Additionally, in the cases of breach or overtopping events, consideration should be given to the structural safety of the dwellings or structures that could be adversely affected by significant high flows or flood depths.

Developers should include an assessment of the residual risk where developments are located in areas benefitting from defences, including identifying rapid inundation zones. They should consider both the impact of breach, including the effect on safe access and egress, as well as potential for flood risk to increase in the future due to overtopping.

At areas susceptible to breach failure, it is expected that more detailed assessment be completed to evidence the severity of the risk. This more detailed assessment should refine the information prepared as part of SFRA assessment and describe how the residual risk will be safely managed at the development site. This more detailed assessment should at least include consideration of the following elements which may also be included within a site flood risk management plan:

- Extent of flooding
- Depth of flooding
- Velocity of flood water
- Speed of onset of flooding
- Hazard to people
- Duration of flooding
- Warning and evacuation procedures
- Forces on buildings and infrastructure

Any improvements to defences should ensure they are in keeping with wider catchment policy.

There is specific guidance relating to the application and use of the Tidal Hazard Mapping Models for the River Nene and River Great Ouse (see Section 8.2.6) and developers are advised to consult the flood design guidance on the Council webpage called: **"Information for planning agents"**.

8 FRA requirements and flood risk management guidance

8.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within the Borough of King's Lynn and West Norfolk. Due to the strategic scope of the study, prior to any construction or development, site-specific assessments will need to be undertaken for individual development proposals (where required) so all forms of flood risk at a site are fully addressed. It is the responsibility of the developer to provide an FRA with an application.

It should be acknowledged that a detailed FRA may show that a site is not appropriate for development of a particular vulnerability or even at all. Where the FRA shows that a site is not appropriate for a particular usage, a lower vulnerability use may be appropriate.

8.2 Requirements for site-specific flood risk assessments

8.2.1 What are site-specific FRAs?

Site-specific FRAs are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted to LPAs with planning applications and should demonstrate how flood risk will be managed over the development's lifetime, taking into account climate change and vulnerability of users.

8.2.2 When are site-specific FRAs 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 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.

A 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);
- Where the site is intended to discharge to the catchment or assets of a water management authority which requires a site-specific FRA;
- Where the site's drainage system may have an impact on an IDB's system;
- Where a site is located 20m from a watercourse that doesn't have an associated Flood Zone;
- Where evidence of historical or recent flood events have been passed to the LPA; and / or
- In an area of significant surface water flood risk.

In some cases, a development meeting the criteria below may need to submit a FRA to the IDB to inform any consent applications:

- Development being either within or adjacent to a drain/ watercourse, and/ or other flood defence
- Structure within the area of an IDB
- Development being within the channel of any Ordinary Watercourse within an IDB area
- Where a direct discharge of surface water or treated effluent is proposed into an IDB's catchment
- For any development proposal affecting more than one watercourse in an IDB's area and having possible strategic implications
- In an area of an IDB that is in an area of known flood risk

- Development being within the maintenance access strips provided under the IDB's by-laws
- Any other application that may have material drainage implications.

8.2.3 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 is likely to be affected by current or future flooding from any source
- 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 LPA to apply the Sequential Test
- Whether, if applicable, the development will be safe and pass the Exception Test, if applicable

FRAs for sites located in the Borough of King's Lynn and West Norfolk should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency. Guidance and advice for developers on the preparation of site-specific FRAs include:

- **Standing Advice on Flood Risk (Environment Agency)**
- **Flood Risk Assessment for Planning Applications (Environment Agency)**
- **Site-specific Flood Risk Assessment: CHECKLIST (NPPG, Defra)**

The Environment Agency has produced a guidance document called "Flood risk assessment: Climate Change allowances" which details the application of the allowances and local considerations in East Anglia. This document, alongside other flood risk guidance, is available from: **https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers**.

Where no hydraulic models exist, no climate change modelling was undertaken. At such locations, developers should prepare detailed hydraulic models as part of a site-specific Flood Risk Assessment and account for climate change in the assessment. The Environment Agency's Climate Change guidance note provides further information on the local precautionary allowances for potential climate change impacts, that can be used in basic assessments in absence of the updated, detailed modelling.

Guidance for LPAs for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 – **Flood Risk Assessment: Local Planning Authorities.**

8.2.4 LLFA guidance note

Part C Technical Guidance of Norfolk County Council's **guidance document** on their Lead Local Flood Authority role as Statutory Consultee to Planning (2017), sets out the expectations of the Council when reviewing flood risk assessments and surface water drainage submissions. It reinforces that all development should consider existing risk of flooding from all sources and that the sequential approach will be supported by the LLFA. Details on the sources of flood risk and drainage information used to assist the LLFA in the review of an application are provided in this document.

The document notes three key criteria which are to be met to protect the public from flooding, on site and downstream:

1. Protection against flooding from watercourses
2. Protection against flooding from the drainage system
3. Protection against flooding from overland flows (from sources within or external to the site).

The LLFA will expect the risk to be assessed if sites are at risk of flooding from an Ordinary Watercourse or from a surface water overland flow route and, where appropriate, this may require hydraulic modelling. Further details can be found in the guidance note.

8.2.5 Local guidance

Developers are advised to refer to policies DM 18 and DM 21 in the **Site Allocations and Development Management Polices Plan.** This details requirements for sites located in the coastal flood risk hazard zone (Hunstanton to Dersingham) as defined in the Councils Policies Map (DM

18) as well as for sites in areas at risk of flooding (DM 21). Developers should note that changes may have been made to these policies since the publication of this document and that they should seek the most up to date guidance to refer to. Developers are also advised to consult the Councils' webpage called: **"Information for planning agents"** which provides further information on flood risk and design guidance.

8.2.6 Tidal Hazard Mapping Model

The Environment Agency commissioned a modelling study to determine the impacts of a series of breaches in the Tidal Defences of the Rivers Great Ouse and Nene. For development proposed within the area covered by the Tidal Hazard Mapping, the Environment Agency and King's Lynn and West Norfolk Borough Council have published guidance in relation to the use and consideration of this modelling in relation to site-specific FRAs and planning applications. This guidance is published on the Councils' webpage called: **"Information for planning agents"**.

When using the Tidal Hazard Mapping model, developers are advised to consider:

1. Whether the breach locations in the Tidal Hazard Mapping model are appropriate to the location of their specific site. The location of the breach will have a greater influence for sites located near defences. A site-specific FRA will need to consider carrying out a site-specific breach analysis where no existing breaches are located close to the site.
2. Review the site-specific topographic survey and compare this with the estimated flood depths from the Tidal Hazard Mapping for the design AEP event. By adding the highest and lowest elevations to the lowest and highest (respectively) flood depths, this can determine whether the topography controls the estimated flood depth. If these match (or are close) then the equation (topographic height + flood depth) can be used to calculate the flood level on site during the design AEP event. If these do not match, the site-specific FRA will need to evaluate why and where this is not apparent, seek clarification from the Environment Agency.
3. Following the estimation of the design flood level, resistance and resilience measures are to be considered.

8.2.7 IDB Guidance

Planners should be aware of local conditions and requirements set by the either the Downham Market Group of Internal Drainage Boards, Ely Group of Internal Drainage Boards, Middle Level Commissioners or the Water Management Alliance. The administration groups have published application guidance notes for each IDB which can be found using the following links:

- **http://www.downhammarketidbs.org.uk**
- **http://www.elydrainageboards.co.uk**
- **https://middlelevel.gov.uk/**
- **https://www.wlma.org.uk/**

8.2.8 Consultations

Developers should consult with the Borough Council of King's Lynn and West Norfolk, Norfolk County Council, the Environment Agency, Anglian Water and, where necessary, relevant IDBs at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design. If applications cross administrative boundaries, the neighbouring LLFAs, Cambridgeshire, Lincolnshire or Suffolk County Council, may need to be approached.

8.3 Challenging the flood map

Where a site-specific FRA has produced modelling outlines which differ from the EAs Flood Map for Planning (Rivers and Sea) then the model can be submitted to the EA for an evidence based review. Where the modelling and results are deemed acceptable to the EA, amendments to the Flood Map for Planning (Rivers and Sea) may take place.

8.4 Flood risk management guidance – mitigation measures

Mitigation measures should be seen as a last resort to address flood risk issues. 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.

8.4.1 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from Flood Zones 2 and 3, to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk zones. However, vehicular parking in floodplains should be based on the nature of parking, flood depths and hazard including evacuation procedures and flood warning.

Waterside areas, or zones along known flow routes, can act as Green Infrastructure, being used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these zones, and avoid the creation of isolated islands as water levels rise.

Making space for water

All new development close to rivers should normally consider the opportunity presented to improve and enhance the river environment. Developments should normally look at opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

The provision of a buffer strip can 'make space for water', allow additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes.

It also enables the avoidance of disturbing riverbanks, adversely impacting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult.

8.4.2 Raised floor levels

The raising of internal floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood.

Finished floor level guidance has been established through consultation with the Environment Agency. Minimum finished floor levels for development should be set to whichever is the higher of the following:

- a minimum of 600mm above the 1% AEP fluvial event plus an allowance for climate change.
- a minimum of 600mm above the 0.5% AEP tidal event plus an allowance for climate change.
- 300mm above surrounding ground levels.

A 300mm freeboard is only applicable where detailed modelling is available which is deemed to be reliable. The additional height that the floor level is raised above the maximum water level is referred to as the "freeboard". If no detailed and reliable modelling is available, the Environment Agency may require a 600mm freeboard to be applied when setting minimum finished floor levels.

Additional freeboard may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

There is specific guidance relating to the application and use of the Tidal Hazard Mapping Models for the River Nene and River Great Ouse (see Section 8.2.6) and developers are advised to consult the flood design guidance on the Council webpage called: **"Information for planning agents"**.

With regards to LLFA guidance and surface water flood risk, finished floor levels are recommended to be set to a minimum of 300mm above the 1% AEP plus an allowance for climate change flood levels (including anticipated flood levels within the drainage system). If there is an uncertainty in flood levels, the freeboard level should be increased from 300mm to 600mm. The LLFA would also expect a minimum of at least 150mm freeboard between proposed external ground levels and the property finished floor level. Further information can be found in the **LLFA guidance document**.

If it is not practical to raise floor levels to those specified above, consultation with the Environment Agency and / or LLFA will be required to determine the suitability of alternative flood mitigation approaches.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels.

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. However, access and egress would still be an issue, particularly when the duration of flooding covers many days.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test.

Safe access and egress will need to be demonstrated at all development sites to a locally identified refuge area. Ideally, waterproof construction techniques used. If safe access and egress cannot be achieved to a locally identified refuge area, the **Defra/EA Technical Report: FD2320: Flood Risk Assessment Guidance for New Development** should be referred to, to determine the hazard to people posed along the access route. This can also be used to inform a Flood Warning and Evacuation Plan for the site.

Emergency vehicular access should be possible during times of flood in accordance with the **Defra/EA Technical Report: FD2320: Flood Risk Assessment Guidance for New Development** wherever possible taking into account depth, hazard and velocity.

