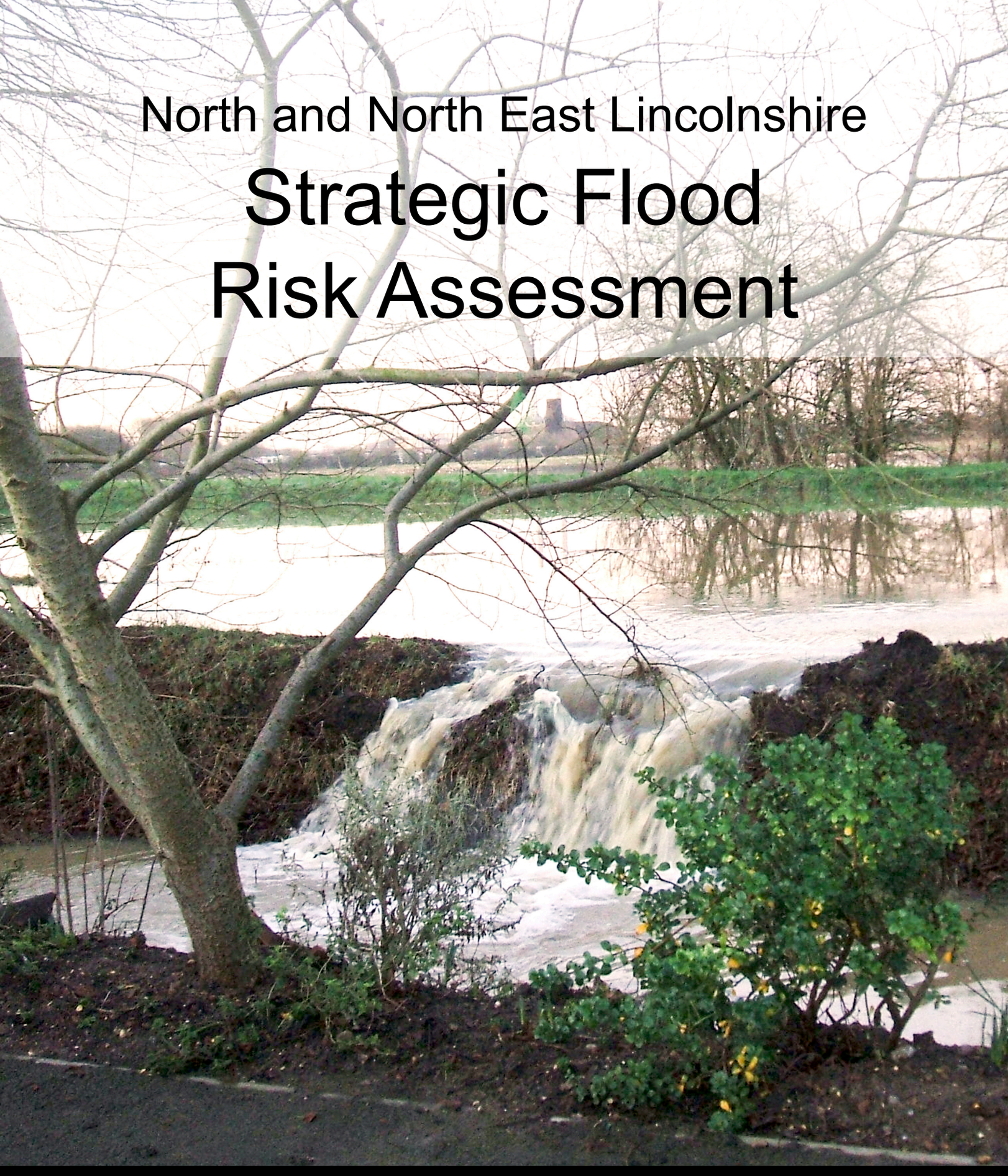
North and North East Lincolnshire

Strategic Flood Risk Assessment



North Lincolnshire Council

www.northlincs.gov.uk

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NORTH EAST LINCOLNSHIRE COUNCIL

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1 Terms of Reference

Introduction

1.1 This Strategic Flood Risk Assessment (SFRA) is an update of the original report, which was published in 2011. The main purpose of an SFRA is to provide the information needed for a planning authority to take flood risk into account when making land use allocations and determining planning applications.

1.2 The purpose of this update is to ensure the SFRA provides a comprehensive and robust evidence base to inform the preparation and production of the North Lincolnshire Local Plan to 2038 and the future review of the North East Lincolnshire Local Plan.

1.3 Since 2011 various new flood risk evidence has become available and National Planning Policy and legislation published.

1.4 This revised SFRA will be used by both North and North East Lincolnshire Councils in decision-making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk taking into account the latest and most up to date information.

Strategic Flood Risk Assessment Objectives

1.5 As set out in the Planning Practice Guidance to the National Planning Policy Framework, a Strategic Flood Risk Assessment is a study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change, and to assess the impact that land use changes and development in the area will have on flood risk taking into account the latest and most up to date information.

1.6 The key objectives of the updated SFRA are to:

- Inform North and North East Lincolnshire Council's (NLC and NELC) Local Plan by assessing flood risk from all sources, current and future.
- Provide both planning authorities and developers with up to date strategic guidance on development and flood risk.
- Critically review the Level 1 element of the 2011 SFRA to provide an update, taking into account latest flood risk information and updates to policy.
- Produce a comprehensive set of maps presenting flood risk from all sources that can be used as an evidence base for use in the Local Plan and by developers.
- Provide recommendations to inform the development of new policies to be included in the NLC Local Plan, development control and technical issues.

Strategic Flood Risk Assessment Outputs

1.7 The outputs of the SFRA are as follows:

- Identification of policy and technical updates.
- Identification of any strategic flooding issues, which may have cross boundary implications.
- Inclusion of new and/or amended data sources.
- Appraisal of all potential sources of flooding, including Main River, ordinary watercourse, surface water, sewers, groundwater, reservoirs and canals.
- Review of historic flooding incidents.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.

- Assessment of surface water management issues, how these can be addressed through development management policies and the application of Sustainable Urban Drainage Systems.
- Flood Risk Assessment guidance for developers.
- 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.
- Assessment of strategic flood risk solutions that can be implemented to reduce risks.

Background Information

1.8 The original Strategic Flood Risk Assessment Report (SFRA) was published in November 2011 and has subsequently been used to inform the Council's planning policies.

1.9 Since the SFRA 2011 was published the National Planning Policy Framework (NPPF) (latest update February 2019) and its associated Planning Practice Guidance (PPG) on Flood Risk and Coastal Change has been published. Individual sections of the PPG are updated as necessary. In addition, the Environment Agency's Flood Map for Planning has been updated and the SFRA needs to take account of this.

1.10 This SFRA update continues to provide the Local Planning Authorities (LPA(s) of NLC and NELC with up to date strategic guidance on development and flood risk. This guidance provides the two LPAs with the evidence they need to make objective judgments about flooding and development in decision making on Development Plans and planning applications.

1.11 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 primary purpose of this SFRA data is to provide an evidence base to inform Local Plans and any future flood risk policies.

1.12 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. At the time of writing, this report was developed using the best available information but should be updated when new information on flood risk, planning guidance or legislation becomes available.

The Study Area

1.13 The study area, shown on the interactive map, stretches from Cleethorpes in the east to Crowle and from Kirton in Lindsey in the south to the Humber Estuary. The total area of land covered by the two councils is 104,000 hectares containing some 329,390 people. Although most people live in urban areas including Cleethorpes, Grimsby, Immingham, Brigg, Barton upon Humber and Scunthorpe, nevertheless a significant number live in smaller towns and villages scattered throughout the remaining rural areas.

1.14 As well as people and the houses they live in, the study area contains industrial and commercial property including food manufacturing, steel mills, power stations, chemical plants and storage areas for a range of goods. It also contains important infrastructure links including port facilities, roads, railway lines, an airport, power transmission lines and gas pipelines. A significant number of the businesses are chemical industries that have working practices and restrictions under the Health and Safety legislation.

1.15 Much of the chemical and energy, industry and logistics is located in the South Humber Bank Industrial Area, which is allocated for estuary- related commercial and industrial development. Other important development proposals include the port area at Grimsby and the planned Lincolnshire Lakes development by the River Trent near Scunthorpe.

1.16 The main sources of flood risk within the study area are the Humber Estuary (as evidenced by the large area of flooding on the South Bank of the Humber Estuary and along the River Trent caused by the tidal surge event of December 2013) and the rivers draining to it, particularly the Ancholme and the Trent (also experienced major over topping of the flood banks during

the tidal surge event of December 2013) but also a number of smaller ones including the River Ouse, Waithe Beck, Freshney, East Halton Beck, Bottesford Beck and the various canals and drains east of the Trent by the Isle of Axholme. Flooding can also arise from smaller drains and from blockages in culverts, while groundwater levels can rise following heavy rain leading to ponding if the water cannot get away, as occurred in the major flooding event in the study area in July 2007.

1.17 The study area has been divided into three parts for the assessment:-

- Eastern Coastal Area; covering the southern shoreline of the Humber Estuary from Humber Fitties to South Ferriby Cliff and extending inland to the eastern boundary of the River Ancholme catchment.
- Ancholme Valley Area; covering the catchment of the River Ancholme, including Brigg and the Humber Estuary shoreline between South Ferriby Ciff and Whitton.
- Trent Valley Area; covering the remaining land including most of Scunthorpe, the River Trent and the Isle of Axholme.

1.18 These areas are further subdivided into 'flood compartments' which take into account local features and whether the dominant risk source is tidal or fluvial.

Context of the SFRA Update

1.19 The North and North East Lincolnshire Councils have agreed with the Environment Agency (EA) that there is a need to update the November 2011 SFRA to take on board the latest information and evidence available in terms of flood risk and to reflect the changes in government guidance since its original publication.

1.20 Since 2011 there has been significant investment in tidal and river defences; a significant tidal event (2013) which has reshaped the understanding of how flood events can impact the estuary and its tributaries; significant investment in and improved flood risk modelling (ongoing) has helped inform and influence planning decisions, and some changes in our understanding of the implications of climate change have emerged. All these factors have been considered in the update of this Strategic Flood Risk Assessment and have contributed towards a better understanding of those risks and how they can be managed through the planning process.

1.21 The information gathered through this process is evidenced through an interactive map. The updated maps incorporated into this review and the revised/updated advice to developers of how development can be made safe into the future in the form of Flood Risk Standing Advice. The SFRA should be an invaluable tool available to developers to help smooth out and speed up the planning process.

1.22 The EA have advised the councils that a comprehensive review of the current SFRA would be premature now given the extensive flood modelling currently being undertaken following recent storm events. Unfortunately, the outputs from this work are unlikely to be available for another two to three years at which time a full review should be considered. The EA's Humber Flood Risk Management Strategy (HFRMS Review) will also give consideration to the new climate change allowances. The EA have advised that much of the SFRA 2011 is still relevant but it will be important to interpret the EA November 2015 EA Flood Map for Planning update and use it with the SFRA 2011 and Tidal River Trent Interim Humber Water levels modelling (2014) datasets for the purposes of this update. There will be an ongoing need for the Maps associated with this SFRA to be updated as new flood risk modelling information becomes available.

1.23 New climate change allowances for sea level rise were published on gov.uk 22 July 2020. This SFRA will remain flexible to using the most up to date guidance issued; planning applications will be required to take climate change into account in line with the latest guidance, evidence and advice from the environment agency.

1.24 This guidance can be found at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances. The Lincolnshire Lakes development proposal in North Lincolnshire has

had substantial flood risk assessment applied to its area and has its own Flood Risk Assessment, which is attached as a separate document. Any proposed development in this area must refer to this FRA and take account of updated climate change allowances for sea level rise as it evolves. Mott MacDonald produced this Lincolnshire Lakes Area Action Plan Flood Risk Assessment (8th August 2019). This document also identifies further elements of flood risk, resilience and resistance that will need to be considered on a site by site basis in order for each developer to determine suitable development levels and strategic to mitigate flood risk. The FRA discusses mitigation options for each development area for all identified sources of flood risk. The proposed flood levels in the flood plain area are dictated by the adopted flood defence scheme on the right bank of the River Trent between the M180 bridge and Keadby Railway Bridge. This scheme is in summary a sheet pile wall that has been installed with a managed overflow area to locally control levels in the channel. These flood defence works along the River Trent aim to reduce the risk of breach between M180 and Keadby Bridge to improve the safety of the Lincolnshire Lakes development.

1.25 This updated SFRA carries forward the concept (from the original SFRA) of using Critical Flood Levels (CFL) to provide guidance on what levels of mitigation are necessary in order to make development "safe". By critical flood level (CFL) we mean either flood levels predicted as a product of flood risk modelling, appropriate site specific assessment or flood levels estimated using a mix of flood risk modelling and engineering judgement. Appendix C and D sets out the councils' and the Environment Agency's advice to developers in terms of mitigation necessary in order to make development safe in the event of an extreme flood event. This varies depending on the form of development and the level of risk involved. This has been updated in line with the latest evidence and understanding of flood risk including climate change.

Information now available or in preparation

1.26 The SFRA 2011 included new LIDAR data from the Environment Agency (EA) covering the whole of the tidal and fluvial floodplain within the study area. This allowed the topography of the area to be mapped more accurately, improving the quality of the assessment and allowing the tidal flood zones to be defined in more detail. Improvement of LIDAR data continues, and new flood modelling is improved and extended as time goes on. The EA produce updated flood maps as part of their regular reviews based on known LIDAR and flood modelling data and the current extent of the flood zones without climate change. In November 2015 the EA produced a new flood map for Planning based on more accurate data, including new LIDAR data and new outputs along the Tidal Trent. This has changed the EA Flood Zones in the Isle of Axholme as shown on the EA Flood Map for Planning update.

1.27 Following the extensive flooding due to very heavy rainfall in June and July 2007, both councils and the Environment Agency collected a considerable amount of data about the areas that flooded, the drainage network and the drainage problems that caused the flooding to occur. This information and data from other flooding events has also been collected it was used to provide a more detailed assessment of the risk of flooding following heavy rainfall. All historic flood complaints have been mapped as part of the Local Flood Risk Extents (LFRE) shown on the interactive map, which is an amalgamation of the 1in100yr flood maps for surface water, historic flooding, local knowledge and buffers on critical watercourses. The EA Flood Map for Planning also includes data on past flood events.