Local requirements for finished floor levels should be discussed with the LPA, LLFA and EA taking into account the individual circumstances of the application.

8.4.3 Development and raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain. It would be preferable for schemes to involve an integrated flood risk management solution.

Temporary or demountable defences are normally not acceptable forms of flood protection for a new development but might be appropriate to address circumstances where the consequences of residual risk are severe but the time required to install the defences, for example in an overtopping scenario, would be realistic. In addition to the technical measures the proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate. The storage and accessibility of such structures must be considered.

Where development is located behind, or in an area benefitting from, defences, consideration should be given to the potential safety of the development, finished floor levels and the potential for safe access and egress to a locally identified refuge area in the event of rapid inundation of water due to a defence breach with little warning.

8.4.4 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities and property; in most areas of fluvial flood risk, raising land above the floodplain would reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land.

All new development within the 1% AEP flood extent including an allowance for climate change (for the lifetime of the development) must not result in a net loss of flood storage capacity. Where

possible, opportunities should normally be sought to achieve an increase in the provision of floodplain storage.

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

For compensatory flood storage to be effective and not require hydraulic modelling, it must be provided on a level for level, volume for volume basis on land which does not already flood and is within the site boundary. Where land is not within the site boundary, it must be in the immediate vicinity, in the applicant's ownership/control and linked to the site. Floodplain compensation should be considered in the context of the 1% annual probability (1 in 100 year) flood level including an allowance for climate change. When designing a scheme flood water must be able to flow in and out unaided. An FRA should demonstrate that there is no loss of flood storage capacity and include details of an appropriate maintenance regime to ensure mitigation continues to function for the life of the development. Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C62430.

Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

Any proposal for modification of ground levels will need to be assessed as part of a detailed flood risk assessment.

8.4.5 Voids and Stilts

The Environment Agency support the use of voids and stilts for replacement dwellings. This will allow an improvement over the existing situation by making the building more resilient to flooding and providing additional flood storage on site.

Voids or stilts should be designed to allow the free flow of water up to and including the 1 in 100 flood event, with an allowance for climate change. Openings should be designed to be as large as feasible within the proposed development. Individual openings should be a minimum of 1 metre wide by the height of the predicted depth of flooding (including an allowance for climate change), from the existing ground level.

Voids and stilts should be kept open and maintained as such in perpetuity. It is imperative that the void space beneath the dwelling is kept free from debris throughout the lifetime of the development. This enables the voids to fulfil their flood storage role. The local planning authority should be satisfied that this is achievable and may wish to consider including a condition on any decision notice where permission is granted or requiring the applicant to enter into a legal agreement.

8.4.6 Developer contributions

In some cases, and following the application of the sequential test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

DEFRA's Flood and Coastal Erosion Risk Management Grant in Aid (FCERM GiA)[17] can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FCERM GiA and therefore any shortfall in funds will need to be found from elsewhere through Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

17 Flood and coastal defence funding: for risk management authorities (Environment Agency, 2014)

For new development in locations without existing defences, or where the development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer.

However, the provision of funding by a developer for the cost of the necessary standard of protection from flooding or coastal erosion does not mean the development is appropriate as other policy aims must also be met. Funding from developers should be explored prior to the granting of planning permission and in partnership with the Council and the Environment Agency.

The Level 2 SFRA for the Borough explores further how new development could identify partnership opportunities to contribute towards wider flood protection for existing communities.

8.5 Flood risk management guidance – resistance measures

Measures designed to keep flood water out of properties and businesses.

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined above. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 0.1% AEP scenario. In these cases, (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not normally be relied on for new development as an appropriate mitigation method.

Most of the measures should be regarded as reducing the rate at which flood water can enter a property during an event and considered an improvement on what could be achieved with sand bags. They are often deployed with small scale pumping equipment to control the flood water that does seep through these systems. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system to ensure the measures are deployed in advance of an event. The following measures are often deployed:

Permanent barriers

Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

Temporary barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

Community resistance measures

These include demountable defences that can be deployed by local communities to reduce the risk of water ingress to a number of properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.

Non-return valves

Non-return valves can be installed on appliances and sewer pipes to prevent waste water from being forced up bathroom and kitchen plugs, or lavatories.

8.6 Flood risk management guidance – resilience measures

Measures designed to reduce the impact of water that enters property and businesses.

These measures aim to ensure no permanent damage is caused, the structural integrity of the building is not compromised and the clean up after the flood is easier. Interior design measures to reduce damage caused by flooding include:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level.

- Water-resistant materials for floors, walls and fixtures such as tiled floors, with waterproof adhesive and grout.
- Front doors that reduce ingress of water all the time with no further installation required. Such methods must consider hydrostatic pressure and that water may still come in through the floor. Such methods offer time and reduce damage but may not remove flood water from entering the house completely.

8.6.1 Further guidance

Norfolk County Council's **guidance document** on their roles as LLFA Statutory Consultee for Planning, details that the LLFA expect any resistance and resilience measures to be followed where it is agreed that it is not possible for development to be avoided in areas at risk of surface water flooding and not possible to mitigate the risks through the site design.

In relation to fluvial and tidal flood risks, the Environment Agency recommend that consideration is given to flood proofing measures to reduce the impact of flooding when it occurs. To minimise the disruption and cost implications of a flood event, the Environment Agency encourage development to incorporate flood resistance and resilience measures up to the extreme 1 in 1,000-year climate change flood level. Further information is provided in the publication **"Improving the flood performance of new buildings"** and **"Prepare your property for flooding."**

8.7 Reducing flood risk from other sources

8.7.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design (development form), ensuring floor levels are raised above the water levels caused by a 1% AEP plus climate change event, or where high ground water levels are known. Site design would also need to preserve any flow routes followed by the groundwater underground and overland to ensure flood risk is not increased upstream or downstream.

Infiltration SuDS can cause increased groundwater levels and increase flood risk on or off of the site. Developers should provide evidence and ensure that this will not be a significant risk.

When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is not considered an acceptable solution.

8.7.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. It is important that a surface water drainage strategy shows that development will not make the risk worse, increase flood risk elsewhere, and that the drainage requirements regarding runoff rates and SuDS for new development are met.

If residual surface water flood risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are preserved and building design should provide resilience against this residual risk.

When redeveloping existing buildings, the installation of some permanent or temporary floodproofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers, providing they are maintained appropriately. Non-return valves can be installed within gravity sewers or drains within a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly, and appropriately, maintained. Consideration must also be given to attenuation and flow ensuring that flows during the 100-year plus climate change storm event are retained within the site if any flap valves shut. This must be demonstrated with suitable modelling techniques.

8.7.3 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) re-create the benefits of natural drainage systems by integrating water management with urban form to create and enhance the public realm, streets and open spaces. The flexibility of SuDS components means that SuDS can apply in both the urban and rural context and in both natural and man-made environments.

The 2018 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165). Further information on SuDS is available in Section 9.

9 Surface water management and SuDS

9.1 What is meant by surface water flooding?

Surface water flooding describes flooding from sewers, drains, and ditches that occurs during heavy rainfall.

Surface water flooding includes:

- **pluvial flooding**: flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (overland surface runoff) before it either enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity;
- **sewer flooding**: flooding that occurs when the capacity of underground water conveyance systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters which may cause water to back up and flood around buildings or in built up areas. Sewer flooding can also arise from operational issues such as blockages or collapses of parts of the sewer network; and
- **overland flows entering the built-up area from the rural/urban fringe**: includes overland flows originating from groundwater springs.

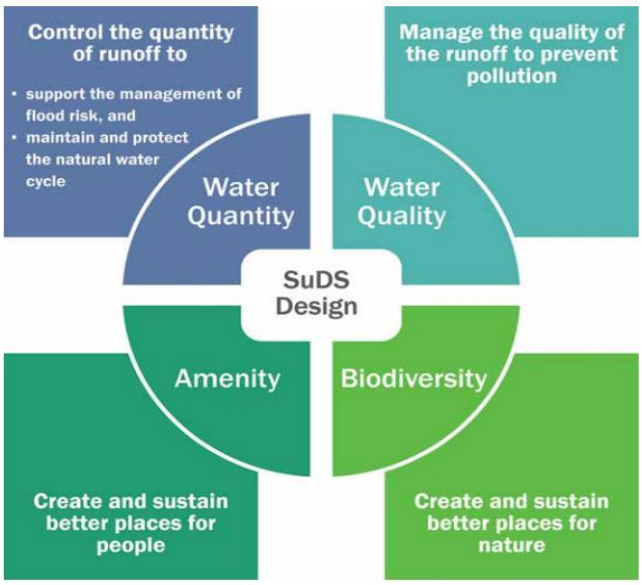
9.2 Role of the LLFA and Local Planning Authority in surface water management

In April 2015 Norfolk County Council was made a statutory consultee on the management of surface water and, as a result, provide technical advice on surface water drainage strategies and designs put forward for major development proposals. When considering planning applications, the Borough Council of King's Lynn and West Norfolk will seek advice from the relevant flood risk management bodies, principally Norfolk County Council (the LLFA) on the management of surface water, to satisfy themselves that the development's proposed minimum standards of operation are appropriate, and to ensure, through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the lifetime of the development. Judgement on what SuDS system would be reasonably practicable is through reference to **Defra's Non-Statutory Technical Standards for SuDS** and the **Guidance on Norfolk County Council's Lead Local Flood Authority role as Statutory Consultee to Planning** and will take into account design and construction costs.

Under Policy CU11 (Securing Sustainable Drainage) in Norfolk County Council's LFRMS, the LLFA shall seek to secure the implementation of SuDS and through voluntary cooperation of landowners, aim to secure adaptation of existing drainage networks to enable SuDS.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS. Proposals should also comply with the key SuDS principles regarding solutions that deliver multiple long-term benefits. These four principles are shown in Figure 9-1.

Figure 9-1: Four principles of SuDS design



Source: **The SuDS Manual (C753) Ciria (2015)**

9.2.1 Norfolk County Council guidance in their LLFA role as Statutory Consultee to Planning

The Norfolk County Council **guidance document** regarding their Lead Local Flood Authority role as Statutory Consultee to Planning (2017) provides information on how SuDS proposals on new developments will be determined, when to consult the LLFA (also discussed in Section 2.5.2), how to screen applications based on local flood risk and records, LLFA standing advice (for Ordinary Watercourse consenting, major development below LLFA thresholds and minor development), the levels of information required for planning applications and technical guidance. The technical guidance relates to local flood risk, SuDS surface water drainage disposal destination, infiltration testing, runoff rate and volume, climate change, Water Framework Directive and water quality, management and maintenance of SuDS and resistance and resilience measures.

There are a series of policies contained in the technical guidance which are summarised as follows:

- **Policy Box 1: Local Flood Risk Guidance** refers to Paragraph 103 of the NPPF and NPPG Paragraph 033 Reference ID: 7-033-20140306. This discusses the requirements for LPAs to consider flood risk when determining planning applications. Norfolk County Council state that the sequential approach is supported, as this is the most sustainable form of flood risk management and describe what sources of flood risk information the LLFA will use to assist with a review of planning applications. Guidance is provided on the assessment of flood risks and mitigation measures relating to Ordinary Watercourses and surface water overland flow routes. Inclusion of opportunities to improve existing local flood risk issues are encouraged.
- **Policy Box 2: Drainage Hierarchy** refers to the NPPG Paragraph 080, Reference ID: 7-080-20150323. Where reasonably practical, the general aim should be to discharge surface runoff as high up the hierarchy of drainage options as possible: 1) into the ground (infiltration), 2) to a surface water body, 3) to a surface water sewer, highway drain or another drainage system, 4) to a combined sewer. How proposals follow this hierarchy should be clearly demonstrated, with adequate evidence and reasoning, to explain why infiltration methods are not considered to be feasible and why methods, lower down the hierarchy, are considered to be feasible.
- **Policy Box 3: Infiltration Testing Guidance** refers to the BRE 365: Soakaway Design (2016). The LLFA expects *"all submitted drainage strategies to include an assessment of the suitability of underlying geology to discharge collected surface water to the ground via infiltration."* Further information regarding infiltration testing and infiltration constraints are provided in the guidance. Section 9.3.4 of this SFRA discusses overcoming SuDS constraints.
- **Policy Box 4: Runoff Rate** refers to the SuDS Non-Statutory Technical Standards (2015), specifically standards S2 and S3 which concern peak runoff rates. In addition, the LLFA

state that consideration needs to be given to the catchment area (e.g. where sub-catchments may exist on the site) and any historical flooding or capacity constraints.

- **Policy Box 5: Runoff Volume** refers to the CIRIA SuDS Manual (C735). Two approaches for the consideration of runoff volume from a development site are detailed in the CIRIA SuDS Manual and the LLFA discuss their preferred approach. The LLFA also state that Urban Creep should be considered in any application and detail the allowances to be used in assessments.
- **Policy Box 6: Climate Change** refers to the requirement to consider climate change in flood risk assessments and the government's climate change allowances (see Section 4). The LLFA discuss expectations and allowances in relation to Ordinary Watercourses and where modelling is used to inform the initial design of surface water drainage systems and SuDS.
- **Policy Box 7: Management and Maintenance** refers to the House of Commons Written Statement (HCWS161) on sustainable drainage systems. The LLFA will require *"applicants to provide a management plan and maintenance schedule of work detailing activities required and who will adopt and maintain the surface water drainage features for the lifetime of the development."* The guidance details some of the options available for the adoption and maintenance of SuDS.
- **Policy Box 8: Flow Exceedance Management** refers to the British Standard BS8582:2013 Section 5.2.2.6. It discusses how exceedance flows on site should be considered and take into account any residual risks for the site. This section also discusses resistance and resilience measures.

9.2.2 Anglian Water guidance

Where it is proposed to connect surface water into the public sewerage network Anglian Water expect applicants to have regard to the **Anglian Water Surface Water Policy** which promotes sustainable alternatives to discharge to sewerage network.

Developers who wish to have their SuDS schemes considered for adoption by Anglian Water should refer to the **Anglian Water SuDS Adoption Manual**. Anglian Water also expect national guidance (i.e. the CIRIA C753 SuDS Manual) to be referred to in addition to Anglian Water's guidance. It should be noted that at the time of preparing the 2018 SFRA, Anglian Water's SuDS Adoption Manual was expected to be updated to take into account national guidance published after the manual was released and to reflect Anglian Water's position relating to health and safety matters associated with open SuDS features. At the time of preparing the 2018 SFRA, Anglia Water's current position is that any developer that wants Anglian Water to adopt open SuDS features, will be required to have an independent risk assessment completed that satisfies RoSPA requirements and incorporate recommendations from that report into their overall design.

Anglian Water recommend that developers contact Anglian Water's SuDS Team (**SuDS@anglianwater.co.uk**) as early as possible to discuss any SuDS features which they would like to see adopted by Anglian Water (ideally before submitting formal planning applications).

9.2.3 Internal Drainage Boards' guidance

Planners should be aware of local conditions and requirements set by the either the Downham Market Group of Internal Drainage Boards, Ely Group of Internal Drainage Boards, Middle Level Commissioners or the Water Management Alliance. Further details regarding their policies for development and SuDS can be found on their websites:

- **http://www.downhammarketidbs.org.uk**
- **http://www.elydrainageboards.co.uk**
- **https://middlelevel.gov.uk/**
- **https://www.wlma.org.uk/**

In general, developers who wish to do the following, will require the respective IDB's prior written consent:

- Discharge surface water into any watercourse (managed by the IDB)
- Attenuate surface water run-off arising from development.

9.3 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are designed to maximise the opportunities and benefits that can be secured from surface water management practices. SuDS provide a means of dealing with the quantity and quality of surface water whilst offering additional benefits over traditional systems of improving amenity and biodiversity. The correct use of SuDS can also allow developments to counteract the negative impact that urbanisation has on the water cycle by promoting infiltration and replenishing ground water supplies. SuDS if properly designed can improve the quality of life within a development offering additional benefits such as:

- Improving water quality
- Habitat creation and improvement
- Improving amenity
- Improving air quality
- Helping to regulate building temperatures
- Reducing noise
- Providing education opportunities
- Cost benefits over underground piped systems.

Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into the majority of spaces. For example, permeable paving could be used in parking spaces or rainwater gardens into traffic calming measures.

Unless demonstrated to be inappropriate, all new major development proposals should ensure that sustainable drainage systems for management of runoff are put in place and should be given priority, as per the **Ministerial Statement** and the NPPF. One of the key changes in the 2018 NPPF is in the consideration of SuDS. 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165). Likewise, minor developments should also mitigate flood risk, and take a suitable approach to surface water drainage. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

Part C Technical Guidance of Norfolk County Council's **guidance document** details the LLFA's expectations on the SuDS disposal destination and the drainage hierarchy to be followed; any submission should clearly demonstrate how the proposals will follow the drainage hierarchy. Details on runoff rates and volumes are also provided in the technical guidance.

9.3.1 Types of SuDS Systems

There are many different SuDS components that can be implemented in attempts to mimic predevelopment drainage (Table 9-1). The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA) e.g. **the CIRIA SuDS Manual C753 (2015)**.

Table 9-1: Examples of SuDS techniques and potential benefits

SuDS Technique	Flood Reduction	Water Quality Treatment & Enhancement	Landscape and Wildlife Benefit
Living roofs	✓	✓	✓
Basins and ponds	✓	✓	✓
Constructed wetlands	✓	✓	✓
Balancing ponds	✓	✓	✓
Detention basins	✓	✓	✓
Retention ponds	✓	✓	✓
Filter strips and swales	✓	✓	✓
Infiltration devices	✓	✓	✓
Soakaways	✓	✓	✓
Infiltration trenches and basins	✓	✓	✓
Permeable surfaces and filter drains	✓	✓	
Gravelled areas	✓	✓	
Solid paving blocks	✓	✓	
Porous pavements	✓	✓	
Tanked systems	✓		
Over-sized pipes/tanks	✓		
Storm cells	✓		

9.3.2 Treatment

A key part of the four pillars of SuDS is to provide the maximum improvement to water quality through the use of the "SuDS management train". To maximise the treatment within SuDS, CIRIA recommends the following good practice is implemented in the treatment process:

1. **Manage surface water runoff close to source:** This makes treatment easier due to the slower velocities and also helps isolate incidents rather than transport pollutants over a large area.
2. **Treat surface water runoff on the surface:** This allows treatment performance to be more easily inspected and managed. Sources of pollution and potential flood risk is also more easily identified. It also helps with future maintenance work and identifying damaged or failed features.
3. **Treat a range of contaminants:** SuDS should be chosen and designed to deal with the likely contaminants from a development and be able to reduce them to acceptably low levels.
4. **Minimise the risk of sediment remobilisation:** SuDS should be designed to prevent sediments being washed into receiving water bodies or systems during events greater than what the feature may have been designed.
5. **Minimise the impact of spill:** Designing SuDS to be able to trap spills close to the source or provide robust treatment along several features in series.

The number of treatment stages required depends primarily on the source of the runoff. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered.

Further guidance on the treatment stages is provided in the CIRIA SuDS Manual C753 (2015). The manual provides a risk based approach to the treatment of SuDS which is dependent upon the land use and sensitivity of the receiving water body. The manual provides guidance on the treatment steps required for the type of SuDS component / scheme being considered.

9.3.3 SuDS Management

SuDS components should not be used individually but as a series of features in an interconnected system designed to capture water at the source and convey it to a discharge location. SuDS components should be selected based on design criteria and how surface water management is to

be integrated within the development and landscaping setting. By using a number of SuDS components in series it is possible to reduce the flow and volume of runoff as it passes through the system as well as minimising pollutants which may be generated by a development

Part C Technical Guidance of Norfolk County Council's **guidance document** provides further information on the management and maintenance of SuDS and options for the adoption of SuDS. This includes guidance on what could be considered within a management plan and maintenance schedule.

9.3.4 Overcoming SuDS constraints

The design of a SuDS system will be influenced by a number of physical and policy constraints. These should be taken into account and reflected upon during the conceptual, outline and detailed stages of SuDS design. Table 9-2 details some possible constraints and how they may be overcome and includes information from the SuDS Manual (C753). Guidance should also be sought from the Environment Agency.

Table 9-2: Example SuDS constraints and possible solutions

Constraint	Solution
Land availability	SuDS can be designed to fit into small areas by utilising different systems. For example, features such as permeable paving and green roofs can be used in urban areas where space may be limited.
Contaminated soil or groundwater below site	SuDS can be placed and designed to overcome issues with contaminated groundwater or soil. Shallow surface SuDS can be used to minimise disturbance to the underlying soil. The use of infiltration should also be investigated as it may be possible in some locations within the site. If infiltration is not possible linings can be used with features to prevent infiltration.
High groundwater levels	Non-infiltrating features can be used. Features can be lined with an impermeable liner or clay to prevent the egress of water into the feature. Additional, shallow features can be utilised which are above the groundwater table.
Steep slopes	Check dams can be used to slow flows. Additionally, features can form a terraced system with additional SuDS components such as ponds used to slow flows.
Shallow slopes	Use of shallow surface features to allow a sufficient gradient. If the gradient is still too shallow pumped systems can be considered as a last resort.
Ground instability	Geotechnical site investigation should be done to determine the extent of unstable soil and indicate whether infiltration would be suitable or not.
Sites with deep backfill	Infiltration should be avoided unless the soil can be demonstrated to be sufficiently compacted. Some features such as swales are more adaptable to potential surface settlement.
Open space in floodplain zones	Design decisions should take into account the likely high groundwater table and possible high flows and water levels. Features should also seek to not reduce the capacity of the floodplain and take into consideration the influence that a watercourse may have on a system. Factors such as siltation after a flood event should also be taken into account during the design phase
Future adoption and maintenance	Local Planning Authority should ensure development proposals, through the use of planning conditions or planning obligations, have clear arrangements for on-going maintenance over the development's lifetime.

There may be constraints to surface water discharges relating to high water levels in a receiving watercourse, especially those which are tidal, in the Borough of King's Lynn and West Norfolk.