1.28 SFRA 2011 had referenced completed studies by the EA relating to the Lower Trent and the River Torne. These had raised major questions about the future management of flood risk in the low-lying land around the Isle of Axholme and they stated that further studies were in hand. Further studies should lead to a comprehensive strategy for managing the risks in this area being agreed but this is likely to take several years. In relation to producing a full SFRA update, new flood modelling of the Humber Estuary and tidal Rivers will be produced by the EA within the Humber Flood Risk Management Strategy Review. However, some new data involving LIDAR and Tidal Trent modelling outputs has been produced by the EA, which is included with the updated EA Flood Map for Planning. These changes are considered significant, particularly to the Isle of Axholme and the EA Flood Map for Planning must therefore be interpreted together with this SFRA update. The Isle of Axholme Strategy did not assess flood risk from the Trent, but it is hoped that this Strategy will be updated in the future in terms of including assessment of flood risk from Rivers Trent, Ouse and Don.

1.29 In considering drainage issues North Lincolnshire Council and North East Lincolnshire Council have produced their Local Flood Risk Management Strategy (LFRMS).These documents essentially deal with current drainage issues causing flooding to occur and need to be referenced and used where appropriate when considering development proposals in Development Plans and through planning applications. The LFRMS (local data source) builds on the Government's Preliminary Flood Risk Assessment (PFRA – national information). In addition, North Lincolnshire Council is in the process of completing a Scunthorpe Surface Water Management Plan. The council are in stage 3 and 4 on this plan.

1.30 North Lincolnshire Council (NLC) has completed detailed flood risk and drainage assessments of the Lincolnshire Lakes site included within the Lincolnshire Lakes Area Action Plan (within SFRA Flood Compartment 3T3). Mott MacDonald produced a Flood Risk Assessment for the Lincolnshire Lakes Area which is being updated to produce a Level 2 assessment taking account of the most up to date modelling data. Any development in this area should refer to the Lincolnshire Lakes Flood Risk Assessment which is a separate document.

1.31 This SFRA update includes a Level 1 assessment for the Study area shown on the interactive map and a Level 2 assessment which uses the hazard mapping for the coastal area between Humberstone Fitties in North East Lincolnshire to Winterton in North Lincolnshire where substantial development is proposed in an existing built up urban setting and where Level 2 information was available from the modelling work carried out by the EA for their Humber Flood Risk Management Strategy 2008. This SFRA update also continues the use of the HFRMS (2008) flood modelling in all the tidal flood compartments within the SFRA, which provides an additional element to the Level 1 assessment areas. The EA are currently reviewing this document. This SFRA update continues to include guidance on the Sequential and Exception Tests and can be linked to separate more detailed North Lincolnshire Council guidance available on the council web site. North Lincolnshire and North East Lincolnshire Councils are promoting some growth in areas of regeneration where the Exception Test has already been implemented or is likely to be required.

Isle of Axholme Flood Risk Management Strategy (IoAFRMS)

1.32 The Isle of Axholme Flood Risk Management Strategy (IoAFRMS) (2010) sets out how flood risk is managed from the River Torne and the River Idle in the low lying area of the Isle. The study area covers an area of 514 square kilometres of which approximately 376 square kilometres is artificially drained low-lying land. The study area is bounded by the River Ouse to the north, the River Trent to the east, high ground to the south and high ground and the River Don to the west. The area covered by the IoAFRMS is within the local authority areas of North Lincolnshire Council, Doncaster MB, Bassetlaw DC, Nottinghamshire CC and East Riding of Yorkshire Council. The water levels are managed by using a heavily engineered and complex network of pumps and drains/watercourses. The whole system of drainage is managed by a combination of the local Water Management Boards (and/ or IDBs) and the Environment Agency. The IoAFRMS does not factor in any flood risk modelling from the Rivers Ouse, Trent and Don. The Isle of Axholme is made up of a number of individual pumped catchments which are hydraulically separate under normal operation but become hydraulically linked either during flooding events or if the pumping is changed. This factor has informed the boundaries of the SFRA flood compartments 3T4, 3F4, 3F5 and 3F6 as set out in this update (the same flood compartments as set out in SFRA 2011).

1.33 The options in the IoAFRMS relate to a more efficient and cost effective way of managing the flood risk and drainage of the study area over the next 100 years and with potential future changes in climate. This will include long term management of the drainage system which will require both the maintenance and replacement of assets, many of which are reaching the end of their working life. Likely measures to be implemented as part of the strategic approach to asset management will be the reduction of the number of pumps where capacity has been identified as too great, rationalisation of pumping stations to provide a more optimised flood risk and drainage management approach, standardisation of pumping station equipment to improve future resilience and help to extend pumping stations lives. Current projects programmed within the IoAFRMS are as follows:

1.34 Keadby Terminal Assisted Outfall (Keadby Pumping Station) – this will renew a current life-expired terminal pumping station in line with recommendations of the IoAFRMS. Capital maintenance was undertaken between (2015 and 2018 to extend the life of the pumping station until replacement works began, this work cost between £1m to £2m. The Capital Replacement of the Pumping Station began in Spring 2019 and will be complete Summer 2021 at a cost of £35m to £37m. The scheme is being delivered by the EA and the Isle of Axholme Implementation partnership with Local IDBs, North Lincolnshire Council, Doncaster Council and the Coal Authority.

1.35 Isle of Axholme Asset Improvements, including Pumping Station Refurbishment Programme – this will introduce a sequential programme of works, amalgamated from individual projects proposed by the EA and IDBs, to review assets and pumping stations in line with recommendations in the IoAFRMS. The timescale is initial implementation of the project phased between 2015 and 2021 (up to £10m) and longer implementation of schemes phased between 2021 and 2035 (up to £50m). The scheme is likely to be delivered by a potential partnership of the EA, IDBs, North Lincolnshire Council and adjacent local authorities as appropriate.

1.36 The benefits of both these projects include reduced pumping costs and reduced carbon footprint and management needs by improving automation and the improvement of resilience and the reduction of maintenance needs. These schemes will provide flood protection for businesses, residential properties, agricultural land and essential infrastructure whilst improving investor confidence in the area. The projects are being promoted through the Greater Lincolnshire Local Enterprise Partnership (GLLEP) Water Management Plan (2015 to 2040).

The Humber Strategy

1.37 The Humber Strategy is considering the future flood risk around the Humber Estuary, which includes the Rivers Ouse, Trent and Don to gain a more accurate position of current and future flood risk across the Isle of Axholme. This approach should help towards a more accurate assessment of flood risk across the Isle of Axholme and improve future flood zone data, including a more precise determination of Critical Flood Levels.

1.38 Three options are being considered which are:-

- **Containing the tide** – The continued management of front line defences in the majority of locations, with defence raising to accommodate rising sea levels. In many places, additional flood storage would also be required. This is the only feasible approach at the outset of the new Strategy.
- **Adapting to the tide** – A gradual process of change in areas where it is not possible or safe to manage defences in their present locations. Defences may be left in place, or deliberately altered or moved back, focusing the protection they provide on specific vulnerable communities whilst potentially providing additional flood storage capacity to manage flood risk elsewhere. This approach would involve a wide range of flood resilience measures including constructing new defences in the floodplain, improving preparedness, property level protection, recovery measures and emergency planning.
- **Keeping out the tide** – The construction of a large barrier or other closable structure, most likely in the outer estuary, which would operate during extreme high tides to prevent water entering the estuary. This would be combined with raising and/or maintaining defences to prevent overtopping during less extreme events.

1.39 Current schemes in the EA Medium Term Plan are also listed below:-

Catchment	Project Title
South Humber & East Coast	East Halton Flood Defence improvements
South Humber & East Coast	Port of Immingham sea defence improvements
South Humber & East Coast	Humber-Winteringham Ings and South Ferriby
South Humber & East Coast	Willingham and Peaksfield Surface Water Scheme
South Humber & East Coast	North East Lincolnshire Surface Water-North Immingham (NPP6)
South Humber & East Coast	Goxhill Surface water Flood Alleviation Scheme

Completed schemes are Freshney Washlands and Grimsby Docks.

2 Planning Policy Context

National Planning Requirements

2.1 Government guidance, contained in the National Planning Policy Framework (NPPF) and the National Planning Practice Guidance (NPPG) advises that a Strategic Flood Risk Assessment (SFRA) should be carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change, and to assess the impact that land use changes and development in the area will have on flood risk.

Planning approach to development and flood risk

2.2 The National Planning Policy Framework sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. Where these tests are not met, national policy is clear that new development should not be allowed. The main steps to be followed are set out below which, in summary, are designed to ensure that if there are better sites in terms of flood risk, or a proposed development cannot be made safe, it should not be permitted.

2.3 A Site-Specific Flood Risk Assessment (FRA) is required to identify the flood risk at the site and to demonstrate how this risk can be mitigated without increasing the risk elsewhere. A Site Specific FRA is required for any development proposal of 1 hectare or greater in SFRA Flood Zone 1 and all development proposals in SFRA Flood Zone 2/3a or within an area where there may be drainage problems, irrespective of whether a Sequential or Exception Tests are required.

Local Planning Policy

2.4 The assessment has been undertaken to ensure there is a consistent evidence base against which the North Lincolnshire and North East Lincolnshire can inform its Local Plan and Development Management decisions. It supports the risk based sequential approach to determine the suitability of land for development that uses the principles of locating development reflecting the NPPF and PPG requirement for Sequential Test, Exception Test, site specific Flood Risk Assessments and the use of Sustainable Drainage Systems where necessary and appropriate.

2.5 A SFRA also has to take into account any policies produced by other organisations, in particular the Environment Agency, which may affect the flood risk in the area in the future. The Environment Agency's long-term plans for managing flood risk are generally set out in Shoreline Management Plans (SMPs) for the coast and Catchment Flood Management Plans (CFMPs) for river catchments, supplemented by any more detailed Strategies or other studies that may have been completed.

2.6 The Humber Estuary Coastal Authorities Group (HECAG) Shoreline Management Plan 2010 Humber Estuary sets out its shoreline management proposals in the short, medium and long term. It presents the preferred option for managing flood and erosion risk for the identified area of shoreline, between Flamborough Head (East Riding of Yorkshire) and Gibraltar Point (East Lindsey - Lincolnshire), whilst recognising the strong relationship with social, economic and environmental activities around that shoreline. This SMP includes the south bank of the Humber seaward of Immingham (southwards) in the North East Lincolnshire Council area.

2.7 The Humber Estuary is not covered by the above Shoreline Management Plan. Tidal flood risk from the Humber Estuary is covered by the Humber Flood Risk Management Strategy (HFRMS), published in 2008). It covers the SFRA Review study area seaward of Keadby Bridge (along the River Trent) and along the south bank of the Humber Estuary. The HFRMS basically studies flood compartments along its shoreline and completes the gap of estuary shoreline between the two sections of North Sea shoreline studied within the HECAG SMP.

2.8 The River Trent Catchment Flood Management Plan (CFMP - December 2010) gives an overview of the flood risk in the River Trent catchment and sets out the EAs preferred plan for sustainable flood risk management over the next 50 to 100 years.

2.9 The Grimsby and Ancholme CFMP (November 2009) gives an overview of the flood risk in the Grimsby and Ancholme catchment and sets out the EAs preferred plan for sustainable flood risk management over the next 50 to 100 years.

2.10 The policies adopted in The River Trent CFMP, Isle of Axholme Flood Risk Management Strategy and the Grimsby and Ancholme CFMP do not affect the flood risk assessments described in this SFRA.

2.11 The Isle of Axholme Flood Risk Management Strategy covers the low lying land surrounding the Isle of Axholme, west of the River Trent but is limited in terms of flood risk assessment, particularly because it does not factor in flood risk from the rivers Trent, Ouse and Don and mainly assesses the drainage of the area and the possible ways of improving it. A fuller description of this Strategy is set out in Chapter 1 (Terms of Reference) of this review.

3 Assessing Flood Risk

3.1 The Environment Agency is responsible for managing the risk of flooding from main rivers, reservoirs, estuaries and the sea.

3.2 Lead Local Flood Authorities are responsible for managing the risk of flooding from local sources: surface water, groundwater and ordinary watercourses.

3.3 Internal Drainage Boards are responsible for managing the risk of flooding within their Drainage Districts.

Factors affecting Flood Risk

3.4 Flooding is a natural process that plays an important role in shaping the natural environment. However, it also threatens life and causes substantial damage to property.

3.5 Flood risk involves both the statistical probability of a flood occurring and the scale of the potential consequences. The main causes of flooding are generally categorised as:-

Tidal flooding - flooding beside the sea or an estuary caused by high sea levels, sometimes influenced by high waves

Fluvial flooding - flooding from a river or large watercourse caused by high river flows

Surface water flooding - flooding from small watercourses, ditches, sewers and overland flow caused by heavy rainfall (pluvial flooding)and

Groundwater flooding - flooding that occurs when groundwater levels rise above ground levels, often following prolonged heavy rainfall (pluvial flooding).

Reservoir flooding - flooding from a reservoir and can occur from as a result of a dam failure. Reservoir flooding will cause very fast flowing water to flow down the natural water path in large quantities. Reservoir flooding is extremely rare in the UK due to very strict regulations and mandatory assessments.

Sewer flooding - flooding that can occur from a blockage or overflowing in a sewer or urban drainage system.

3.6 The mechanism of flooding is different in each case and this can have an impact on how floods develop, how often they are likely to occur and how they can be managed. Further information is given in Appendix B.

Flood Zones and Flood Maps

3.7 A key element in the assessment of flood risk is the concept of Flood Zones. These Flood Zones (1, 2, 3a and 3b) refer to the probability of river and sea flooding, ignoring the presence of defences, and are defined in the NPPF Planning Practice Guidance Flood Risk and Coastal Change section, paragraph 065, table 1. This table is reproduced here as table 3.1.

3.8 The Flood Zones are shown on the Environment Agency's Flood Map for Planning (Rivers and Sea). This map does not however distinguish between Zones 3a and 3b.

3.9 The Flood Zones shown on the Flood Map for Planning do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. The PPG advises that reference should therefore also be made to the local SFRA when considering location and potential future flood risks to developments and land uses; the SFRA should assess the risk from all sources of flooding, now and in the future, taking account of the impacts of climate change, and to assess the impact that land use changes and development in the area will have on flood risk.

3.10 This SFRA does this in three main ways.

- Firstly, a simple assumption was made that areas currently in Flood Zone 2, being at greater risk is future, will become part of Flood Zone 3. Maps were then produced showing this extended area at high probability of flooding, renamed 'SFRA Zone 2/3a'. These have since been updated in line with the EA's latest Flood Map for Planning.
- Secondly, along the Humber coast, the Environment Agency carried out modelling and produced 'hazard mapping' (2019) which is included in the SFRA. This mapping takes account of existing flood defences and illustrates the potential flooding that could occur should they be breached or overtopped. The mapping includes scenarios for present day sea levels (2006) and for the higher sea levels expected to result from climate change (2115). The hazard maps give a more detailed and realistic picture of risk than either the EA Flood Map or SFRA Flood Zones. The EA are confident the data presented in these maps remains fit for purpose. They will be updated as new modelling information becomes available.
- Thirdly, in certain areas where growth is expected, NLC have commissioned detailed flood risk modelling which also considers climate change in line with the current guidance on these matters.

3.11 An SFRA should also identify areas at risk from surface water flooding and drainage issues, taking account of the surface water flood risk map published by the Environment Agency and any other available evidence, such as local flood risk management strategies.

3.12 The surface water maps are based on a high-level assessment, however, that does not take existing drainage systems into account. As a result, they give a broad indication only of where surface water flooding might occur, and so have been provided to Local Authorities for use in their Local Flood Risk Management Strategies (LFRMS) and flood risk and emergency planning. North East Lincolnshire Council have produced their LFRMS and North Lincolnshire Council produced their LFRMS in August 2016. Therefore please contact the Local Authority to get the latest surface water information as work may have been carried out to address any historic surface water issues.

The sequential, risk-based approach

3.13 The NPPF advocates a sequential approach to development allocation via the Sequential Test. 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. Table 3-1 describes the Flood Zones from the Flood Map for Planning.

3.14 The preference when allocating land is, whenever possible, to place all new development on land in Zone 1. Since the Flood Zones identify locations that are not reliant on flood defences, placing development on Zone 1 land means there is no future commitment to spending money on flood banks or flood alleviation measures. It also does not commit future generations to costly long-term expenditure that would become increasingly unsustainable as the effects of climate change increase.

3.15 However, 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. In these instances, the Exception Test will be required.

3.16 Table 3.1

Flood Zone	Definition
Zone 1 Low Probability	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%).
Zone 2 Medium Probability	This Zone comprises land assessed as having between a 1 in 100 and 1 in 1000 (1% – 0.1%) annual probability of river flooding or between a 1 in 200 and 1 in 1000 (0.5% – 0.1%) Annual probability of sea flooding in any year.
Zone 3a High Probability	This Zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (> 1%) or a 1 in 200 or greater annual probability of flooding from the sea (> 0.5%) in any year.
Zone 3b The 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 SFRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. But land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or, is designed to flood in an extreme (0.1%) flood should provide a starting point for consideration and discussions to identify the functional floodplain.

Table 3.1 - Flood zone definitions (reflects the table in NPPG Note 25).

3.17 NPPF and the associated Planning Practice Guidance on Planning and Flood risk states that local planning authorities should prepare and implement planning strategies that helps deliver these aims by:-

Appraising Risk

- Identifying land at risk and the probability of flooding from river, sea and other sources in their areas
- Preparing Strategic Flood Risk Assessments (SFRAs) as freestanding assessments that contribute to the Sustainability Appraisal of their plans;

Managing Risk

- Framing policies for the location of development which avoid flood risk to people and property where possible, and manage any residual risk, taking into account the impacts of climate change
- Only permitting development in areas liable to flood when there are no reasonably alternative available sites in areas where the probability of flooding is lower and the benefits of the development outweigh the risks from flooding.

Reducing Risk

- Safeguarding land from development that is required for current and future flood management e.g. conveyance and storage of flood water, and flood defences
- Reducing flood risk to and from new development through location, layout and design, incorporating Sustainable Drainage Systems (SuDS)
- Using opportunities offered by new development to reduce the causes and impacts of flooding e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SUDS; recreating functional floodplain; and setting back defences.

A partnership approach

- Working effectively with the Environment Agency, other operating authorities and other stakeholders to ensure that best use is made of their expertise and information so that plans are effective and decisions on planning applications can be delivered expeditiously and
- Ensuring planning supports flood risk management policies and plans, River Basin Management Plans and emergency planning.
- NPPG on Flood Risk and Coastal Change: 'How neighbourhood plans and neighbourhood development/community right to build orders should take account of coastal change' (Note 31) covers the issue of settlements wanting a Neighbourhood Plan and/or a right to build order in a flood risk and coastal change area. The LPA should be consulted on what information about the vulnerability of new development would be helpful to demonstrate appropriateness in a coastal management area. North Lincolnshire following consultation exercises have a number of formally designated areas in North Lincolnshire Council and NLC actively supports local communities that wish to pursue a neighbourhood plan. Please go to the North Lincolnshire Neighbourhood Planning webpage for the latest information https://www.northlincs.gov.uk/planning-and-environment/planning-policy/neighbourhood-planning/ . A number of other communities are considering whether to start work on a plan. No neighbourhood plans have been prepared in North-East Lincolnshire. However, the Council have stated that they will support any expressions of interest that come forward over the plan period.

Preparing a Strategic Flood Risk Assessment

3.18 NPPF (paragraph 156) and various notes on NPPG Flood Risk and Coastal Change cover general principles that should be adopted when preparing Strategic Flood Risk Assessments, Site Specific Flood Risk Assessments (FRA's) and sets out the circumstances in which they should be produced. Government have produced guidance, which was updated in August 2019 on how to prepare a strategic flood risk assessment.

3.19 The NPPG defines two levels of assessment that may need to be undertaken during the preparation of a Strategic Flood Risk Assessment (SFRA):

3.20 A Level 1 Assessment provides the information required to apply the Sequential Test across the whole of the area covered by the SFRA;

3.21 A Level 2 Assessment provides the more detailed information required to undertake the Exception Test, in those areas where the combination of development pressure and the lack of reasonably alternative available sites in SFRA Flood Zones 1 or 2/3a make this necessary.

3.22 The main outputs to be provided by a SFRA are:

For a Level 1 Assessment:

- Maps showing the area covered by the assessment, main sources of river and sea flooding, the SFRA Flood Zones (taking climate change into account) and areas liable to flooding from other sources such as surface water and groundwater. This will help developers determine if their proposals will be subject to the sequential test.
- A review of existing flood management measures including flood defences and flood warning systems
- A review of locations where additional development may significantly increase flood risk elsewhere and where development pressure may require the Exception Test to be applied (i.e. where a Level 2 assessment is needed)
- Guidance on the preparation of site-specific FRAs
- Guidance on the likely applicability of Sustainable Drainage System (SuDS) techniques for managing surface water run-off at key development sites.
- Coastal Erosion

3.23 NPPG on Flood Risk and Coastal Change (2) -'Diagram 1: Taking flood risk into account in the preparation of a Local Plan' gives further guidance on the process of undertaking a Level 1 SFRA.

For a Level 2 Assessment:

- Additional information about the current condition and future maintenance and improvement of existing flood defenses.
- An appraisal of the probability and consequences of overtopping or failure of existing flood defences, including plans showing areas where the danger due to high flow velocities or flood depths would be significant
- Guidance on appropriate policies for sites that satisfy the two parts (wider sustainable benefits and safe development) of the Exception Test to be considered at the Local Plan stage (if deemed necessary to be applied by the LPA) and at the planning application stage. If a Level 2 Assessment was required during the Local Plan Stage this should be included within the Sustainability Appraisal (SA) to the Local Plan and the Local Plan SA should inform the decision making process on individual planning applications. It should be noted that North Lincolnshire Council include a sustainability checklist in their local 'Development and Flood Risk and Guidance Note' (April 2013), taken from the council's Core Strategy SA. Future SAs of Local Plans will also update and inform future sustainability checklists within such guidance notes.
- An appraisal of critical drainage areas and identification of the need for Surface Water Management Plans. North East Lincolnshire Council and North Lincolnshire Council have published their Local Flood Risk Management Strategy (LFRMS).

Preparing a Site-Specific Flood Risk Assessment

3.24 NPPF requires that a site-specific Flood Risk Assessment (FRA) should accompany all planning applications for development proposals of 1 ha or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3. The FRA should identify and assess the risks of all forms of flooding to and from the development and should demonstrate how these risks will be managed, taking climate change into account. For major developments in Flood Zone 1, the FRA should identify opportunities to reduce the probability and consequences of flooding.

3.25 The FRA should also consider if the proposal (including change of use to a more vulnerable class) may be affected by other sources of flooding or where the Environment Agency, Internal Drainage Board/Water Management Boards, both Council's as lead flood authorities or other bodies have indicated there may be drainage problems. All proposals must be accompanied by a surface water drainage strategy with the submission of a planning application.

3.26 See Appendix B for further information. Further guidance can also be found at: https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment

Get information to complete an assessment

3.27 The Environment Agency have products or packages of information to help you complete your flood risk assessment. The products are:

- Product 1: Flood Map, including flood zones, defences and storage areas and areas benefiting from flood defences
- Product 3: Basic Flood Risk Assessment Map, including flood zones, defences and storage areas, areas benefiting from defences, statutory main river designations and some key modelled flood levels
- Product 4: Detailed Flood Risk Assessment Map, including flood zones, defences and storage areas, areas benefiting from defences, statutory main river designations, historic flood event outlines and more detailed information from our computer river models (including model extent, information on one or more specific points, flood levels, flood flows)

- Product 5: Reports, including flood modelling and hydrology reports and modelling guidelines
- Product 6: Model Output Data, including product 5
- Product 7: Calibrated and Verified Model Input Data (CaVMID), including product 5
- Product 8: Flood Defence Breach Hazard Map including, maximum flood depth, maximum flood velocity, maximum flood hazard

How to choose the correct product

3.28 You need to know the size of your development and the flood zone it is in to help you choose the right product.

Non-domestic extensions with a footprint of less than 250 square metres and all domestic extensions

For:

- flood zones 2 and 3 use product 3
- flood zone 3 in an area behind raised flood defences use product 8
- flood zone 1 use product 1

Applications with a site area less than 1 hectare

For:

- flood zone 3 choose from products 4, 5, 6, or 7
- flood zone 3 in an area behind raised flood defences use product 8
- flood zones 1 and 2 use product 3

Applications with a site area greater than 1 hectare

For:

- flood zones 2 and 3 choose from products 4, 5, 6 or 7
- flood zone 3 in an area behind raised flood defences use product 8
- flood zone 1 use product 3

How to order products

Contact the Environment Agency to find out the contact details of the local team that will deal with your request.

The contact for product requests for sites in the EA Lincolnshire & Northamptonshire water management Area is lnenquiries@environment-agency.gov.uk

For East Midlands Area it's EMDenquiries@environment-agency.gov.uk

To ensure the correct data is provided include one of these:

- a map showing the site boundary, with either a grid reference or postcode
- an aerial photo with a grid reference
- a GIS (Geographical Information System) polygon file of the boundary

The Planning Practice Guidance has a checklist that you may find useful when preparing your flood risk assessment.

Flood Risk Emergency Plans for New Development

3.29 The Environment Agency along with the association of directors of environment, economy , planning and transport (ADEPT) have produced a guide for planners- Flood risk emergency

plans for new development. The guidance is principally aimed at local authority planners, to help them understand when they should be asking for planning applications to be supported by flood risk emergency plans, and what should be included in them. It encourages local planning authorities to produce their own guidelines and set up local consultation arrangements to ensure emergency plans are fit-for-purpose and receive proper scrutiny. It also provides a framework for them to appraise emergency plans in the absence of such local arrangements.

3.30 The guidance will also help developers and their consultants produce suitable emergency plans, and should ensure emergency planners, local resilience forums, the emergency services and other risk management authorities are involved appropriately in the planning process. The guidance aims to support robust consideration of whether proposed development will be safe.

3.31 An Emergency Plan will need to demonstrate that:-

- Safe access and escape routes are included
- Voluntary and free movement of people will be available during a design flood, taking climate change into account
- There is the potential for evacuation before a more extreme flood (a flood with an annual probability of 0.1%) taking climate change into account
- Appropriate evacuation procedures and flood
- People will not be exposed to hazardous flooding from any source, now or in the future, including in an extreme flood event
- Any residual risks remaining after other location and design measures have been incorporated, can be safely managed.
- The relevant building regulations are capable of being complied with in relation to suitable on-site access for the fire service, within the constraints of any planning permission granted.

3.32 It will also need to assess whether proposals would increase the number of people living or working in areas of flood risk and whether this would increase the likely scale of any evacuation and consequently the burden on the emergency services.

4 SFRA Assessment

4.1 This chapter sets out the Methodology used to produce the SFRA Flood Zone maps covering the whole area as required for the Level 1 Assessment, and the more detailed Breach hazard maps as required for the Level 2 Assessment.

Sources of Data

Existing Flood Risk

4.2 An initial assessment of the current probability of flooding in the study area was obtained from the Environment Agency's Flood Map for Planning, and shown on the interactive map is the EA Flood Zones. This shows the extent of EA Flood Zones 1, 2 and 3a based on the results of a broad-scale modelling approach, updated as more detailed information becomes available. These EA Flood Zones are referred to in NPPG paragraph 65 Table 1. NPPG Flood Risk and Coastal Change is viewed as 'living' guidance.

4.3 As the new climate change allowances are updated and released the Environment Agency will make decisions on whether existing flood models can remain in use, or whether interim measures need to be put in place. The Environment Agency's advice is updated in line with the latest figures and guidance and is incorporated into this SFRA review accordingly.

4.4 The latest government guidance on this can be found at: https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

4.5 The flood modelling outputs from this new data will be assessed in the next SFRA Review after the Humber Flood Risk Management Strategy Review has been completed (programmed for several years hence as stated in Chapter 1 (Terms of Reference) and in this chapter below.

Ground Levels

4.6 The standard Ordnance Survey mapping provides ground level contours at 10m intervals. While these give a general impression of the topography they do not give sufficient detail in broad, low-lying areas, where differences of less than 1m in ground level can have a significant impact on flood risk.

4.7 Further updated LIDAR data (Composite LIDAR Data 2016), has been included on the interactive map of this SFRA Review. Different parts of the study area were surveyed on different dates, and some parts have been surveyed more than once. The LIDAR is derived from a combination of the full EA dataset, which has been merged and re-sampled to give the best possible coverage for the study area. The data resolution of the LIDAR data varies at 2 metre, 1 metre, 50cm, and 25cm. For example the majority of the study area has 2 metre resolution source data whereas the coastal area bordering the River Humber has 25cm resolution source data.

4.8 The accuracy of the data is continually being updated by the Environment Agency and it will be important for site specific Flood Risk Assessments to use such data in determining topographical data for a proposed development site.