For proposed developments, geotechnical investigations should be undertaken to determine whether material on site has infiltration potential. This information should be representative of on-site conditions. If material is found to have infiltration potential, detailed infiltration testing should be undertaken in line with BRE 365 to establish representative infiltration rates.

For SuDS components that are designed to encourage infiltration, it is imperative that groundwater levels are low enough and a site-specific infiltration test is conducted early on as part of the design of the development. Infiltration should be considered with caution within areas of possible subsidence or sinkholes.

LLFA requirements for infiltration testing for applications and infiltration constraints are detailed in Part C Technical Guidance of Norfolk County Council's **guidance document**.

9.4 Other surface water considerations

9.4.1 Groundwater Source Protection Zones (SPZ)

In addition to the AStGWf data the Environment Agency also defines Groundwater Source Protection Zones (SPZ) in the vicinity of groundwater abstraction points. These areas are defined to protect areas of groundwater that are used for potable supply, including public/private potable supply, or for use in the production of commercial food and drinks. The Groundwater SPZ requires attenuated storage of runoff to prevent infiltration and contamination. The definition of each zone is shown below:

- Zone 1 (Inner Protection Zone) – Most sensitive zone: defined as the 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres
- Zone 2 (Outer Protection Zone) – Also sensitive to contamination: defined by a 400-day travel time from a point below the water table. This zone has a minimum radius around the source, depending on the size of the abstraction
- Zone 3 (Total Catchment) - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source.

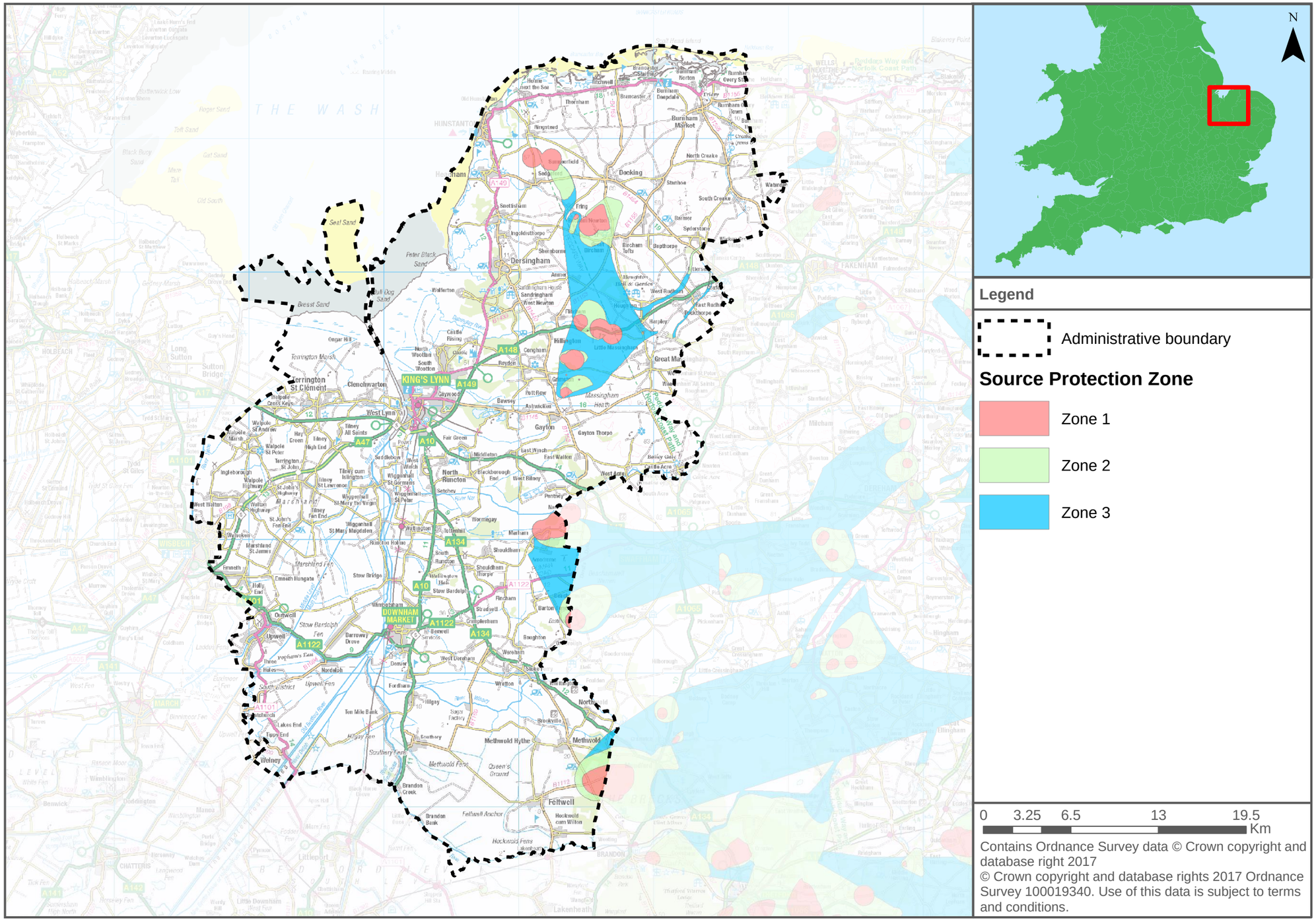
A number of Groundwater SPZs have been identified in the Borough of King's Lynn and West Norfolk; these are predominantly located to the east of the study area. The locations of the Groundwater SPZs are shown in Figure 9-2.

Figure 6-2 shows that the Borough is partially underlain by principal aquifers; thus, water resources may be at risk from development in areas outside of Groundwater PSZs e.g. private supplies, may not have an associated Groundwater SPZ.

Where sites are underlain by an aquifer, treatment steps may be required ahead of discharge to the ground, sewers etc. Development proposals at sites across the area should assess the pollution risk to receiving waterbodies, and include appropriate treatment steps ahead of any discharge to surface or groundwaters. Chapter 8 of the CIRIA SuDS Manual C753 (2015) provides information and guidance on how to design SuDS in areas with particular constraints. Further restrictions may be applicable and guidance should be sought from the LLFA. Where potentially polluting activities are proposed, the Environment Agency should also be consulted.

Where development is located in a SPZ, it is recommended that consultation with the relevant stakeholders (e.g. the EA for pollutant matters and the LLFA for SuDS) is undertaken as early as possible.

Figure 9-2: Location of Groundwater Source Protection Zones in the study area



9.5 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated to 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 definition of each NVZ is as follows:

- Groundwater NVZ – water held underground in the soil or in pores and crevices in rock, which has, or could have if action is not taken, a nitrate concentration greater than 50mg/l.
- Surface Water NVZ – areas of land that drain into a freshwater water body which has, or could have is action is not taken, a nitrate concentration greater than 50mg/l.
- Eutrophic NVZ – bodies of water, mainly lakes and estuaries, that are, or may become, enriched by nitrogen compounds which cause a growth of algae and other plant life that unbalances the quality of the water and to organisms present in the water.

NVZs locations can be viewed on **interactive mapping** provided by the Environment Agency. Groundwater NVZs are located towards the centre, east, south and north of the study area. 13 surface water NVZs lie or partially lie across the majority of the Borough. No eutrophic NVZs lie within the Borough of King's Lynn and West Norfolk.

9.6 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. The results of the assessment are shown in Table 9-3; mapping of the soil characteristics is shown in Figure 9-3 and Figure 9-4. This indicates that the soils to the east of the Borough and east of the Great Ouse are permeable and suggests that infiltration techniques, which are at the top of the drainage hierarchy (NPPG Paragraph 080, Reference ID: 7-080-20150323) may be suitable in these areas. Soils to the west of the Borough and west of the Great Ouse have a largely mixed permeability; depending on the proportion of clay in the soil, infiltration techniques may / may not be suitable in these areas. A number of other SuDS techniques are also considered to be appropriate based on soil type.

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 the 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, as discussed in Section 9.3.4 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.

Table 9-3: General application of SuDS in relation to soil types in the Borough of King's Lynn and West Norfolk

General soil type	Description	Infiltration potential	Appropriate SuDS Techniques	Borough of King's Lynn and West Norfolk
Sand	Brown sand	Good, relatively permeable	Living roofs, basins and ponds (depends on depth of water table), constructed wetlands, balancing ponds, detention basins, retention ponds, filter strips and swales, infiltration devices and soakaways (depends on depth of water table), permeable surfaces, porous paving, gravelled areas and filter drains and tanked systems.	✓ - generally found towards the coastline, in the north-east of the Borough.
Sand and gravel	Glacial sand and gravel	Good, relatively permeable	Living roofs, basins and ponds (depends on depth of water table), constructed wetlands, balancing ponds, detention basins, retention ponds, filter strips and swales, infiltration devices and soakaways (depends on depth of water table), permeable surfaces, porous paving, gravelled areas and filter drains and tanked systems.	✓ -.generally found towards the east of the Borough and tends to be found in areas of high ground.
Sand and gravel	River Terrace Deposits	Good, relatively permeable	Living roofs, basins and ponds (depends on depth of water table), constructed wetlands, balancing ponds, detention basins, retention ponds, filter strips and swales, infiltration devices and soakaways (depends on depth of water table), permeable surfaces, porous paving, gravelled areas and filter drains and tanked systems.	✓ - generally found in sporadic locations to the south-west of the Borough and towards the coastline, to the north-east of the Borough.
Clay, silt and sand	Alluvium	Variable, mixed permeability	Living roofs, basins and ponds (depends on depth of water table), constructed wetlands, balancing ponds, detention basins, retention ponds, filter strips and swales, porous paving, gravelled areas and filter drains and tanked systems. SuDS techniques which rely on infiltration (e.g. infiltration devices, soakaways and permeable surfaces etc.) may / may not be suitable depending upon the concentration of clay in the soil.	✓ - generally found along the bottom of valleys, particularly along the floodplain of the Great Ouse and its tributaries. Also found towards the coastline. A predominant soil type in the Borough.
Diamicton	Till (also referred to as Boulder Clay)	Variable, mixed permeability	Living roofs, basins and ponds (depends on depth of water table), constructed wetlands, balancing ponds, detention basins, retention ponds, filter strips and swales, porous paving, gravelled areas and filter drains and tanked systems. SuDS techniques which rely on infiltration (e.g. infiltration devices, soakaways and permeable surfaces etc.) may / may not be suitable depending upon the concentration of clay in the soil.	✓ -.generally found towards the east of the Borough and tends to be found in areas of high ground. A predominant soil type in the Borough.
Clay	Lacustrine deposits (Clay)	Poor permeability	Living roofs, basins and ponds (depends on depth of water table), constructed wetlands, balancing ponds, detention basins, retention ponds, filter strips and swales, porous paving, gravelled areas and filter drains and tanked systems. SuDS techniques which rely on infiltration (e.g. infiltration devices, soakaways and permeable surfaces etc.) may / may not be suitable depending upon the concentration of clay in the soil.	✓ - an isolated area of lacustrine deposits is shown at the southern Borough boundary, towards the Little Ouse River.
Peat	Peat	Poor permeability	Living roofs, basins and ponds (depends on depth of water table), constructed wetlands, balancing ponds, detention basins, retention ponds, filter strips and swales, porous paving, gravelled areas and filter drains and tanked systems. SuDS techniques which rely on infiltration (e.g. infiltration devices, soakaways and permeable surfaces etc.) may / may not be suitable as Peat is prone to water-logging.	✓ - largely found to the south of the Borough. An isolated area of peat is shown in the centre of the Borough.