Flooding from the sea

4.9 A number of the studies carried out for the Humber Flood Risk Management Strategy (HFRMS) provide information about flooding from the sea (in effect from the Humber Estuary). This SFRA Review does not include assessment of the tidal surge flood event December 2013 currently being assessed under the Humber Flood Risk Management Strategy (HFRMS) Review expected to be completed sometime in 2021 and submitted to Government for consideration in 2023. However the modeling work undertaken as part of the Lincolnshire Lakes overarching Flood Risk Strategy does consider an assessment of the tidal surge events in December 2013.

4.10 The EA are continuously producing new flood maps based on more accurate data, including new LIDAR data and some new flood modelling outputs along the Tidal Trent. The EA

considered that whilst the EA Flood Map for Planning does not factor in a climate change allowance and the SFRA does do this, the data is still of significance to use with SFRA Review. This SFRA Review does therefore include an interpretation of using this data in relation to the EA Flood Risk Zones updates and with this SFRA Review as stated in the 'Terms of Reference' chapter earlier in this document and in this chapter under the heading 'Level 1 Assessment'.

4.11 The Environment Agency have also carried out modelling and produced 'hazard mapping' (2009) which is included in the SFRA. This mapping takes account of existing flood defences and illustrates the potential flooding that could occur should they be breached or overtopped. The mapping includes scenarios for present day sea levels (2006) and for the higher sea levels expected to result from climate change (2115). The hazard maps give a more detailed and realistic picture of risk than either the EA Flood Map or SFRA Flood Zones.

4.12 The Flood Zone 2 boundary from the Environment Agency's flood zone maps was taken to represent the SFRA Flood Zone 2/3a boundary including the effects of climate change to 2115.

4.13 The detailed breach hazard model studies carried out for the Environment Agency and this study simulate the flow of water through a breach of pre-determined width in the defences and spreading across the floodplain behind them. The models used assume each breach remains open for 72 hours and allows flow from the estuary into the floodplain while the tide level is above the water level on the inland side of the breach, and in the reverse direction when it drops below this.

4.14 The models simulate the flood spreading by dividing the floodplain into a grid of cells and determining the flood depth and flow velocity in each cell at intervals of 3 to 5 minutes for a period of 4 days after the breach occurs. As a result they show how the resulting flood would develop and then stabilise once the breach is closed. The flood depths and flow velocities are strongly influenced by the ground level in each cell, which is taken as the average level across it calculated from LIDAR data. This means that significant obstructions to the flow, such as low ridges or raised banks (including road embankments) are likely to be properly represented although smaller ones may not. The Environment Agency's study used a 20m square grid except in the Grimsby urban area, where an 8m grid was used, while the North Lincolnshire Council study used a 10m grid.

Flooding from rivers

4.15 The Environment Agency has permissive powers which it can use in 'main river' watercourses for flood risk management purposes and are shown on the interactive map. Information about the probability of flooding from these watercourses was obtained from reports of other strategies, flood studies and schemes within the area and from discussions with the Environment Agency and local council staff. This SFRA Review includes the consideration of the Tidal Trent modelling outputs produced for the EA Flood Maps October 2016 update to be interpreted with this SFRA Review as explained in Chapter 1 'Terms of Reference' of this SFRA Review.

4.16 The Flood Zone 2 boundary from the Environment Agency's flood zone maps was taken to represent the SFRA Flood Zone 2/3a boundary including the effects of climate change to 2115.

Functional floodplain

4.17 Areas were taken to be in SFRA Flood Zone 3b (functional floodplain) if they were identified:

- within Environment Agency reports (or by Environment Agency staff) as providing flood storage under defined conditions (i.e. during events with return periods greater than a given figure) and so forming part of the flood management system; or
- within publicly available Environment Agency documents as being considered in the HFRMS as potential managed realignment sites.

Flooding from other sources

4.18 The information held by the councils about local flooding and the Environment Agency's historic and surface water flooding maps identify areas where there may be drainage problems.

4.19 The data from the Local Flood Risk Management Strategy, and North Lincs /NE Lincs Historic Flooding was used. The tidal surge event of December 2013 affecting the Humber Estuary, River Trent and River Ouse has not been factored into this SFRA Review as the data is awaiting EA analysis. However, such data was factored into the Lincolnshire Lakes development proposals on a case by case basis producing a Flood Risk Assessment for all developers to follow within this proposed development of the Lincolnshire Lakes site.

4.20 For the Local Flood Risk Management Strategy North Lincolnshire Council has mapped Local Flood Risk Extents which is an amalgamation of the 1 in 100 yr flood maps for surface water, historic flooding, local knowledge and buffers on critical watercourses. North East Lincolnshire have mapped historical flooding and sewerage drainage problems. There are no Critical Drainage areas in this area. These can be viewed on the interactive maps.

4.21 More information on Risk of Flooding from Surface Water and how to understand the map and use the map can be found at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297429/LIT_8986_eff63d.pdf

4.22 The drainage from most of the low-lying land beside the estuary and in the Trent and Ancholme Valleys is administered by a number of Internal Drainage Boards (IDBs). They have provided information about the drainage arrangements (including watercourses, outfalls, pumping stations and design standards) for which they area responsible.

4.23 An Internal Drainage Board (IDB) is an independent public body responsible for managing water levels in specified low- lying areas. They are an integral part of managing flood risk and land drainage within areas of special drainage need in England and Wales. Each IDB has permissive powers to undertake work to provide water level management within their Internal Drainage District (IDD), undertaking works to reduce flood risk to people and property and manage water levels for local needs. Much of their work involves the maintenance of rivers, drainage channels, outfalls and pumping stations, facilitating drainage of new developments and advising on planning applications. IDBs also have statutory duties with regard to the environment and recreation when exercising their permissive powers.

4.24 IDB activities are primarily funded by those who benefit from their works, through drainage rates and levies from land occupiers and local authorities. They are made up of elected members who represent land occupiers, and others nominated by local authorities who represent the public and other interested groups. Both Councils have full representation on the respective IDBs in their area at officer and elected member level.

4.25 Approximately 50% of the study area is located within an IDD split into different IDB or Water Land Management Drainage Board (WLMDB) areas. The drainage from most of the low-lying land beside the estuary and in the Trent and Ancholme Valleys is administered by six Internal IDBs or WLMBs.

The administrative areas are shown on the Interactive map and listed as follows:

- Isle of Axholme IDB
- Ancholme IDB
- Doncaster East IDB
- Scunthorpe and Gainsborough WMB
- North East Lindsey IDB
- Lindsey Marsh IDB

4.26 There are a number of 'ordinary watercourses' (OWs) within the study area which are potentially significant sources of flood risk because of their characteristics and the density of development nearby. They are shown, with the 'main river' watercourses, on the interactive map. Information about them can be obtained from the organisations responsible for them (generally the relevant IDB or local authority).

Historic Flooding

4.27 The Environment Agency's historic flood maps show the location and extent of recorded fluvial and tidal flooding. This is shown on the interactive map. Further information about the events causing the flooding can be obtained from the Environment Agency. Information on Long term flood risk assessment for locations in England can be found at https://flood-warning-information.service.gov.uk/long-term-flood-risk. This service allows you to find out:-

- The probability that a location will flood
- The possible causes of flooding
- Where to find advice on managing flood risk

4.28 Since 2010 the Councils became the lead flood authority and the interactive map shows the historic flooding events up to October 2019 for North Lincolnshire and North East Lincolnshire.

Reservoir Flooding

4.29 The NPPG requires those proposing developments to assess the risk from all forms of flooding. The failure of a reservoir is one form of flooding that has the potential to cause catastrophic damage due to the sudden release of large volumes of water. The local planning authority has to evaluate the potential damage to buildings or loss of life in the event of dam failure, compared to other risks, when considering development downstream of a reservoir.

4.30 There are eight large raised reservoirs in North Lincolnshire and North East Lincolnshire which are Alkborough Flats Reedbed, Buringham Pumping Station Drain, Cadney Carrs, Elsham Service Reservoir Frogmore Farm Reservoir, Grimsby Service Reservoir, Low Santon Farm and New Cut Washland. They are designated as large raised reservoirs under the Reservoirs Act 1975.

4.31 The Environment Agency is the enforcement authority in England for the Reservoirs Act 1975. The Reservoirs Act 1975 applies to all large raised reservoirs in England. Large raised reservoirs are those reservoirs capable of holding 25,000m³ or more of water above natural ground level.

4.32 Appendix B Local Planning Guidance provides some advice on what to consider in the two most common scenarios: development of a new reservoir and development downstream of or adjacent to an existing raised reservoir.

Flood Warning Process and Alerts

4.33 The purpose of Flood Warnings is to alert people that flooding is expected and they should take action to protect themselves and their property. Flood Warnings are issued when flooding is expected to occur, Severe Flood Warnings are issued to similar areas when there is a danger to life or widespread disruption is expected.

4.34 Flood Warning in North and North East Lincolnshire can be found at https://flood-warning-information.service.gov.uk/warnings?location=Lincolnshire and for North East Lincolnshire at https://flood-warning-information.service.gov.uk/warnings?location=+north+east+lincolnshire

4.35 You can sign up for flood warnings at https://www.gov.uk/sign-up-for-flood-warnings. You can sign up to get warnings in England by phone, email or text message if your home or business is at risk of flooding. The service is free.

Warnings for more than one place

4.36 If you're in England you can register for warnings for more than one place, for example if your business has several sites.

4.37 To register, call the Targeted Flood Warning Service. The service costs £4,700 a year, but is free for not-for-profit organisations.

Targeted Flood Warning Service

Telephone: 03708 506 506
Monday to Friday, 8am to 6pm
Find out about call charges

Existing flood defences and related information

4.38 The Environment Agency use a system called AIMS which is available from the EA on request. The information is not published as it is constantly been updated.

The Level 1 Assessment

4.39 For the purposes of this study, the aim of the Level 1 Assessment is to produce mapping showing the extent of the SFRA Flood Zones, taking into account the effects of climate change. The Environment Agency's Flood Map for Planning shows the current extent of the flood zones, i.e. without the effects of climate change. An assumption was made that areas currently in Flood Zone 2 of the Environment Agency Flood Map for Planning, being at greater risk is future, will become part of Flood Zone 3. Mapping was then produced showing this extended area at high probability of flooding, renamed 'SFRA Zone 2/3a'. The boundary of Flood Zone 1 has not been adjusted for climate change. This replicates the methodology used in the 2011 SFRA, using the up to date Flood Map for Planning.

4.40 It was therefore agreed that the Level 1 maps should show only the boundary between SFRA Flood Zones 1 and 2/3a, covering flooding both from the sea (estuary) and from rivers, together with the functional floodplain (SFRA Flood Zone 3b) and areas where drainage problems may lead to flooding from other sources. This assumes that, in effect, SFRA Flood Zone 2 is incorporated into SFRA Flood Zone 3a to become SFRA Flood Zone 2/3a.

The Level 2 Assessments

4.41 The purpose of Level 2 Assessment is to produce an in depth assessment of flood risk – for example one which identifies the depths and velocity of floods which might occur in the design flood and importantly how they might be safely mitigated and how residual risks should be managed. It is to help provide data and information for developers to complete Site Specific Flood Risk Assessments where development is necessary in areas at risk of flooding.

Humber Estuary hazard mapping

4.42 The 2011 SFRA described two level 2 assessments carried out by North East Lincolnshire Council and the Environment Agency respectively, along the Humber estuary and south to Humberston. The Council's assessment was superseded by the Environment Agency's modelling, which has formed the basis of flood risk advice in this area since its publication. The Council's assessment has therefore not been included in this updated SFRA.

4.43 The Environment Agency's study simulates breaches at 30 locations in the Humber defences within the study area. Each breach was assumed to be 50m wide, except for one at Grimsby intended to simulate the failure of a dock gate. The results from all the breaches modelled for a given event were combined to show the peak depth, velocity and hazard rating across the whole of the area liable to flood. Maps were produced for 'present day' (2006) and 'climate change' (2115) scenarios, and for the 0.5% annual probability and extreme 0.1% annual probability scenarios.

Lincolnshire Lakes Area Flood Risk Assessment

4.44 To inform the proposed mixed use Lincolnshire Lakes development in the Trent catchment (Compartment 3T3), North Lincolnshire Council commissioned Mott MacDonald to carry out modelling of a range of combined fluvial and tidal flood scenarios, including breaching and overtopping. Based on this, Mott MacDonald are producing a Level 2 Assessment for the Lincolnshire Lakes Area which includes the Environment Agency' new modelling data and updates to climate change figures. Any development in this area should refer to this Assessment which will be published when this work is complete.

4.45 The coastal hazard mapping is available on the SFRA interactive map and the Lincolnshire Lakes data will be available once this work is completed.

Outcome of Level 1 Assessment

4.46 The Level 1 Assessment results are presented on the interactive map covering the three parts into which the study area has been divided for convenience:

4.47 Eastern Coastal Area; covering the southern shoreline of the Humber Estuary from Humberston Fitties to South Ferriby Cliff and extending inland to the eastern boundary of the River Ancholme catchment.

4.48 This section has not been updated as part of the SFRA review due to the huge amount of data. Developers can get up to date datasets directly from the Environment Agency (requesting for a product 4) which can be provided in an up to date form and specific to a location /enquiry and free of charge. This can be obtained directly from EMDenquiries@environment-agency.gov.uk.

4.49 Ancholme Valley Area; covering the catchment of the River Ancholme, including Brigg, and the Humber Estuary shoreline between South Ferriby Cliff and Whitton.

4.50 Trent Valley Area; covering the remaining land including most of Scunthorpe, the River Trent and the Isle of Axholme.

4.51 The interactive maps show the following information:-

- The council boundaries;
- The extent of SFRA Flood Zone 2/3a (as defined in paragraph 4.20), with areas where the source of flooding is mainly from the sea shaded blue and from rivers shaded green;
- The extent of SFRA Flood Zone 3b (the functional floodplain, as defined in paragraph 4.23), marked with cross-hatching;
- The location of all places where surface water flooding due to drainage or other problems has been recorded;
- Watercourses designated as main river or as OWs;
- Drainage pumping stations;
- Existing flood defences; and
- Flood compartments

4.52 It is important to note that the SFRA Flood Zone Map 2/3a shown here is different to the EA Flood Map for planning because it:-

- Takes into account the effects of climate change by combining Flood Zones 2 and 3 from the Flood Map for Planning

4.53 The areas shown as FZ2/3a on these maps should be considered as Flood Zone 3 as defined in NPPF when preparing development plans, making planning allocations or determining planning applications and informing the sequential test.