Figure 9-3: Soil Types in the Borough of King's Lynn and West Norfolk – by general type (ROCK_D)

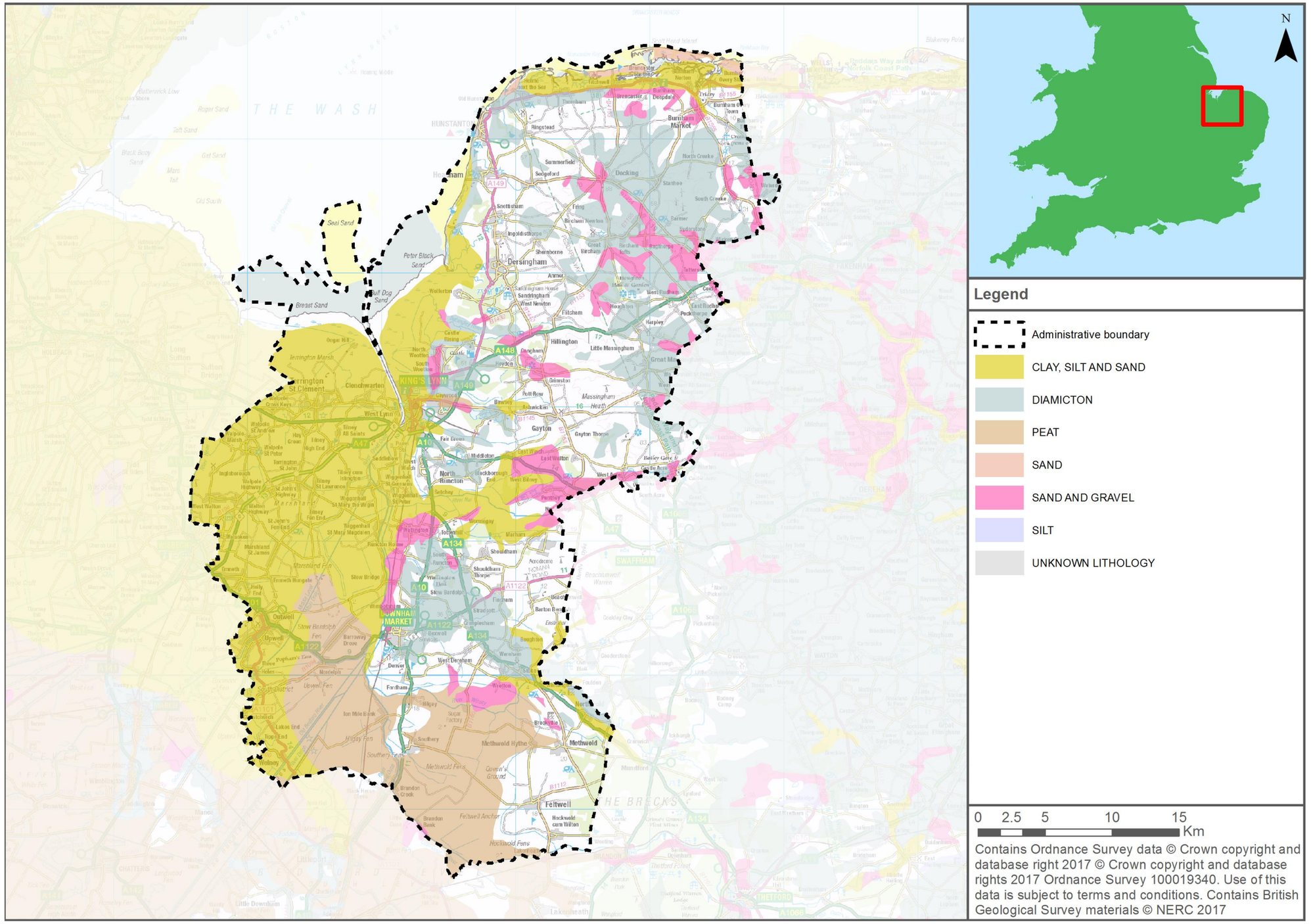
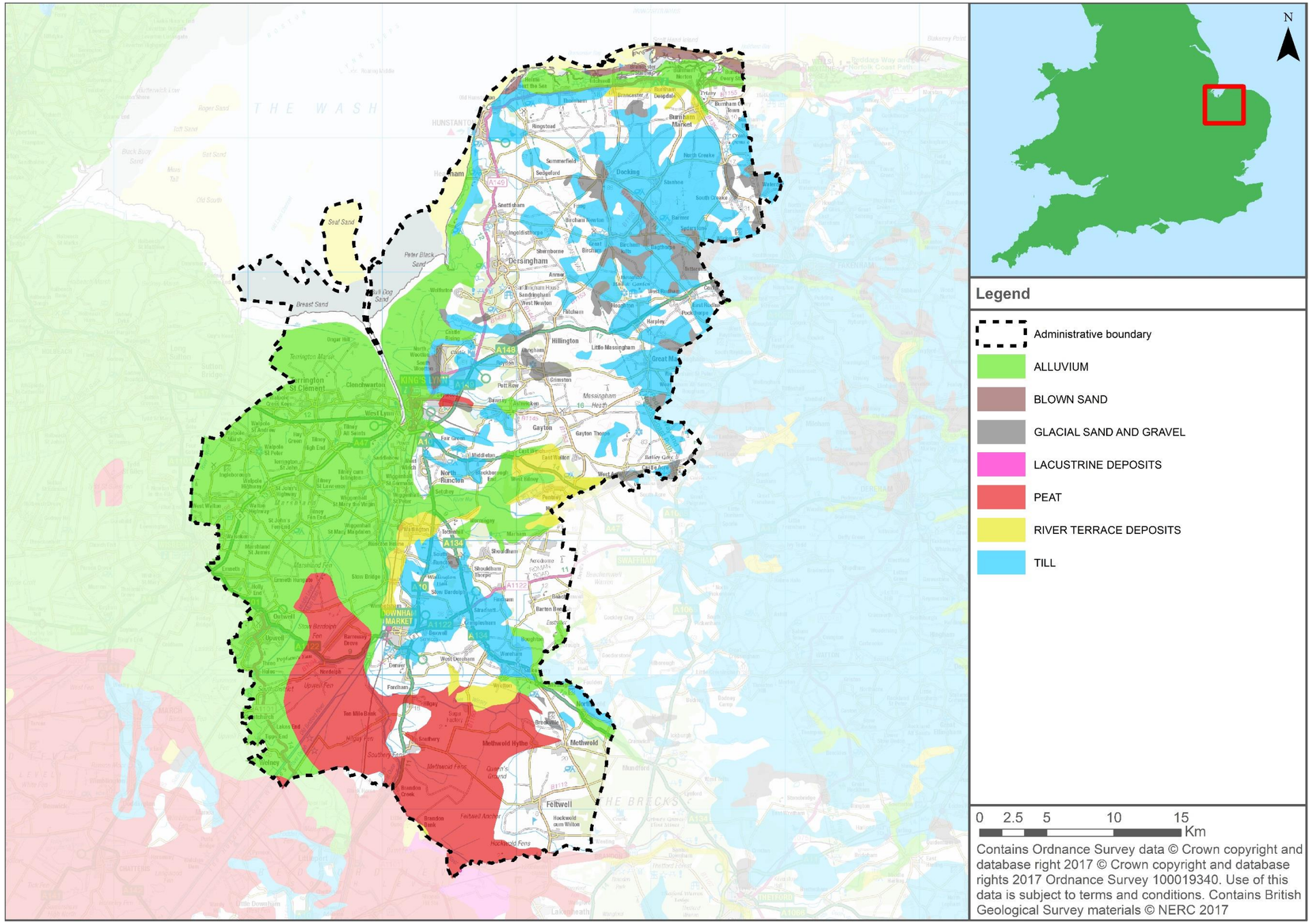


Figure 9-4: Soil Types in the Borough of King's Lynn and West Norfolk – by description (LEX_D)



10 Strategic flood risk solutions

10.1 Introduction

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in the Borough. As described in Section 2.7, the Borough of King's Lynn and West Norfolk lies within the Great Ouse CFMP, the Broadland Rivers CFMP, the North Norfolk CFMP and the River Nene CFMP

The policies for the Borough within the Great Ouse CFMP, the Broadland Rivers CFMP and the North Norfolk CFMP are:

- **Policy 2** - Areas of low to moderate flood risk where further action to reduce flood risk can generally be taken.
- **Policy 3** - Areas of low to moderate flood risk where existing flood risk is generally managed effectively.
- **Policy 4** - Areas of low, moderate or high flood risk where existing flood risk is generally managed effectively but where further action is needed, to keep pace with climate change.

Specific 'actions' for flood risk management are described for each sub-area within the CFMP.

Further detailed strategic information on proposed strategic measures and approaches is available in the **Anglian River Basin District Flood Risk Management Plan.**

The shoreline along the Borough of King's Lynn and West Norfolk is covered by the **Gibraltar Point to Old Hunstanton (2010)** SMP and the **Hunstanton to Kelling Hard (2010)** SMP. Within these two SMPs the following plans are outlined in Section 2.9.

Strategic flood risk solutions should be in alignment with the objectives and actions detailed in wider strategies such as the CFMPs, RBMPs and SMPs.

When considering strategic flood risk solutions, it is important not only to consider whether a solution provides the most effective way at removing parcels of land from a given magnitude event or Flood Zone, but must also consider many other factors, including:

- Whether the flood risk solution will make the development safe e.g. whether safe access and egress to a locally identified refuge area can be achieved
- How the flood risk solution will be managed and maintained for the lifetime of development
- The cost of implementing the solution (and maintaining it)
- Environmental implications of the flood risk solution (both during and after implementation)
- How the flood risk solution could affect the entire catchment

Water Framework Directive (WFD) requirements should also be taken into consideration. The WFD requires that Environmental Objectives be set for all surface and ground waters in England and Wales to enable them to achieve 'Good Ecological Status' (or 'Good Ecological Potential' for Heavily Modified and Artificial Water Bodies) by a defined date. It is important that developments aim to take positive measures to conform to the WFD, which can be impacted as a result of development, for example in terms of 'deterioration' in ecological status or potential.

The following sections outline different options which could be considered for strategic flood risk solutions.

10.2 Flood storage

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding. Development increases the impermeable area within a catchment, creating additional and faster runoff into watercourses. Flood storage schemes aim to detain this additional runoff, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. Methods to provide these schemes include[18]:

- enlarging the river channel;

18 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2

- raising the riverbanks; and/or
- constructing flood banks set back from the river.

Flood storage schemes have the advantage that they generally benefit areas downstream, not just the local area.