4.54 Information about the study area's three parts and the probability of flooding there is given in the following sections. Further information is given in the Flood Compartment Appendices F, G and H. Directions for determining Critical flood levels across the study area are given in Appendix D.

Eastern Coastal Area

Location, extent and development potential

4.55 The Eastern Coastal Area stretches from Humberston Fitties, which is east of Cleethorpes, to the high ground outcropping at South Ferriby Cliff, west of Barton-upon Humber and the Humber Bridge. The shoreline of the Humber Estuary forms the northern and eastern boundaries while the council borders form the southern boundary. The watershed dividing the

River Ancholme catchment from the catchments draining east to the estuary acts as the western boundary.

4.56 The main centres of population in the area are Cleethorpes, Grimsby, Immingham and Barton-upon- Humber, all lying within 5km of the estuary. The area also contains the major ports of Grimsby and Immingham and wharfage facilities at North Killingholme and New Holland. There are major industrial and commercial facilities beside the coast between Grimsby and North Killingholme, including power stations, chemical works and storage areas. Many of these are either linked to the docks or are associated with the estuary in some other way. The remainder of the area is largely devoted to agriculture.

4.57 The coastal plain between Grimsby and East Halton Skitter (about 3 km along the coast from North Killingholme) has been allocated for estuary-related development in Development Policy Plans in both Council areas. A detailed development study has been carried out. Between North Killingholme and Grimsby the development will consist primarily of infilling between existing facilities but further north the land is largely undeveloped and is currently used for agriculture. No other parts of the area are allocated for major development.

Main sources of flooding

4.58 A main source of flooding in this Area is from the sea and tidal estuary. The level of risk varies according to meteorological conditions and the state of the tides. The greatest risk is likely to develop when meteorological conditions create a surge to the tide, there are strong on-shore winds and these coincide with the peak of a Spring tide.

4.59 There are nine main river watercourses, ten watercourses that are classified as OWs and six pumping stations within the area, shown on the interactive map. Five of the main river watercourses lie wholly within the tidal flood plain and one (Stallingborough North Beck) has only a very short length (~300m) lying outside. All but five of the OWs lie within the tidal or fluvial floodplain, as currently defined, and North East Lindsey IDB is responsible for all but two of them.

4.60 The responsibility for draining the low-lying land within the area is shared by two IDBs, Lindsey Marsh (which deals with the Waithe Beck and the Humberston Fitties and surrounding area) and North East Lindsey (which deals with the remainder). The IDB boundaries are also shown on the interactive map. The IDB has to approve the drainage arrangements of all significant new development within its boundaries or affecting its watercourses. In principle the site runoff characteristics should remain unchanged, although often the IDB will accept the receiving drainage system being improved so it can accept the increased discharge, at the developer's expense. It is understood that the design standard for these improvements is the event having a 1.0% annual probability of occurrence.

Flood compartments

4.61 To allow more detailed assessment, the area shown as SFRA Flood Zone 2/3a on Flood Zone on the interactive map has been divided into flood compartments taking into account the topography, type of defence, drainage arrangements and land use. These compartments are listed in the table below with the sources of flood risk they include.

Table 4.1 - Flood compartments; Eastern Coastal Area

Compartment Reference	Compartment Name	Primary Sources of Flood Risk
1T1	Cleethorpes	Humber Estuary Lower Buck Beck Little Buck Beck
1T2	Grimsby & Stallingborough	Humber Estuary Lower River Freshney New Cut Mawmbridge Drains Oldfleet Drain Middle Drain, Stallingborough Stallingborough North Beck
1T3	Immingham & North Killingholme	Humber Estuary Stallingborough North Beck Habrough Marsh Drain South Killingholme Main Drain Lower East Halton Beck
1T4	Goxhill	Humber Estuary Lower East Halton Beck Goxhill complaints
1T5	Barton upon Humber	Humber Estuary New Holland Main Drain Barrow Beck Butts Beck Midby Drain, Barrow Barrow complaints
1F1	Waithe Beck	Waithe Beck
1F2	Buck Beck & Goosepaddle Drain	Buck Beck Buck Beck, Waltham (a & b)
1F3	River Freshney & Laceby Beck	River Freshney
1F4	East Halton Beck/Skitter Beck	East Halton Beck Brockelsby Beck
1F5	Barrow Beck/Midby Drain	Barrow Beck Midby Drain, Barrow

The reference prefix denotes the primary source of flood risk in the compartment;
T = Tidal;
F = Fluvial

Ancholme Valley Area

Location, extent and development potential

4.62 The Ancholme Valley Area stretches from the high ground outcropping at South Ferriby Cliff, west of Barton-upon Humber, to the high ground at Whitton and south as far as Waddingham in the Ancholme Valley. The shoreline of the Humber Estuary forms the northern boundary while the NLC boundary forms the southern boundary. The watersheds dividing the River Ancholme catchment from the catchments draining east to the estuary and from the River Trent catchment act as the eastern and western boundaries respectively.

4.63 The main centres of population in the area are Winterton, Broughton and Brigg. Winterton and Broughton are both on high ground well above the floodplain but much of Brigg is in the bottom of the Ancholme Valley, about 14 km from its outfall at South Ferriby on the Humber. A number of villages (or parts of them) also lie within the floodplain, including Winteringham, South Ferriby, Wrawby and Hibaldstow. There are some industrial and commercial facilities at Brigg and a cement works at South Ferriby. The remainder of the area is largely devoted to agriculture.

4.64 In September 2000, the Council identified a number of potential sites for development in Brigg. The Environment Agency objected to any development in the floodplain and the Council appointed WS Atkins to prepare an SFRA for the Local Plan Inquiry. The council modified its proposals in the light of this assessment and the Inspector accepted the revised proposals in his report dated January 2003.

Main sources of flooding

4.65 There are two main sources of flooding in the River Ancholme area, a combination of large waves and high water levels in the Humber Estuary and high river flows in the River Ancholme.

4.66 There are two sections of fluvial floodplain within the area, a relatively small one associated with the Winterton Beck that discharges to the estuary at Winteringham Haven, and the main one associated with the River Ancholme that has a gated outfall at South Ferriby. Both sections contain complex drainage systems that are managed by the Ancholme IDB.

4.67 There are twenty-one main river watercourses within the area, shown on the interactive map. Throughout the study area the River Ancholme is embanked and acts as a highland carrier (carrying drainage flows from high ground further upstream at levels that are above the local ground level). Two separate main river watercourse systems (for the left and right bank respectively) drain the low-lying land beside the lower reaches of the river to the estuary, again discharging through gated outfalls at South Ferriby. Further upstream more highland carriers drain the uplands on either side of the Ancholme Valley, receiving gravity or pumped flows from the IDB drainage system and discharging them to the River Ancholme. They are all classified as main river watercourses.

4.68 Four watercourses lying within the River Ancholme Area are classified as OWs. They lie within the tidal or fluvial floodplain (as currently defined), are managed by the Ancholme IDB and are shown on the interactive map.

4.69 The responsibility for draining all the low-lying land within the River Ancholme area lies with the Ancholme IDB. Its drainage system is complex and, except near the estuary, much of it is pumped. The areas near the estuary are currently drained by gravity but siltation at the outfalls is becoming a serious problem and the IDB considers in due course most of them will need to be pumped. The IDB boundaries and pumping stations are shown on the interactive map.

4.70 The IDB aims to provide a standard of between 10% and 5% annual probability of occurrence (1:10 and 1:20 years return period) for agricultural land throughout the system but this includes a freeboard of at least 1m below local ground level (to prevent the land from being waterlogged). As a result the standard provided to property (which is not affected by flooding until the water level rises above local ground level) is generally in the range 2.0% and 1.0% annual probability (1:50 to 1:100 years return period). The IDB has to approve the drainage arrangements of all significant new development within its boundaries or affecting its watercourses. In principle the site runoff characteristics should remain unchanged, although the IDB may accept the receiving drainage system being improved so it can accept the increased discharge, at the developer's expense. It is understood that the design standard for these improvements is the event having a 1.0% annual probability of occurrence.

Flood compartments

4.71 To allow more detailed assessment, the area shown as SFRA Flood Zone 2/3a on the interactive map has been divided into flood compartments taking into account the

topography, type of defence, drainage arrangements and land use. These compartments are listed in Table 4.2 below, with the sources of flood risk they include. Further information about the area and its compartments is given in Appendix F.

Table 4.2 - Flood Compartments; Ancholme Valley Area

Compartment Reference	Compartment Name	Primary Sources of Flood Risk
2T1	South Ferriby (East)	Humber Estuary New River Ancholme East Drain Lower Fulseas & Marsh Drains
2T2	South Ferriby (West)	Humber Estuary New River Ancholme West Drain
2T3	Winterton	Humber Estuary Winterton Beck
2F1	Lower Ancholme Right Bank	New River Ancholme Land Drain Bonby Catchwater Worlaby Catchwater Little Carr Drain Wrawby Catchwater Humber Estuary
2F2	Lower Ancholme Left Bank	New River Ancholme West Drain Appleby Mill Beck Ella & Moor Beck Spring Dyke West Drain (IDB) Humber Estuary
2F3	Island Carr	Island Carr North
2F4	Middle Ancholme Right Bank	New River Ancholme North Kelsey & Grasby Beck Froghall Drain Kettleby Beck
2F5	Middle Ancholme Left Bank	New River Ancholme Castlethorpe Drain Scawby Catchwater Hibaldstow Catchwater Hibaldstow North Drain Redbourne Old River Redbourne Catchwater Sallow Row drain Scawby Brook

Note:- The reference prefix denotes the primary source of flood risk in the compartment;
T = Tidal;
F = Fluvial
although note that all compartments north of Brigg are at risk from both tidal and fluvial flooding

Trent Valley Area

Location, extent and development potential

4.72 The Trent Valley Area extends from Whitton Ness on the Humber in the north to the NLC boundary about 4 km south of Haxey, a total distance of some 30 km. The watershed along the Lincolnshire Edge dividing the River Ancholme and River Trent catchments forms the eastern boundary while the NLC boundary forms the northern and western boundary except for a short section between Whitton Ness and Trent Falls, where the boundary is the estuary shoreline.

4.73 The main centre of population in the area is the heavily industrialised town of Scunthorpe. Much of this is on relatively high ground but it extends east as far as the low-lying ground that forms the River Trent floodplain. There are a number of villages, wharves and industrial areas along the river, notably at Burton upon Stather, Flixborough, Gunness, Keadby, Althorpe, East and West Butterwick, Grove Wharf, Burringham and Owston Ferry. Further west, the flat, low-lying floodplain extends well beyond the NLC boundary. Originally marshland, this area was reclaimed in the 16th and 17th Centuries and is very fertile but relies on an extremely complex drainage system, almost entirely pumped, to maintain water levels low enough for arable agriculture to take place. There are a number of villages and small towns within the marsh, generally located on local high spots. The Isle of Axholme is particularly significant in this respect, reaching an elevation of 35mOD and supporting the towns and villages of Belton, Epworth, Haxey and Upperthorpe. Further north, part of Crowle stands on a noticeable high point but the small villages of Eastoft, Luddington and Garthorpe are only just above the surrounding marsh level.

4.74 The Lincolnshire Lakes Area Action Plan (AAP) was adopted May 2016 by North Lincolnshire Council. This AAP sets out the planning policy framework to deliver the Lincolnshire Lakes development within SFRA FZ 3T3 in a consistent and properly planned way within the River Trent flood plain, west of Scunthorpe. In association with this development 3.8 km of soft earth floodbank (right bank) will be hard piled between the M180 and Keadby Bridge and ground raising will take place to lift all proposed development above the Critical Flood Level (CFL) to create a development platform to a minimum of 300mm above the CFL, as determined by the Flood Risk Assessment (August 2019). This project will create a number of high quality, sustainable village communities, including some 6,000 dwellings on land between the western edge of Scunthorpe and the River Trent, set within an attractive waterside environment with major opportunities for leisure, sport and recreation. Please refer to the Lincolnshire Lakes Flood Risk Assessment, which is a separate document for further detailed information.

4.75 There may also be some pressure for additional development along the banks of the River Trent in the future as the wharves and industrial facilities there expand.

Main sources of flooding

4.76 There are two main sources of flooding in the Trent Valley area, high water levels in the River Trent and failure of the network of watercourses and pumping stations that together drain the marshland surrounding the river.

4.77 Water levels in the lower section of the River Trent (north of Keadby) are dominated by tidal conditions and so are related to water levels in the Humber Estuary.

4.78 Further upstream water levels during extreme events are due to a combination of tidal and fluvial conditions. An extensive study of the Trent flood defences was carried out during the 1960s and 1970s and included a detailed assessment of extreme fluvial flood levels. The river defences were then raised to provide a consistent standard of 1:100 years against fluvial flooding, equivalent to a 1% annual probability, and have since been maintained to these levels. The Environment Agency has undertaken a Flood Defence Strategy Study of the Tidal Trent (from Trent Falls to the tidal limit at Cromwell Weir) that has reviewed the extreme water levels and flood probability throughout the system and confirmed that the standard is generally 1:200 years or better against tidal flooding, equivalent to a 0.5% annual probability.

4.79 There are three sections of fluvial floodplain within the area, the main one being beside the River Trent (which includes the River Torne, River Idle and other important water courses, as discussed below) with smaller ones beside the Bottesford Beck and the River Eau respectively. The Bottesford Beck collects water from much of the eastern part of Scunthorpe, flowing initially south and then turning west to discharge to the Trent by gravity. The River Eau drains high land further south and much of its indicative floodplain lies outside the NLC boundary. Both the Bottesford Beck and the River Eau are embanked where they cross the Trent floodplain and so act as highland carriers.

4.80 The main river watercourses within the area (there are no OWs) are shown on the interactive map. Those on the right bank of the Trent are discussed above. On the left bank there are four principal watercourse groups connected to the Trent. The most northerly of these is the Stainforth & Keadby Canal, which is managed by British Waterways. This connects the River Don with the River Trent and is separated from the river at either end by a set of locks. There is no flow in the canal but it is embanked for part of its length and is consequently a potential source of flooding if the embankment fails since the water it contains will drain out. The two Soak Drains (one on either side of the canal) are both main river watercourses.

4.81 South of the canal three main river watercourses (the Hatfield Waste Drain, the River Torne and the South Level Waste Drain, each of which has some lengths of tributary watercourses which are also designated as main river) come together and run parallel with each other to the Keadby pumping station, where the flow is pumped to the River Trent. A number of pumping stations, some operated by the Environment Agency and some by the adjacent IDB, pump water into these watercourses.

4.82 South of the Isle of Axholme is the Warping Drain, which is about 9 km in length but now only collects the discharge from one small pumping station so has a very low flow. It is embanked in places, however, so is a potential source of flooding if an embankment fails. The flow is pumped to the River Trent. Further south again is the River Idle, most of which is outside the study area except for a short section where it forms the NLC boundary. This is an embanked watercourse draining high ground to the south and west of the study area as well as collecting local drainage flows from Environment Agency and IDB pumping stations. The River Idle flows to West Stockwith where it is pumped to the River Trent.

4.83 The responsibility for draining the low-lying land within the Trent Valley Area on both sides of the River Trent, and managing the extremely complex drainage system that does this, is shared by two IDBs, the Isle of Axholme and North Nottinghamshire WLMB (IDB) has the responsibility for draining the low-lying lands west of the River Trent and the Scunthorpe and Gainsborough IDB has the responsibility for draining the low-lying lands east of the River Trent. Both IDBs are managed by the Shire Group of IDBs and the engineers are from JBA Consulting.

4.84 The pumping stations that discharge to the main watercourses are shown on the interactive map. Only pumping stations within the study area are included, others operated by the same authorities lie just outside the area but are not included in the list.

4.85 As discussed earlier, the River Trent's tidal flood defences provide a standard of protection that is currently better than 0.5% annual probability of occurrence while its fluvial defences are designed to provide a standard of 1.0% annual probability against fluvial events. The standards provided by the internal drainage system are not as good as this, however. The Environment Agency indicates that the Bottesford Beck and River Eau offer a standard of about 3.0% annual probability (a return period of 30 years) while the River Idle provides a standard of about 2.0% annual probability (return period of 1 in 50 years). The watercourses of the Three Rivers system generally give a standard of about 10% (return period of 1 in 10 years) although this rises to about 3.0% for the River Torne and the South Level Engine drain if freeboard is taken into account.

4.86 The IDBs aim to provide a standard of between 10% and 5% annual probability of occurrence (1:10 and 1:20 years return period) for agricultural land throughout the system but this includes a freeboard of at least 1m below local ground level (to prevent the land from being waterlogged). As a result the standard provided to property (which is not affected by flooding

until the water level rises above local ground level) is generally in the range 2.0% and 1.0% annual probability (1:50 to 1:100 years return period). The IDBs have to approve the drainage arrangements of all significant new development within their boundaries or affecting their watercourses. In principle, the site runoff characteristics should remain unchanged, although the IDB may accept the receiving drainage system being improved so it can accept the increased discharge, at the developer's expense.

4.87 The above discussion concentrates on sources of flooding within the Stage 3 area. The part north of the Stainforth & Keadby Canal is, however, also potentially at risk of flooding from two sources outside the area, the River Ouse and the River Don. The implications of this are discussed in Appendix I under the assessment for compartment 3T4.

Flood compartments

4.88 To allow more detailed assessment, the area shown as SFRA Flood Zone 2/3a on Flood Zone the interactive map has been divided into flood compartments taking into account the topography, type of defence, drainage arrangements and land use. These compartments are shown on the interactive map and listed in Table 4.3 below with the sources of flood risk they include. Further information about the area and its compartments is given in Appendix G.

Table 4.3 - Flood compartments; Trent Valley Area

Compartment Reference	Compartment Name	Primary sources of Flood Risk
3T1	Alkborough	Humber Estuary
3T2	Flixborough	River Trent Scunthorpe IDB
3T3	Gunness	River Trent Bottesford Beck Scunthorpe IDB
3T4	Garthorpe & Keadby	River Trent (River Ouse) (River Don) Stainforth & Keadby Canal North Soak Drain Garthorpe IDB Adlingfleet & Whitgift IDB Tween Bridge IDB Crowle IDB
3F1	Upper Bottesford Beck	Bottesford Beck
3F2	Messingham	River Trent Bottesford Beck River Eau
3F3	Upper River Eau	River Eau Gainsborough IDB
3F4	Three Rivers	River Trent Stainforth & Keadby Canal South Soak Drain North Level Engine Drain Hatfield Waste Drain River Torne Hatfield Chase IDB

Compartment Reference	Compartment Name	Primary sources of Flood Risk
3F5	Isle of Axholme	River Trent River Torne South Level Engine Drain Warping Drain Althorpe IDB West Butterwick IDB South Axholme IDB West Axholme IDB Hatfield Chase IDB
3F6	River Idle	River Trent Warping Drain South Ancholme IDB Finningley IDB

Outcome of Level 2 Assessments

4.89 The results of the Level 2 Assessments are presented on the interactive map and in the Lincolnshire Lakes FRA. These maps show the following information:-

- The boundaries of the flood compartment and any significant obstructions to the flow (including road embankments)
- The extent of SFRA Flood Zone 2/3a and SFRA Flood Zone 3b (the functional floodplain, as shown on the relevant Flood Zone Maps
- The flood hazard zones due to breaching as defined in the matrix
- The location of all places where surface water flooding due to drainage or other problems has been recorded
- Watercourses designated as main river or as OWs
- Drainage pumping stations
- Existing flood defences.

4.90 The maps may be used to steer new development to areas of lowest hazard when applying the Information about the compartments for which Level 2 Assessments were carried out, the sources of flood risk there and the defences protecting them are given in the relevant Flood Compartment Appendices. Further information about the Flood Hazard Assessments is given in the following sections. Directions for determining critical flood levels for compartments covered by a Level 2 Assessment are given in Appendix D.

Flood Compartment 1T1 – Cleethorpes

4.91 Ground levels below +6.0mOD in the area of Compartment 1T1 are shown the interactive map. The compartment can be divided into two sub-compartments by the line shown on the map, which runs along a road that is generally at a level of between +4.5mOD and +5mOD. The area east and south of this line includes the Thorpe Park Caravan Park and the Humberston Fitties Holiday Camp, which contains a large number of single-storey chalets. The Buck Beck valley lies to the west and north, with residential property on the higher ground to either side of it.

4.92 The eastern area, Sub-Compartment 1, is protected by a combination of earth embankments and sand dunes reinforced by stone-filled gabion boxes. These exposed gabion boxes have all been replaced in the period 2011 to 2017. There is a significant possibility that these defences will not protect against flooding by events having a 1 in 200 or less (<0.5%) annual probability of occurring. It should be noted that this defence line held in the surge tide of December 5th 2013 which was the highest tide recorded for 60 years. However, if there had been more significant wave action that night the likelihood of a breach would have increased.

4.93 Compartment 1T1 is currently being assessed by the Environment Agency to identify where upgrades are required.

Flood Compartment 1T2 – Grimsby and Stallingborough

4.94 Ground levels below +6.0mOD in the area of Compartment 1T2 are shown the interactive map. The compartment can be divided into two sub-compartments by the line shown on the map, which runs just west of the Royal Docks to higher ground further south. Ground levels along this line are generally above +4.5mOD, although there are short lengths where the level is between +4mOD and +4.5mOD. Floodwater will not flow overland across this boundary until it rises above these levels, so the two sub- compartments have been assessed separately. The flood hazard zones for them both are shown on the interactive map.

Sub-Compartment 1 – Grimsby Docks and Grimsby

4.95 The eastern area, Sub-Compartment 1, is in effect a shallow dish in which most of the town of Grimsby has been built. The Grimsby Dock area forms the northern edge of this dish, and the ground there is generally above +4.5mOD, although there is a length of about 200m where the level is about +4mOD. This area includes the Fish and the Royal Docks, where under normal circumstances the highest water level is limited to about +3.2mOD and +3.5mOD respectively. The area is protected by a combination of concrete sea walls, sheet piling and embankments which were upgraded in a scheme, completed in 2015, to provide protection to the town against events having about a 1 in 200 (0.5%) annual probability . The defence upgrades extend to the eastern end of the Sub Compartment. The detailed breach model studies show that if the Sub-Compartment defences breach there will be only very limited overland flow into Sub-Compartment 2.

Sub-Compartment 2 – Stallingborough

4.96 Although the defences protecting the western area, Sub-Compartment 2, from the estuary have a concrete slab on the crest, a concrete wave wall and a revetment on the front face, these items rest on top of a simple earth embankment and do not contribute greatly to its innate structural strength. As a result the defences have been treated as earth embankments. Defence upgrades were carried out during 2011/12 at this location with further improvements programmed for the period 2021 to 2026 to ensure a 1 in 200 standard of protection is maintained.

4.97 Sub-Compartment 2 is effectively divided into two by the A180, which is embanked and so could act as a barrier preventing floodwater from a breach in the defences flowing further south. The detailed breach model studies indicate that in practice the presence of culverts and other passages through the embankment mean this will not happen. They also indicate, however, that there will be only very limited flow into Sub-Compartment 1.

4.98 The sub-compartment's western boundary is the flood defence embankment beside the Stallingborough North Beck. If this defence fails floodwater would flow into the southern end of the neighbouring Flood Compartment 1T3 and affect Immingham. The detailed breach model studies indicate this is likely to happen, and that in practice Immingham is at risk of flooding from breaches in the defences to Sub- Compartment 2.

4.99 The HFRMS notes that the foreshore is being eroded along this frontage and the Environment Agency has therefore recommended that in future no permanent buildings should be located immediately behind the defences.

Flood Compartment 1T3 – Immingham and North Killingholme

4.100 Ground levels below +6.0mOD in the area of Compartment 1T3 are shown the interactive map. The compartment can be divided into three sub-compartments by the lines shown on the map, one of which is on the raised ground on which the main road and rail access to the raised Immingham Dock area (which is also raised) are located, while the other is on higher land near the oil terminal at North Killingholme. Ground levels along both lines are generally above +4.5mOD, although along the second there are short lengths where the level is between +4mOD and +4.5mOD. Floodwater will not flow overland across these boundaries until it rises above these levels, so the three sub-compartments have been assessed separately. The flood hazard zones for all three are shown on the interactive map.

4.101 The defences protecting this compartment from the estuary have a concrete slab on the crest, a concrete wave wall and a revetment on the front face, these items rest on top of a simple earth embankment and do not contribute greatly to its innate structural strength. As a result the defences have been treated as earth embankments.

4.102 The HFRMS (2008) identifies that the foreshore is being eroded along this frontage and the EA applied a limitation in relation to permanent buildings, suggesting that a width of 200m would provide space for defences to be moved if it became necessary to do this in the future. However, circumstances have changed since the approval of Able UK proposals (National Planning Infrastructure decision) to develop a Marine Energy Park (AMEP), including a new quay frontage, between the northern end of the Port of Immingham and the Humber Sea Terminal (within SFRA flood compartment 1T3 (Sub-Compartment 2). Preliminary construction enabling work started on AMEP in March 2015 and is programmed to be operational by 2018/2019. The HFRMS Review is programmed to deliver a draft Strategy for agreement by mid 2021 and the EA will be examining whether flood defence improvement will be required either side of AMEP's new quay. There is a separate project (£6.5m as at 2016) to improve the drainage, including a new pumping station and regrading of water channels, in and around AMEP at Killingholme Marshes.

4.103 Able UK also have planning permission to develop a logistics park (ALP) between the Humber Sea Terminal at North Killingholme Haven and East Halton Skitter (East Halton Marshes) within SFRA flood compartment 1T3 (Sub Compartment 3). There is a project (East Halton Flood Alleviation Defence Scheme) for improving the flood bank along the frontage to the Estuary. The HFRMS 2008 identified that these flood defences required immediate strengthening or re-structuring if development is to procede. The HFRMS Review will include reference to this scheme. There are various options being considered to provide a solution. The current proposed flood defence improvement works have been costed at some £13.5m with funding sources being investigated.

Sub-Compartment 1 – Immingham

4.104 Most of this sub-compartment is protected from the estuary by defences on top of the relatively high land by Immingham Docks, where the ground level is generally between +4.5mOD and +5mOD. Phase 2 of the Immingham Dock defence upgrades is being planned. These upgrades will provide a 1 in 200 year standard of protection for the next 25 years. There is, however, a length of about 1.5 km of earth embankment at the east end of the area (between Stallingborough North Beck and Habrough Marsh Drain) where the ground level is about 3.0mOD. The area is also liable to flooding from a breach in the defences protecting the Flood Compartment 1T2 if the embankment beside the Stallingborough North Beck fails, as discussed in the previous section.

4.105 The detailed breach model results confirm this sub-compartment is liable to flooding from a breach in the defences to Flood Compartment 1T2, and also that the reverse will be the case (i.e. there will be flooding in Flood Compartment 1T2 if the defences in this sub-compartment breach). They also show that there will be some limited flooding in Sub-Compartment 2.

Sub-Compartment 2 – Killingholme Marshes

4.106 The ground level behind the defences protecting this sub-compartment is as high as +5mOD in places but there is a significant length where the level is about +2.5mOD. There are no significant ridges or other features that could affect the flow of floodwater across this sub-compartment itself, but if flood levels rise above +4mOD there could be some flow into Sub-Compartment 3 to the north while if they rise above +4.5mOD it could flow into Sub-Compartment 2 to the south as well.

4.107 The detailed flood breach model results indicate that floodwater from a breach in the defences to this sub-compartment will not only flow into Sub-Compartment 3, but also across the East Halton Skitter into Flood Compartment 1T4. In addition there will be some flooding in Sub-Compartment 1.

Sub-Compartment 3 – Halton Marshes

4.108 The ground level behind the defences protecting this sub-compartment varies between about +2mOD and +3mOD. The lower of these was adopted for the Assessment. There are no significant ridges or other features that could affect the flow of floodwater across this sub-compartment itself, but if flood levels rise above +4mOD there could be some flow into Sub-Compartment 2 to the south.

4.109 The detailed flood breach model results indicate that flood water from a breach to the defences in this compartment will flow into both Sub-Compartment 2 and across the East Halton Skitter into the adjacent Flood Compartment 1T4. Similarly, a breach in the defences to the adjacent flood compartment will cause flooding here.

Lincolnshire Lakes

4.110 The Lincolnshire Lakes proposals and associated evidence on flood risk assessment and drainage management provided a more detailed assessment of flood risk for this area. This evidence has been referenced separately in relation to the Lincolnshire Lakes plan area.

Flood Compartments 1T4 – Goxhill and 1T5 – Barton upon Humber

4.111 Ground levels are shown on the interactive map as are the flood hazard zones.

4.112 The defences between Barton upon Humber and New Holland predominantly consist of earth embankments. In some places such as the Humber Bridge Visitor Centre, New Holland and Goxhill there are concrete, stone and tarmac revetments.