There are already a number of FSAs within the Borough including the Ouse Washes and the Ely Ouse Flood Protection Scheme. A number of options for flood storage areas outside the Borough, further upstream in the Great Ouse catchment have been recommended in the CFMP. Such FSAs could have the potential to reduce flood risk within the Borough.

10.2.1 Promotion of SuDS

By considering SuDS at an early stage in the development of a site, the risk from surface water can be mitigated to a certain extent within the site as well as reduce the risk that the site poses to third party land. SuDS should be promoted on all new developments to ensure the quantity and quality of surface water is dealt with sustainably to reduce flood risk. The guidance produced by Defra and Norfolk County Council as LLFA (summarised in Chapter 9), should actively encourage developers to use the information to produce technically proficient and sustainable solutions for drainage.

10.3 Catchment and floodplain restoration

Compared to flood defences and flood storage, floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state, and by creating space for naturally functioning floodplains working with natural processes.

Although the restoration of floodplain is difficult in previously developed areas where development cannot be rolled back, the following measures should be adopted:

- Promoting existing and future brownfield sites that are adjacent to watercourses to naturalise banks as much as possible. Buffer areas around watercourses provide an opportunity to restore parts of the floodplain
- Removal of redundant structures to reconnect the watercourse and the floodplain. There are a number of culverted sections of watercourse located throughout the district which if returned to a more natural state would potentially reduce flood risk to the local area
- Apply the Sequential Approach to avoid new development within currently undefended floodplain.

For those sites considered within the Local Plan and / or put forward by developers, that also have watercourses flowing through or past them, the sequential approach should be used to locate development away from these watercourses. This will ensure the watercourses retain their connectivity to the floodplain. Loss of floodplain connectivity in rural upper reaches of tributaries which flow through urban areas in the district, could potentially increase flooding within the urban areas. This will also negate any need to build flood defences within the sites. It is acknowledged that sites located on the fringes of urban areas within the district are likely to have limited opportunity to restore floodplain in previously developed areas.

The Seven Sisters Drain, which runs along the King's Lynn Town Football Club, was abandoned and had become overgrown and silted. Norfolk Rivers Trust, King's Lynn Internal Drainage Board and the Borough Council worked together to dig out the silt and created a new winding channel. This area will also become a wildlife haven. Further details can be found on the Norfolk Rivers Trust **website**.

10.3.1 Structure Removal and / or modification (e.g. Weirs), de-culverting

Structures, both within watercourses and adjacent to them can have significant impacts upon rivers including, alterations to the geomorphology and hydraulics of the channel through water impoundment and altering sediment transfer regimes, which over time can significantly impact the channel profile including bed and bank levels, alterations to flow regime and interruption of biological connectivity, including the passage of fish and invertebrates.

Many artificial in-channel structures (examples include weirs and culverts) are often redundant and / or serve little purpose and opportunities exist to remove them where feasible. The need to do this is heightened by climate change, for which restoring natural river processes, habitats and connectivity are vital adaptation measures. However, it also must be recognised that some artificial

structures may have important functions or historical/cultural associations, which need to be considered carefully when planning and designing restoration work.

In the case of weirs, whilst weir removal should be investigated in the first instance, in some cases it may be necessary to modify a weir rather than remove it, for example by lowering the weir crest level or adding a fish pass. This will allow more natural water level variations upstream of the weir and remove a barrier to fish migration.

With careful early planning, watercourses can be made a feature of the site and ownership and maintenance should be considered early. De-culverting of a watercourse, to open it up and make it a feature of the site to allow for flood storage and betterment downstream, should be considered for all sites with culverted watercourses within their boundary.

Further information is provided in the **Trash and Security Screen Guide 2009**, published by the Environment Agency/ Defra, which should be used as evidence for any culvert assessment, improvement or structure retention.

10.3.2 Bank Stabilisation

It is generally recommended that bank erosion is avoided where possible and all landowners are encouraged to avoid using machinery and vehicles close to or within the watercourse.

There are a number of techniques that can be employed to restrict the erosion of the banks of a watercourse. In an area where bankside erosion is particularly bad and/or vegetation is unable to properly establish, ecologically sensitive bank stabilisation techniques, such as willow spiling, can be particularly effective. Live willow stakes thrive in the moist environment and protect the soils from further erosion allowing other vegetation to establish and protect the soils.

10.3.3 Bank removal, set back and / or increased easement

The removal or realignment of flood embankments and walls can allow the natural interrelationship between the river channel and the floodplain to be reinstated. This can be achieved at a small scale within urban areas providing pockets of attractive green spaces along rivers, whilst also improving floodplain storage within confined urban environments at times of flooding.

A detailed assessment would need to be undertaken to gain a greater understanding of the response to the channel modification, including flood risk analysis to investigate flood risk impacts.

An assessment of formal flood defences has been undertaken as part of this SFRA. All formal defences have a role in reducing flood risk, and therefore opportunities for bank removal, set back and / or increased easement will be limited. However, there may be informal artificial structures (embankments, walls) or defences within the district which are now redundant.

10.3.4 Re-naturalisation

There is potential to re-naturalise a watercourse by re-profiling the channel, removing hard defences, re-connecting the channel with its floodplain and introducing a more natural morphology (particularly in instances where a watercourse has historically been modified through hard bed modification). Detailed assessments and planning would need to be undertaken to gain a greater understanding of the response to any proposed channel modification.

The River Nar, Pentney has historically been modified for human use. A **Norfolk River Trust Project** was completed in March 2015, with the following works carried out:

- Re-profiling to create a shallower bank
- The creation of riffles and bars
- Removal of timber revetments and flow deflectors
- Install brushwood faggots into the channel
- Install large woody debris.

10.4 Natural flood management

Developments provide opportunities to work with natural processes to reduce flood and erosion risk, benefit the natural environment and reduce costs of schemes. Natural flood management requires integrated catchment management and involves those who use and shape the land. It also requires partnership working with neighbouring authorities, organisations and water management bodies.

Conventional flood prevention schemes may be preferred, but consideration of 're-wilding' rivers upstream could provide cost efficiencies as well as considering multiple sources of flood risk; for example, reducing peak flows upstream such as through felling trees into streams or building earth banks to capture runoff, could be cheaper and smaller-scale measures than implementing flood walls for example. With flood prevention schemes, consideration needs to be given to the impact that flood prevention has on the WFD status of watercourses. It is important that any potential schemes do not have a negative impact on the ecological and chemical status of waterbodies.

10.5 Flood defences

There are a number of formal flood defences present within the Borough of King's Lynn and West Norfolk (see Section 7 for further information).

Flood mitigation measures should only be considered if, after application of the Sequential Approach, development sites cannot be located away from higher risk areas. If defences are constructed to protect a development site, it will need to be demonstrated that the defences will not have a resulting negative impact on flood risk elsewhere, and that there is no net loss in floodplain storage.

10.6 Green Infrastructure

Green Infrastructure (GI) is a planned and managed network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and rural fringe and consist of:

- Open spaces – parks, woodland, nature reserves, lakes
- Linkages – River corridors and canals, and pathways, cycle routes and greenways
- Networks of "urban green" – private gardens, street trees, verges and green roofs.

The identification and planning of Green Infrastructure is critical to sustainable growth. It merits forward planning and investment as much as other socio-economic priorities such as health, transport, education and economic development. GI is also central to climate change action and is a recurring theme in planning policy. With regards to flood risk, green spaces can be used to manage storm flows and free up water storage capacity in existing infrastructure to reduce risk of damage to urban property, particularly in city / town centres and vulnerable urban regeneration areas. Green infrastructure can also improve accessibility to waterways and improve water quality, supporting regeneration and improving opportunity for leisure, economic activity and biodiversity.

10.6.1 Green infrastructure strategies

The following section provides details of the GI studies that have been produced for the Borough of King's Lynn and West Norfolk.

The Norfolk Green Infrastructure Mapping Project

There is an on-going study called the Norfolk Green Infrastructure Mapping Project (Norfolk GIMP). Flood mitigation is to be a significant element of the project.

Borough of King's Lynn and West Norfolk - Green Infrastructure Study

A Green infrastructure study for the Borough of King's Lynn and West Norfolk has been prepared.

A number of strategic objectives were identified in Stage One of the study. These consist of:

- protecting, restoring and creating woodlands and orchards in appropriate locations;
- promoting and improving the marketing of accessible green spaces and routes;
- developing and creating recreational and orbital routes around the key centres of King's Lynn, Downham Market and Hunstanton;
- creating a range of new strategically accessible green spaces in and around King's Lynn, Downham Market and Hunstanton;
- protecting, enhancing and creating corridors for biodiversity, which link up strategic habitats, within the Borough and adjoining districts;
- seeking the creation of multifunctional spaces;

- designing GI sites to mitigate and adapt to the impacts of Climate Change, integrating Sustainable Drainage Systems (SUDS) into major development sites, plus providing appropriate planting within developments and town centres;
- maintaining and restoring historic features where possible;
- connecting urban and rural settlements and the countryside; and
- protecting and, where possible, enhancing railway lines for access and biodiversity.

10.7 Engaging with key stakeholders

Where complex flood risk issues are highlighted it is important that all stakeholders are actively encouraged to work together to identify issues and provide suitable solutions. Engagement with riparian owners is also important to ensure they understand their rights and responsibilities including maintaining river beds and banks; allowing the flow of water to pass without obstruction; and controlling invasive alien species e.g. Japanese knotweed.

Engagement is also important to determine whether an Environmental Permit is required from the Environment Agency (see Section 2.12.3) or whether consent from the LLFA or IDB is required.

More information about riparian owner responsibilities can be found in the Environment Agency's guidance for **Owning a Watercourse**.

10.8 Level 2 SFRA

The Level 2 SFRA for the Borough explores further how new development could contribute towards strategic flood risk solutions.

11 Summary

11.1 Overview

A consortium of Norfolk LPAs, comprising Broadland District Council, Great Yarmouth Borough Council, the Borough Council of King's Lynn and West Norfolk, North Norfolk District Council, Norwich City Council, South Norfolk Council and the Broads Authority, have commissioned four Level 1 SFRAs to inform strategic planning decisions, the preparation of Local Plans and to inform development management decisions.

The 2018 Level 1 SFRA delivers a strategic assessment of risk from all sources of flooding in the Borough of King's Lynn and West Norfolk. This SFRA also provides an overview of policy and provides guidance for planners and developers.