4.113 Defences in these compartments were substantially overtopped in many locations during the December 2013 tidal surge incident, causing extensive damage to the earth embankment defences. Further events similar to 2013 would lead to more overtopping and possibly breaches of the existing defences. Sea level rise due to climate change will increase this risk.

4.114 The 2008 Humber Flood Risk Management Strategy identified that properties in Goxhill, Barrow upon Humber and New Holland could be protected by building a secondary line of new defences. An Environment Agency led partnership project is currently ongoing to identify options to improve the standard of protection of defences between Barton-upon-Humber and New Holland. Future management of the defences between New Holland and East Halton Skitter is also being investigated and will align with the Humber 2100+ flood risk management strategy.

5 Guidance on the use of Sustainable Drainage Systems

Introduction

5.1 The NPPF and NPPG on Flood Risk and Coastal Change require that local planning authorities should seek flood risk management opportunities (e.g. safeguarding land) and to reduce the causes and impacts of flooding (e.g. through the use of sustainable drainage systems (SuDS). NPPF states 'when determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate applications should be supported by a site-specific flood risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate.

5.2 SuDS is a term used to describe the various ways that can be used to manage surface water drainage so that it mimics the drainage that would occur from a natural, undeveloped site. The effective management of surface water caused by heavy rain (or from any other source) is essential for reducing flood risk both to the site itself and to the surrounding area.

Types of sustainable drainage systems

5.3 SuDS may improve the sustainable management of surface water at a site by:

- Reducing peak flows to watercourses or sewers and so potentially reducing the probability of flooding downstream
- Reducing the total volume of water flowing directly to watercourses or sewers from developed sites
- Improving water quality, compared with conventional surface water sewers, by removing pollutants from diffuse pollutant sources
- Reducing potable water demand by rainwater harvesting
- Improving amenity through the provision of public open space and wildlife habitat
- Replicating natural drainage patterns, including the recharge of groundwater so base flows Are maintained.

5.4 Although the reduction in peak flow or total volume originating from any particular site may be small, the cumulative effect from a number of sites across a catchment can be significant and have a real impact on extent and frequency of flooding.

5.5 There are a number of different types of SuDS that can be incorporated into a development. Their effectiveness depends on the topography and geology of the site and the surrounding area, and careful consideration of the site's characteristics is needed to ensure the most suitable choice is made. The most commonly found components are:

Permeable surfaces

5.6 Surfaces that allow rainwater to flow through them into the underlying construction or soil.

Green roofs

5.7 Roofs that are vegetated and so provide some natural storage of rainwater, reducing the volume and rate of runoff and helping to remove pollution.

Filter drains

5.8 Linear drains consisting of trenches filled with a permeable material that can store and conduct water, and may also encourage infiltration into the underlying soil. They may have a perforated pipe in the base to assist drainage.

Filter strips

5.9 Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and filter out silt and other particulates.

Swales

5.10 Shallow vegetated channels that retain and conduct water, and may also permit infiltration. The vegetation filters particulate matter.

Basins

5.11 Ponds and wetland areas that can be used to store surface water runoff.

Infiltration devices

5.12 Any sub-surface structure, such as a trench, basin or soakaway that promotes the infiltration of surface water to the ground.

Bio-retention areas

5.13 Vegetated areas designed to collect and treat surface water before discharging it through a piped system or allowing it to infiltrate the ground.

Pipes and accessories

5.14 A series of conduits and their accessories, normally laid below ground that convey surface water to a suitable location for treatment and disposal. Although sustainable, this approach should be used only where other SUDS techniques are not practicable.

5.15 As well as a formal SUDS, there are a number of other measures that can be designed into new developments and will, in the right circumstances, provide the same benefits. These include the re- contouring of land levels to form green spaces that can hold rainwater, or the installation of water butts to store rainwater runoff from roofs (although it should be noted that the capacity of water butts is limited so their success depends on regular emptying, either for garden watering or some other purpose).

SuDS Update

5.16 As with all development proposals drainage of the site will be critical and drainage assessments must be included with FRAs. This also applies to sites where flood risk is no issue. Drainage advice is given in this SFRA Review and both Council's Drainage Teams advise on drainage in a SuDs approach to development proposals (April 2015 Ministerial Statement), where appropriate. For planning applications applicants must complete the LPAs SUDs validation form and developers must be guided by the National SUDs guidance together with any local SUDs developer guidance that may be produced.

Use of SuDS techniques in North and North East Lincolnshire

5.17 Priority should be given to the use of infiltration techniques rather than the direct discharge of surface water to watercourses. Where infiltration is not viable (due to a high water table, impermeable soils, or location in a Source Protection Zone, for example), run-off attenuation techniques discharging to open Watercourses should be considered in preference to discharge to a closed sewer. Details of the superficial deposits (soils) across the study area can be obtained from Canfield University 's Landis Information Service website at www.landis.org.uk and may help to make an initial assessment of the viability of infiltration techniques at a site. Further information, including methods of measuring permeability/ infiltration rates, can be obtained from BRE Digest 365 (Soakaways) and CIRIA 156 (Infiltration Design;Manual of Good Practice).

5.18 Government guidance on SuDS was issued by Ciria (The SuDS Manual – Ciria report C753) on behalf of the Department of Environment, Food and Rural affairs in December 2015. This guidance takes the place of previous national SuDS guidance. A Ministerial Statement of April 2015 confirms the responsibility for implementing SuDS is now with local authorities to administer. North Lincolnshire Council has produced a Local SuDS and Flood Risk Guidance Document (April 2017)) based on the Ciria SuDS manual as to the requirements and

expectations of SuDS delivery in North Lincolnshire. The purpose of this document is to provide developers and designers with guidance on SuDS.

5.19 If a development leads to a large increase in impermeable area (i.e. through paving or building over an open space) there is likely to be a significant increase in both the volume and rate of surface run-off that could increase flood risk elsewhere unless effective SuDS techniques are implemented. Such techniques could include, for example, the use of permeable rather than impermeable paving combined with surface water collection, infiltration and rainfall harvesting.

5.20 All planning applications will require a site-specific Flood Risk and Drainage Assessment showing that a full range of SuDS techniques has been considered and that the one proposed will, as a minimum, attenuate the surface water runoff so that both the peak discharge and the total volume are no greater than would occur from the site in its natural condition (i.e. with no development). This requirement (where appropriate) applies also to applications for the re-development of previously developed sites. Full details of how any SuDS elements will be maintained throughout its life should be given together with confirmation that, if adoption by a third party is assumed, that the third party has agreed to this. Developers should consult with the Local Lead Flood Authorities of North Lincolnshire Council or North East Lincolnshire Council (depending on the location of the development proposal) about their SUDS proposals at an early stage (preferably at pre-planning application stage).

Additional Considerations

Implications of Flood and Water Management Act

5.21 The Flood and Water Management Act, which is the Government's response to Sir Michael Pitt's Review of the flooding in 2007, came into force in April 2010. A key aim of the Act is greater sustainability by helping people and their communities adapt to the increasing likelihood of severe weather events due to climate change. The Act will encourage the use of sustainable drainage systems in new developments as this will provide better protection to communities and the environment against the risk of flooding.

5.22 The Act introduces a range of measures that should be taken into account when considering both the information in this SFRA and in preparing site-specific Flood Risk Assessments (FRA's). At the strategic scale, the Environment Agency will be responsible for Mapping a national strategy for managing flood risk in general and will retain overall responsibility for managing the risk from tidal and fluvial (main river) sources.

5.23 The role of local authorities will be enhanced, with unitary authorities (such as North Lincolnshire and North East Lincolnshire Councils) and county councils taking on the new role of 'Lead Local Flood Authority' for their respective areas. They will be responsible for bringing together all risk management authorities to form local partnerships and will also be required to 'develop, maintain, apply and monitor a strategy for local flood risk management' in their areas. In this context 'local flood risk' covers flooding from all sources not dealt with by the Environment Agency, such as ordinary watercourses, groundwater, surface water, sewers and artificial infrastructure such as canals. North Lincolnshire Councils Local Flood Risk Management Strategy was published following consultation in 2016, and can be found online at https://www.northlincs.gov.uk/wp-content/uploads/2018/07/Local-Flood-Risk-Management-Strategy.pdf

5.24 The Act also supported the use of Sustainable Drainage Schemes (SuDS) by establishing a SuDS Approving Body (SAB) at county or unitary local authority level. SABs being responsible for approving proposed drainage systems in new developments and redevelopments, subject to exemptions and thresholds. However, the process for applying SuDS under the Flood and Water Act 2010 Act was delayed until a Ministerial Statement was issued in April 2015 and this Statement changes the process laid down in the Act. From this Ministerial Statement the application of SuDS became the responsibility of the Local Lead Flood Authorities (LLFA) (Schedule 3 of this Act, relating to SuDS Approving Bodies, has not been enacted). The LLFA for SuDS within the study area are North Lincolnshire Council and North East Lincolnshire Council depending on where the proposed development is located. In addition the Government through Ciria issued the SuDS Manual (Ciria Report 753) in December 2015.

5.25 Developers should refer to North Lincolnshire Council SuDS and Flood Risk Guidance Document in all new major developments when applying for planning permission within North Lincolnshire, it can be found online here: https://www.northlincs.gov.uk/wp-content/uploads/2018/07/NLC-SuDS-Guidance-Published-document.pdf.

5.26 Further information can be obtained from the Defra website at www.defra.gov.uk/environment/flooding/legislation/.

Preparation of Local Flood Risk Management Strategy

5.27 Lead local authorities will in general follow a four-stage process for managing flood risk, as set out in the European Floods Directive (implemented in the UK by the Flood Risk Regulations 2009). The first stage involves undertaking a Preliminary Flood Risk Assessment, a high-level screening exercise aimed at identifying historic and future (potential) flood risk. This identifies Local Flood Areas using the information available at the time and provides the initial basis for the Local Flood Risk Management Strategy (LFRMS). The flood areas and their boundaries will be refined as the Strategy develops through local consultations and more detailed location-specific assessments. The process will be iterative, responding to new information and changing circumstances.

5.28 North East Lincolnshire Council and North Lincolnshire Council have produced their LFRMS which were discussed earlier in Section 3 and links provided to the documents.

Procedure for reviewing the SFRA

5.29 This SFRA is a 'living document' and will be reviewed on a regular basis and amended as necessary. The document has been structured so that, as far as possible, such amendments will be limited to information held in tables or appendices.

6 Appendix A Factors Affecting Flood Risk

6.1 On the east coast of England high sea levels are generally caused by a combination of tidal conditions (caused by relative movements of the moon, earth and sun) and a surge (caused by the weather conditions, particularly the movement of low-pressure storm systems). As a result, unusually high sea levels tend to rise fairly rapidly, remain at their peak for one or two hours and then fall away equally rapidly. There will then be a further peak at the following high tide some 12½ hours later, which is generally lower than the first one but could be higher if the surge is particularly prolonged.

6.2 If the strip of low-lying land beside the coast (the coastal/tidal floodplain) is relatively narrow then there will normally be enough time for water from the sea to flood across it and rise to the same peak level that occurs just offshore. If the floodplain is broad, however, or if it lies towards the head of an estuary, then the flow of water from the sea to the area being flooded can be insufficient to fill it before the sea level begins to fall again. As a result the peak water level in the flooded area is less than the peak sea level. This effect is particularly marked in the tidal reaches of the rivers draining to the estuary, where the flooding of a large area of land can lower the water levels in the river as well.

6.3 Historically, the normal response to coastal flooding has been to build flood defences and the whole of the south bank of the Humber is protected in this way (apart from a few points where high land comes to the water's edge). These defences would be high enough to keep out all but the most extreme events if there were no waves. The weather conditions causing large surges, however, often cause waves as well. The spray from these can lead to local flooding nearby and, more importantly, could undermine the defences causing them to breach and allow the sea to flow through.

6.4 The defences can breach for a number of other reasons, including structural failure and accidental damage. A similar effect can be caused by the failure of a floodgate or barrier to close, either because of a mechanical or electrical fault or through operator error. Whatever the cause, if there is a gap in the defences the sea will flow through it and flood low-lying land behind. The extent of flooding will depend on the topography of the area and the volume of water flowing through the defences, which in turn will depend on the peak sea level and the size, number and timing of the breaches.

Fluvial flooding

6.5 When rainfall occurs over land some of the water will be absorbed into the vegetation or other materials on the surface and some will infiltrate into the underlying ground. Surplus water collects on the surface and flows downhill until it enters a ditch or other drainage system. In time some of the infiltration water will also enter the drainage system and from there the water will flow to a river and, eventually, to the sea. This takes time, however, so rain falling in the upper catchment of a large UK river can take several days to arrive at the lower reaches. Rainfall on the lower catchment will reach the same place more quickly, with the effect that the flow from two storms can converge giving results that are more serious than either one alone.

6.6 In most UK rivers, the bank-full capacity of the natural channel is about the mean annual flood (the flow that occurs, on average, once a year). When the flow is greater than this the river comes out of its banks and spreads across the surrounding land (the fluvial floodplain). This increases the area of flow, allowing more water to pass downstream, and provides storage for surplus water until conditions downstream have improved sufficiently for it to flow away. If the river channel is constricted at some point downstream the flow function is limited and the storage function becomes more important. The depth of water on the floodplain will depend on the severity of the flood and the conditions downstream.

6.7 Man's activity in the catchment, particularly urbanisation and agriculture, can affect both the proportion of rainfall entering the drainage system and the rate at which it does so. Urbanisation (the construction of buildings, roads, car parks and their drainage systems) tends to reduce the volume of water infiltrating into the ground (since the surfaces are normally impervious), reduce the volume of water stored on the surface (since puddles are not normally

acceptable) and increase the rate of discharge into the river (since water normally flows more rapidly through a designed drainage system than across natural ground). Agricultural practices, such as ploughing down rather than across a slope, can have similar effects. The result will generally be to increase the size and speed of flooding that occurs during small or medium rainfall events. The effect is normally less important during extreme events since prolonged heavy rainfall causes the ground to become sodden and fills the available surface storage, so any subsequent rain runs off into the rivers more rapidly.

6.8 Man's activity on the floodplain can affect both its ability to allow water to flow downstream and its storage capacity. A road across a valley or a wall across a field can obstruct the flow and cause water to pond upstream, raising flood levels. A building raised above the surrounding ground will reduce the volume available for storing floodwater. The water that would have been stored there has to go somewhere else, again raising flood levels.