11.2 Sources of flood risk

- There have been a number of recorded flood incidents across the Borough, from a combination of sources. The predominant source of flooding is from tidal surges. Under Section 19 of the Flood and Water Management Act, Norfolk County Council in their role as LLFA, have published Section 19 reports. Within the King's Lynn and West Norfolk Borough, two flood events have been recorded. Section 19 reports are available to download from Norfolk County Council's **website.** A total of 47 flood incidents along the A47 highway have been recorded since 2008.
- Fluvial flooding is associated with a number watercourses throughout the Borough. Due to their low-lying elevations, many settlements across the Fens are at risk of tidally induced flooding, fluvial flooding or both in the event of overtopping / breach from embanked watercourses that are higher than the adjacent land. As the Fens area is heavily managed by the Internal Drainage Boards, a mechanical or structural failure of engineering installations such as land drainage pumps, sluice gates, lock gates, outfall flap valves etc. or their support infrastructure (i.e. power supplies in the case of drainage pumps) could exacerbate flooding.
- The low-lying areas in the west and south of the Borough in the Fens are highly susceptible to tidal flooding. The actual tidal flood risk though within the Great Ouse catchment is generally considered to be low, due to the defences in place and their standards of protection. Tidal waters have the potential to rise over embankments and inundate the land behind them in the Nene catchment. The greatest risk related to tidal flooding in the Borough would be if a spring tide coincided with a major storm surge.
- Coastal erosion is a predominant process along Hunstanton Cliffs causing potential threats to settlements and coastal defences. The emerging **Hunstanton Coastal Management Plan** will address these issues by defining a plan to manage the coastline at a local level. The (2010) **North Norfolk Shoreline Management Plan** (SMP) covering Huntstanton to Kelling and the (2010) **The Wash SMP** covering Gibraltar Point to Old Hunstanton describe the high level strategy and coastal polices. It should be noted that the policies described in the SMPs do not always focus on the "hold the line" approach.
- There are 18 IDBs in the Borough which are administrated by the either the **Downham Market Group of Internal Drainage Boards**, **Ely Group of Internal Drainage Boards**, **Middle Level Commissioners** or the **Water Management Alliance**. The IDBs manage water level and flood risk and further policy information can be found on their administrator's website. The IDB coverage is mapped in Appendix B with details about the extent of watercourses and standard of protection of structures summarised in Table 6-1.
- The RoFfSW dataset shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys, with some isolated ponding located in low-lying areas. The Stage 1 the **King's Lynn and West Norfolk Settlements SWMP** initially addressed 17 localities affected by surface water flooding or carrying a high surface water flood risk. The later work focused on producing surface water flood risk mapping for the four highest priority areas: King's Lynn, Downham Market, Heacham and Snettisham.
- Groundwater also plays a role in coastal erosion, as water within the rock strata can create instabilities within coastal cliffs. Due to the characteristics or The Wash and the underlying Chalk features there is a potential for groundwater flooding. The lowest lying areas (the Fens) are highly managed, so it is reasonable to assume the pumping infrastructure

operated by the Internal Drainage Board maintains a low water table. This would be reducing the probability of groundwater flooding.

- Historical incidents of flooding are detailed by Anglian Water in their sewer flooding register. This database records incidents of flooding relating to public foul, combined or surface water sewers and identifies which properties suffered flooding. A total of 118 recorded flood incidents have been identified on the sewer flooding register for King's Lynn and West Norfolk Borough.
- There are no records of flooding from reservoirs impacting properties inside the study area.
- Currently there are 14 Flood Alert Areas and 31 FWAs covering the study area. Mapping showing the coverage of the Flood Alert Areas and FWAs is provided in Appendix C.
- A high-level review was undertaken to identify the main settlements where flood risks / extents are more prominent; this is shown in Table 6-6. If a settlement is not listed in this table this does not mean that the settlement is not at flood risk.
- The mapping of all potential sources of flooding including climate change is provided in Appendix A. The mapping provided in Appendix A can be used as a high-level screening exercise, to identify whether a location or site has a potential risk of flooding.

11.3 Climate change

The NPPF and accompanying Planning Practice Guidance set out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. The Environment Agency published **updated climate change guidance** on 19 February 2016 (further updated on 3 February 2017), which supports the NPPF and must now be considered in all new developments and planning applications. The 2018 NPPF states that 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158) in relation to the impacts of climate change. The Environment Agency has also published guidance to LPAs in the application of appropriate climate change allowances when considering climate change effects (updated April 2016 **Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities**). The SFRA has considered the impact of climate change on fluvial, tidal and surface water flooding.

11.4 Flood defences

There are a number of Environment Agency assets throughout King's Lynn and West Norfolk Borough. The assets comprise a mixture of embankments, quays, bridge abutments, demountable defences, flood gates and walls. The standard of protection provided by these assets varies, as does the condition. The flood risk analysis in Section 7 and Appendix E demonstrates that much of the Borough is heavily dependent on flood defences to protect settlements from flooding, particularly from tidal / coastal sources.

The potential impacts of a breach of flood defences along: the River Nene, River Great Ouse River Nar and breach at Wells-next-the-sea has been modelled by the Environment Agency and are a key consideration for planning applications which falls within the coverage of those models. The Environment Agency and the Council have published flood design guidance relating to the application and use of this modelling on the Council webpage called: **"Information for planning agents"**.

The breach modelling results show that significant areas of the Borough of King's Lynn and West Norfolk are at risk should the defences breach; it demonstrates that King's Lynn and many smaller urban settlements are reliant on defences to protect against tidal (sea) flooding.

11.5 Dry islands

In this SFRA, dry islands are defined as an area of 0.5 hectares or greater in size, identified as being in Flood Zone 1 and completely surrounded by land which falls within Flood Zone 2 (i.e. the extreme 1 in 1,000-year extent). Dry islands can present specific hazards, primarily the provision of safe access and egress during a flood event. There are 564 dry islands in the King's Lynn and West Norfolk area. These are primarily located towards the southern and western areas of the Borough and a few dry islands cross administrative boundaries into neighbouring districts.

11.6 Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and FRAs have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities such as the LLFA and the Environment Agency.

11.7 Relevant studies

There are many relevant regional and local key studies which complement the SFRA and have been considered, such as the CFMPs, RBMPs, SMPs, the PFRA and LFRMS. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

11.8 Level 2 SFRA

A separate Level 2 SFRA considers flood risk and hazard at a community level to key settlements considered to be at the highest flood risk and where development pressure is highest. It also explores further how developers could contribute towards strategic flood risk solutions for existing communities and new developments.

12 Recommendations

A review of national and local policies has been conducted against the information collated on flood risk in this SFRA. Following this, several recommendations have been made for the Council to consider as part of Flood Risk Management in the Borough of King's Lynn and West Norfolk.

12.1 Development management

12.1.1 Sequential approach to development

The NPPF supports a risk-based and sequential approach to development and flood risk in England, so that development is located in the lowest flood risk areas where possible; it is recommended that this approach is adopted for all future developments within the Borough of King's Lynn and West Norfolk. The 2018 NPPF now also states that strategic policies should also now consider the 'cumulative impacts in, or affecting, local areas susceptible to flooding' (para 156), rather than just to or from individual development sites.

New development and re-development of land should, wherever possible seek opportunities to reduce overall level of flood risk at the site, for example by:

- Reducing volume and rate of runoff through the use of SuDS, as informed by national and local guidance. The revised 2018 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165).
- Relocating development to areas with lower flood risk
- Creating space for flooding
- Considering Green Infrastructure within the mitigation measures for surface water runoff from potential development and considering using Flood Zones 2 and 3 as public open space.

12.1.2 Site-specific flood risk assessments

Site-specific FRAs are required by developers to provide a greater level of detail on flood risk, highlight any protection provided by defences and, where necessary, demonstrate the development satisfies part b of the Exception Test.

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including consideration of the latest climate change allowances), inform the sequential approach within a site and prove, if required, whether the Exception Test can be satisfied.

Flood Zones, whilst generally accurate on a large scale, are not provided where the catchment of a watercourse falls below 3km^2. There are a number of small watercourse and field drains which may pose a risk to development; therefore, whilst these smaller watercourses may not be shown as having flood risk on the flood risk mapping, it does not necessarily mean that there is no flood risk. As part of a site-specific FRA the potential flood risk and extent of flood zones should be determined for these smaller watercourses.

Where a site-specific FRA has produced modelling outlines which differ from the EA's Flood Map for Planning (Rivers and Sea) then a Flood Map Challenge may need to be undertaken. Where the modelling and results are deemed acceptable to the EA, amendments to the Flood Map for Planning (Rivers and Sea) may take place.

Where watercourses are embanked, the effect of overtopping and breach must be considered and appropriately assessed.

All new development within the 1% AEP flood extent, including an allowance for climate change (for the lifetime of the development) must not normally result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage. Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water, and seek opportunities to provide floodplain betterment. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should normally be provided so the total volume of the floodplain storage is not reduced.

There are a number of guidance documents which provide information on the requirements for site-specific FRAs:

- **Standing Advice on Flood Risk (Environment Agency);**
- **Flood Risk Assessment for Planning Applications (Environment Agency);** and,
- **Site-specific Flood Risk Assessment: CHECKLIST (NPPG, Defra).**

The Environment Agency has produced a guidance document called "Flood risk assessment: Climate Change allowances" which details the application of climate change allowances and local considerations in East Anglia. This document, alongside other flood risk guidance, is available from: **https://www.norfolk.gov.uk/rubbish-recycling-and-planning/flood-and-water-management/information-for-developers**.

Developers are further advised to refer to policies DM 18 and DM 21 in the Borough's **Site Allocations and Development Management Polices Plan.** This details requirements for sites located in coastal flood risk hazard zone (Hunstanton to Dersingham) as defined in the Council's Policies Map (DM 18) as well as for sites in areas at risk of flooding (DM 21). Developers should note that changes may have been made to these policies since the publication of this document and that they should seek the most up to date guidance to refer to. Developers are also advised to consult the Council's webpage called: **"Information for planning agents"** which provides further information on flood risk and design guidance.

Developers should consult with King's Lynn and West Norfolk Borough Council, Norfolk County Council, the Environment Agency, Anglian Water and, where necessary, relevant IDBs at an early stage to discuss flood risk, including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design. If applications cross administrative boundaries, the neighbouring LLFAs, Suffolk County Council, Cambridgeshire County Council and Lincolnshire County Council, may also need to be consulted.

At locations reliant on flood risk management measures to provide appropriate levels of safety for communities, special consideration should be given to the assessment of residual risk, particularly in relation to tidal flooding and areas relying on pumped drainage systems. Where residual risks give rise to unsafe conditions, consideration should be given to the introduction of additional measures or identification of tactical responses that can be conducted during an emergency.

12.1.3 Sequential and Exception Tests

The SFRA has identified that areas of King's Lynn and West Norfolk are at high risk of flooding from fluvial/tidal and surface water sources. Therefore, a large number of proposed development sites will be required to satisfy the Sequential and, where necessary, Exception Tests in accordance with the NPPF. King's Lynn and West Norfolk Borough Council should use the information in this SFRA when deciding which development sites to take forward in their Local Plan.

12.1.4 Review of planning applications

The Council should consult the Environment Agency's **'Flood Risk Standing Advice (FRSA) for Local Planning Authorities'**, last updated 15 April 2015, when reviewing planning applications for proposed developments at risk of flooding. The Council will consult the relevant statutory consultees as part of the planning application assessment and they should also contact non-statutory consultees (e.g. IDBs or Anglian Water) that have an interest in the planning application.

12.1.5 Drainage strategies and SuDS

- Planners should be aware of the conditions and local requirements set by Norfolk County Council, the LLFA, for surface water management for major and minor developments and ensure development proposals and applications are compliant with the LLFA's policy.
- Developers should consult Norfolk County Council's guidance for developers: Norfolk County Council, **Lead Local Flood Authority, Statutory Consultee for Planning, Guidance Document (2017).** The guidance provides information on how SuDS proposals for new developments will be considered by the LLFA, when to consult the LLFA, how to screen applications based on local flood risk and records, LLFA standing advice (for Ordinary Watercourse consenting, major development below LLFA thresholds and minor development), the levels of information required for planning applications and technical guidance. The technical guidance is split into the following themes:
    - Local flood risk guidance

  - Drainage hierarchy
  - Infiltration testing guidance
  - Runoff rates
  - Runoff volumes
  - Climate change
  - Management and maintenance
  - Flood exceedance management

- All new development should aim to minimise areas of impermeable ground to reduce surface water runoff.
- SuDS should be used on all new development.
- Planners should be aware of local conditions and requirements set by the IDBs' administrators (either the **Downham Market Group of Internal Drainage Boards**, **Ely Group of Internal Drainage Boards**, **Middle Level Commissioners** or the **Water Management Alliance**.)
- Where it is proposed to connect surface water into the public sewerage network Anglian Water expect applicants to have regard to the **Anglian Water Surface Water Policy** which promotes sustainable alternatives to discharge to sewerage network.
- Developers who wish to have their SuDS schemes considered for adoption by Anglian Water should refer to the **Anglian Water SuDS Adoption Manual**[19]. Anglian Water also expect national guidance (**the CIRIA C753 SuDS Manual**) to be referred to in addition to Anglian Water's guidance.
- It should be demonstrated through a Surface Water Drainage Strategy, that the proposed drainage scheme, and site layout and design, will provide an appropriate standard of protection from surface water flooding to properties and critical infrastructure from flooding from surface water both on and off site. A detailed site-specific assessment of SuDS would be needed to incorporate SuDS successfully into the development proposals. All development should adopt source control SuDS techniques to reduce the risk of frequent low impact flooding due to post-development runoff. The 2015 **DEFRA non-statutory technical standards for sustainable drainage systems** should be followed, alongside the LLFA guidance note and national guidance.
- For proposed developments, geotechnical investigations should be undertaken to determine whether the ground at the site has infiltration potential. This information should be representative of on-site conditions. If the ground at the site is found to have infiltration potential, detailed infiltration testing should be undertaken in line with BRE 365 to establish representative infiltration rates. The LLFA have published information relating to infiltration tests within their **guidance document.**
- A number of Groundwater SPZs have been identified throughout King's Lynn and West Norfolk (see Section 9.4.1). Where sites lie within or close to aquifers (see Section 6.2), treatment steps may be required ahead of discharge to the ground, sewers etc. Development proposals at sites across the area should assess the pollution risk to receiving waterbodies and include appropriate treatment steps ahead of any discharge to surface or groundwaters. The CIRIA C753 SuDS manual provides further guidance on this issue.
- A management and maintenance plan of sustainable drainage and surface water systems covering the lifetime of the development will be required. Consideration must also be given to the residual risks associated with the use of SuDS.

12.1.6 Dry Islands

It is recommended that emergency planners review the outputs of the 2018 SFRA and the areas identified as being located in a dry island. A site-specific Flood Risk Assessment and / or Flood Warning and Evacuation Plan may be required if a proposed development is located within a dry island (even for sites less than 1 hectare and in Flood Zone 1).

19 At the time of preparing this SFRA, Anglian Water's current manual is expected to be revised to take account of national guidance published after the manual and Anglian Water's position regarding health and safety matters associated with open SuDS features.

12.1.7 Residual risk

Residual risk is the risk that remains after mitigation measures are considered. The residual risk includes the consideration of flood events that exceed the design thresholds of the flood defences or circumstances where there is a failure of the defences, e.g. flood banks collapse, reservoir failure etc. The flood risk analysis in Section 6, indicates that much of the Borough is heavily dependent on flood defences to protect settlements from flooding. The Environment Agency's 2015 and 2017 coastal breach modelling of the Norfolk coastline indicates breaches along defences in King's Lynn and West Norfolk pose a significant risk. Residual risks should be considered as part of site-specific Flood Risk Assessments.

Where the watercourses are embanked, the effect of overtopping and breach must be considered and appropriately assessed. In addition, any developments located within an area protected by flood risk management measures, where the standard of protection is not of the required standard, or where the failure of the intended level of service gives rise to unsafe conditions, should be identified.

12.1.8 Finished floor levels and safe access and egress

Finished floor level guidance has been established through consultation with the Environment Agency. Minimum finished floor levels for development should be set to whichever is the higher of the following:

- a minimum of 600mm above the 1% AEP fluvial event plus an allowance for climate change.
- a minimum of 600mm above the 0.5% AEP tidal event plus an allowance for climate change.
- a minimum of 300mm above surrounding ground levels

A 300mm freeboard is only applicable where detailed modelling is available which is deemed to be reliable. If no detailed reliable modelling is available, the Environment Agency may require a 600mm freeboard to be applied when setting minimum finished floor levels.

There is specific guidance relating to the application and use of the Tidal Hazard Mapping Models for the River Nene and River Great Ouse (see Section 8.2.6) which considers the impact of a breach of tidal defences. Developers are advised to consult the flood design guidance relating to the application and use of this modelling on the Council webpage called: **"Information for planning agents"**.

With regards to LLFA guidance and surface water flood risk, finished floor levels are recommended to be set to a minimum of 300mm above the 1% AEP plus an allowance for climate change flood levels (including anticipated flood levels within the drainage system). If there is an uncertainty in flood levels, the freeboard level should be increased from 300mm to 600mm. The LLFA would also expect a minimum of at least 150mm freeboard between proposed external ground levels and the property finished floor level. Further information can be found in the **LLFA guidance document**.

If it is not practical to raise floor levels to those specified above, consultation with the Environment Agency and / or LLFA will be required to determine the suitability of alternative flood mitigation approaches.

Safe access and egress will need to be demonstrated at all development sites to a locally identified refuge area. Ideally, waterproof construction techniques used. If safe access and egress to a locally identified refuge area cannot be achieved, the **Defra/EA Technical Report: FD2320: Flood Risk Assessment Guidance for New Development** should be referred to, to determine the hazard to people posed along the access route. This can also be used to inform a Flood Warning and Evacuation Plan for the site.

Emergency vehicular access should be possible during times of flood in accordance with the **Defra/EA Technical Report: FD2320: Flood Risk Assessment Guidance for New Development** wherever possible taking into account depth, hazard and velocity.

Where development is located behind, or in an area benefitting from, defences, consideration should be given to the potential safety of the development, finished floor levels and the potential for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning.

Resistance and resilience measures will be required if buildings are situated in the flood risk area, and as applicable in all cases of flood risk, opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought. Further information is provided in Section 8.5 and 8.6 and in the publications **"Improving the flood performance of new buildings"** and **"Prepare your property for flooding."**

Local requirements for finished floor levels should be discussed with the LPA, LLFA and EA taking into account the individual circumstances of the application.

12.1.9 Future flood management

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 amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted.

The information provided in the SFRA should be used as a basis for investigating potential strategic flood risk solutions within King's Lynn and West Norfolk. Opportunities could consist of the following:

- Catchment and floodplain restoration;
- Flood storage areas;
- Opening up culverts, weir removal, and river restoration; and
- Green infrastructure.

For successful future flood risk management, it is recommended that LPAs adopt a catchment partnership working approach in tackling flood risk and environmental management. The Level 2 SFRA explores such opportunities further.

12.2 Technical recommendations

Use of Strategic Flood Risk Assessment data

SFRAs are high-level strategic documents and, as such, do not go into detail on an individual site-specific basis. The 2018 SFRA has been developed using the best available information, supplied at the time of preparation, taking into account the latest flood risk information and the current state of national planning policy. This relates both to the current risk of flooding from fluvial, tidal, pluvial, groundwater, sewers and reservoirs as well as the potential impacts of future climate change. Please note that as part of UKCP18 climate change allowances are likely to be amended. It is this data that guidance singles out as the most appropriate for forward planning.

The accompanying SFRA appendices comprise:

- Appendix A: Mapping of all sources of flood risk across King's Lynn and West Norfolk Borough (historic flood extents are not included)
- Appendix B: Watercourses in the King's Lynn and West Norfolk Borough and coverage of IDB districts
- Appendix C: Flood Alert and Flood Warning coverage across King's Lynn and West Norfolk Borough
- Appendix D: Technical Summary including a list of all detailed models used in the 2018 SFRA and a map showing the coverage of these models
- Appendix E: Mapping showing the location, type and condition flood defences across the Borough of King's Lynn and West Norfolk, as well as the design standard of protection offered by the defences

The SFRA appendices are published separately to the main SFRA report.

Appendix A is presented in interactive GeoPDFs. An accompanying User Guide is provided with the GeoPDFs which provides step-by step instructions on how to navigate to data and how to use the GeoPDFs. The GeoPDFs can be used to perform high-level screening exercises, to identify whether a location or site has a potential risk of flooding. The GeoPDFs primarily display flood extents and are subject to the limitations of the flood risk datasets that are used. If detailed flood risk information is required (e.g. flood level, depth, velocity and hazard to people information), this

should be addressed as part of a Level 2 SFRA and / or as part of a site-specific Flood Risk Assessment.

It is important that the 2018 SFRA and appendices are read in conjunction with the Technical Summary provided in Appendix D. The Technical Summary provides further information on the hydraulic modelling and mapping approaches used in the 2018 SFRA.

The SFRA is a tool for refining information on river and sea flooding risk shown on the Environment Agency flood maps. The Environment Agency's Flood Zones, on their Flood Map for Planning website, may differ to the maps in the SFRA for a short period of time. The modelled fluvial and tidal flood risk datasets shown in the 2018 SFRA and Appendix A, will be incorporated into the Environment Agency's flood maps in due course.

At the time of writing, this report was developed using the best available information. However, the 2018 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. The Environment Agency regularly reviews their hydrology, hydraulic modelling and flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA.

The 2018 SFRA was commissioned by a consortium of Norfolk authorities and was produced in conjunction with the LLFA and Environment Agency. The assistance of these organisations and external stakeholders including IDBs, Anglian Water and planners at the neighbouring authorities and LLFAs, is acknowledged

Appendices

A Mapping of all sources of flood risk across the Borough of King's Lynn and West Norfolk

The SFRA appendices are published separately to the main SFRA report.

B Watercourses in the Borough of King's Lynn and West Norfolk and coverage of IDB districts

The SFRA appendices are published separately to the main SFRA report.

C Flood Alert and Flood Warning coverage across the Borough of King's Lynn and West Norfolk

The SFRA appendices are published separately to the main SFRA report.

D Technical Summary

The SFRA appendices are published separately to the main SFRA report.

E Defences

The SFRA appendices are published separately to the main SFRA report.

JBA consulting

Offices at
Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
PeterBorough
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

Registered Office
South Barn
Broughton Hall
SKIPTON
North Yorkshire
BD23 3AE
United Kingdom

t:+44(0)1756 799919
e:info@jbaconsulting.com

Jeremy Benn Associates Ltd
Registered in England 3246693

Visit our website
www.jbaconsulting.com