6.9 Generally the most significant impacts on floodplain function are caused by flood defences. These, until they are overtopped, cut off the floodplain from its river so the water that would have been stored there has to pass further downstream, raising water levels and possibly causing referred flooding if the channel capacity is inadequate. Once the defences are overtopped any surplus water will flow into the floodplain and will be trapped there until the flood has passed. If the defences are breached, either accidentally, due to structural failure or because they are washed out, the flow into the floodplain will increase and is likely to lower the water levels in the river. The extent of flooding will depend on the volume of water stored in the river and the capacity of the channel downstream as well as the size and duration of the flood event. If the system is pumped the extent will also be controlled by the pump capacity and will be seriously affected if the pumps fail to operate.

Surface and groundwater flooding

6.10 During periods of very heavy rainfall (pluvial) the volume of the water flowing off the surface of the ground can exceed the capacity of the existing drainage system, either natural or man-made, to remove it. This can be because the channels, ditches or pipes are not large enough to carry all the flow, or because they have become blocked so their capacity is reduced.

6.11 When this happens the surface water will tend to flow overland where the ground is sloping towards a low point where it will collect. The velocity and depth of flow will depend on the slope of the ground and the volume of water that cannot enter the existing drainage system – the steeper the slope the faster and more dangerous the flow. The depth of water collecting in low points will depend on the local topography, the level will rise until the water can overflow and flood into an adjacent area. This is known as pluvial flooding (caused by high volumes of rainfall).

6.12 Maintenance of the drainage system can be an important factor in surface water flooding. If ditches and culverts are not kept clear they will not operate effectively, increasing the probability of a flood occurring. Not all blockages are due to poor maintenance, however, as a build-up of debris washed into the system during an event will have the same effect.

6.13 Groundwater flooding is most likely to occur in low-lying areas underlain by permeable rocks, or aquifers. Water levels below the ground rise during wet winter months and fall again during the summer, when water flows out into rivers. During very wet periods the water level can rise above the level of the ground surface, causing flooding of areas that are normally dry. Groundwater flooding may take weeks or months to dissipate because water flows much more slowly through the ground than over the surface so high water levels take a long time to fall.

Future changes

6.14 The assessment of flood probability is based on a statistical analysis of past events, either in the same catchment (or at the same point on the shore for coastal flooding) or in similar catchments elsewhere. These records are generally quite short (possibly 30 or 40 years or less) which introduces some uncertainty when predicting events that may happen on average once every 100 or 200 years. This uncertainty is increasing, as the world's climate appears to be changing. As a result, the UK is expected to experience more frequent winter storms (and

less rainfall in summer), which is likely to mean that high river flows, and hence fluvial flooding, will also occur more frequently. The incidence of coastal flooding is also likely to increase, partly because the increased storminess will increase the frequency of waves and surges but also because sea levels are expected to rise.

6.15 The effect of these changes is difficult to estimate but Government guidance currently suggests that sea levels off the East Coast could rise by to just over 1m over the next 100 years, flood flows in rivers could increase by perhaps 20% and peak rainfall intensities by 30%.

7 Appendix B Local Planning Guidance

Introduction

7.1 This document provides guidance for developers and others preparing planning applications for submission to the North and North East Lincolnshire Planning Authorities. It has been produced in consultation with the Environment Agency and takes into account the particular conditions in the areas covered by these authorities.

Background

7.2 Although current government policy places an increasing emphasis on the delivery of significant levels of new development, it is important that this development takes place within an environmentally responsible framework. At present the government's policy on how flood risk should be taken into account in the planning process is set out in NPPF and NPPG, This guidance includes two tests, the Sequential Test and the Exception Test, and it basically reiterates earlier guidance on the requirement for site-specific Flood Risk Assessments (FRAs).

7.3 The NPPF and NPPG on flood risk and coastal change indicates that local plans should continue (from its policy and guidance predecessor) to apply a sequential, risk-based approach to the location of development to avoid flood risk to people and property where possible; to manage any residual risk by applying the Sequential and Exception Tests. It also requires planning applications to be accompanied by site-specific FRAs.

7.4 In particular, the current Development Plans for North Lincolnshire and North East Lincolnshire Councils show that planning policy will only support development proposals that can show, through the preparation of site-specific FRAs and the application of the Sequential Test, that they will avoid areas of current or future flood risk where possible (taking sustainability issues into account) and will not increase the risk of flooding elsewhere.

7.5 The Development Plans of both council's also confirm that the requirement that land use is related to its vulnerability to flooding and that development will only be permitted in areas of high flood risk if it meets the requirements of the Exception Test. In addition all developments will be required to incorporate Sustainable Urban Drainage Systems (SUDS) to manage surface water drainage wherever practicable. Relevant planning policies and planning guidance in respect of flood risk and drainage can be accessed on both council web sites. This information includes the requirement for Sequential Test and Exception Test in support of site specific planning applications, where applicable and relevant.

Flood Risk Assessment

7.6 A Site-specific Flood Risk Assessment (FRA) is required for all development proposals in SFRA Flood Zone 2/3 and for proposals in Flood Zone 1:

- involving sites of 1 hectare (ha) or more
- involving sites less of than 1ha that could be affected by sources of flooding other than rivers and the sea (for example surface water runoff, groundwater, reservoirs), where their development would introduce a more vulnerable use.

7.7 All FRAs should consider all potential sources of flood risk.

7.8 Surface water runoff from new development sites must be managed sustainably such that flood risk is not increased on site or elsewhere. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate.

Sequential and Exception Tests

7.9 The Sequential Test is required to explain why development proposed for a site where there is a risk of flooding cannot take place elsewhere, and so ensure that sites where there is little or no probability of a flood occurring (i.e. in Flood Zone 1) are developed in preference to sites where there is a medium or high probability (in Flood Zones 2 or 3). A Sequential Test is therefore normally required where development is proposed in Flood Zones 2 or 3, or where the SFRA or other evidence indicates there may be flooding issues now or in the future. In the

case of North and North East Lincolnshire, the Environment Agency tidal hazard mapping should be referred to for sites in the relevant areas, with the test being required for sites shown to be at risk in the future in case of a breach in the defence.

7.10 The Exception Test is not always required, whether it is depending on the type of development proposed and the degree of flood risk at the proposed site. If it is required, it needs to address the following two issues:-

- The wider sustainability benefits to the community
- The need for the development to be safe without increasing flood risk elsewhere and, where possible, to reduce flood risk overall.

7.11 North and North East Lincolnshire councils have separately produced their own Flood Risk Guidance on how the Sequential Test and Exception Test should be applied in relation to development proposals in the higher flood risk areas. This includes an interpretation of area of search for alternative sites.

7.12 You can view these at: North Lincolnshire Development and Flood Risk Guidance Note and North East Lincolnshire Flood Risk Sequential and exception Tests Guidance Note.

Undertaking the Sequential and Exception Tests

7.13 This section describes the process that should be followed when preparing a planning application for a proposed development. The key steps are summarised in Table E.1 below.

1	**Is the proposal within a flood risk area? (see Step 1)**			
	Yes	Go to Section 2	No	Sequential and Exception Tests not required, but site-specific Flood Risk Assessment covering drainage and SUDS issues may be required
2	**Is the proposal change of use, minor development, a replacement dwelling or a housing renewal scheme? (see Step 2)**			
	No	Go to Section 3	Yes	Sequential Test not required, but Exceptions Test may and site-specific Flood Risk Assessment covering drainage and SUDS issues may be required
3	**Does the Sequential Test indicate that the development could be located in an area where the flood risk is lower than at the proposed site? (see Step 3)***			
	No	Go to Section 4	Yes	If the development could be in an area where the flood risk is lower than it has failed the Sequential Test and planning permission will be refused
4	**In view of the type of development and the degree of flood risk, is an Exception Test required? (see Step 4)**			
	Yes	Go to Section 5	No	Site-specific Flood Risk Assessment covering flooding, drainage and SUDS issues required
5	**Does the development meet all parts of the Exception Test? (see Step 5)**			
	Yes	Flooding issues mitigated	No	Exception Test failed, planning permission will be refused

Table 7.1 Undertaking the Sequential and Exception Tests

* Note: At this stage undertake the following steps:

- identify appropriate area of search
- identify potential sites within area of search
- explain why potential sites should be discounted

Step 1 – Is the proposal within a flood risk area?

7.14 The SFRA Flood Zone Maps accompanying this document show the areas classified as SFRA Flood Zone 1 (Low probability of flooding), SFRA Flood Zones 2 and 3(a) (Medium and High probability) combined and SFRA Flood Zone 3(b) (Functional floodplain). Flood Zones 2 and 3a have been combined on the basis that areas currently in Flood Zone 2 will be at greater risk in future owing to climate change.This makes the SFRA Flood Zone maps slightly different to the EA Flood Map for Planning. Neither takes into account the presence of defences. . Development proposals in combined SFRA Flood Zone 2/3(a) should generally be subjected to the Sequential Test, the overall aim of which is to steer new development to SFRA Flood Zone 1 (there are some exemptions, as discussed in Section 2). Only if there are no reasonably available sites in Flood Zone 1 should sites in combined SFRA Flood Zone 2/3(a) be considered. The Sequential Test will not normally be required for sites in SFRA Flood Zone 1 unless local drainage issues exist.

7.15 When applying the Sequential Test, development proposals should take into account the flood risk vulnerability of the land uses involved, as set out in Table 3.1. In general the more vulnerable uses should not be located in the SFRA Flood Zone 2/3(a), although this requirement may be relaxed in exceptional circumstances through the application of the Exception Test. The possibility that this could happen should not influence the outcome of the Sequential Test.

7.16 The Flood Hazard Maps included in the SFRA show the distribution of flood hazard if the defences protecting selected areas ('flood compartments') are breached. They may be used to steer new development to areas of lowest hazard when applying the Sequential Test to development proposals in these areas.

Step 2 – Is the proposal a change of use, minor development, replacement dwelling or housing renewal scheme?

7.17 The Sequential Test should be applied to all forms of development other than those listed below. Note that if the Exception Test is required this should be applied after the Sequential Test; the potential to pass the Exception Test does not remove the requirement to pass the Sequential Test beforehand.

7.18 Change of use Where no material operational development is proposed, a Change of Use application does not require a Sequential Test provided it does not involve use of land for caravans, camping, mobile homes or similar types of occupancy.

7.19 Minor development Minor development does not require either the Sequential Test or the Exception Test. Minor development is defined as:-

7.20 Minor non-residential extensions. Industrial/commercial/leisure etc. extensions with a footprint <250 m2 (noting that if a subsequent proposal makes the total area of all extensions > 250 m2 it will require a Sequential Test)

7.21 Alterations. Development that does not increase the size of buildings (e.g. alterations to external appearance)

7.22 Householder development. Sheds, garages, games rooms etc. within the curtilage of the existing dwelling as well as physical extensions to the existing dwelling (noting that any proposal to create a separate dwelling within the curtilage of the existing dwelling, e.g. sub-division of a house into flats, is excluded).

7.23 Sub-division of dwellings Although the sub-division of a house into flats is specifically excluded from the definition of minor development, where no significant external alterations are required it would be viewed as a Change of Use application and so a Sequential Test would not be required, provided after the sub-division all ground floor accommodation has permanent access to a place of safety as described in Appendix E. So the sub-division of a dwelling into two or more dwellings would not require a Sequential Test provided it does not involve significant external alterations/extensions and all ground floor accommodation has access to a higher floor that will act as a suitable refuge in time of flood. It may need to pass

the Exception Test, however, showing how it has been made safe through design and flood resistant and resilient construction and that it does not increase flood risk elsewhere.

7.24 Replacement dwellings These will not normally require a Sequential Test provided they do not expose people to an increase in flood risk and, in particular, do not:-

- Increase the number of bedrooms
- Replace houses having more than one floor with single-storey dwellings
- Increase the number of dwellings in an area of flood risk (i.e. by replacing a single dwelling with an apartment block)
- Does not increase the volume of building by more than 20% of the original
- Will not be placed at an unacceptable level of flood risk, irrespective of the risk posed to the existing dwelling.

7.25 They may need to pass the Exception Test, however, showing how they have been made safe through design and flood resistant and resilient construction and that they do not increase flood risk elsewhere.

7.26 The principles of replacement dwellings will also be applied to new applications on sites that have existing unimplemented permission (i.e. the permission is still live) and for applicants to renew existing residential permissions. For proposals on sites with lapse permission a Sequential Test will be required.

7.27 Developments partially within SFRA Flood Zone 2/3(a) A Sequential Test is not required where only a small part of the site is in SFRA Flood Zone 2/3(a) and that part will only be used for soft landscaping or access. In these circumstances the site-specific FRA will need to show clearly how emergency access would be gained in times of flood and how issues of 'islanding' would be dealt with.

Step 3 – Does the Sequential Test indicate that the development could be located in an area where the flood risk is lower than at the proposed site?

Who should apply the Sequential Test?

7.28 Although the council Officer determining a planning application will assess the Sequential Test, it is the responsibility of the applicant to supply all the information needed to do this. The Environment Agency will advise on site-specific FRAs but will not generally comment on the Sequential Test for smaller developments.

What is the Area of Search for Alternative sites?

7.29 Where there are large areas in Flood Zones 2 and 3, and development is needed in those areas to sustain the existing community, sites outside them would not be reasonable alternatives. It is therefore important to clarify the area of search at the pre-application stage. This will normally be the whole of the council area but in some places issues of national or regional policy may restrict the area that needs to be considered.

7.30 Where there are large areas in Flood Zones 2 and 3, and development is needed in those areas to sustain the existing community, sites outside them would not be reasonable alternatives. It is therefore important to clarify the area of search at the pre-application stage. This will normally be the whole of the council area but in some places issues of national or regional policy may restrict the area that needs to be considered.

Development with specific location requirements ?

7.31 Where a development proposal will be operationally linked to an existing building (including agriculture) the Sequential Test will only be applied to the land within which the operational link can be maintained. If the current development is located in SFRA Flood Zone 2/3a the applicant will still need to demonstrate (where necessary) that the Exception Test is passed.

What are Reasonably Available Sites?

7.32 Once it has been determined that a development requires a Sequential Test and the area of search has been identified, the next step is to determine if there is any reasonably available sites. It should be noted that a recent appeal decision stated that 'the fact that the appellant personally has no alternative sites within their ownership does not have a bearing on the application of the NPPF and NPPG in the public interest'. Where different uses are proposed on different parts of a site (e.g. employment on one part and housing on another, rather than a mixed use site) the Sequential Test should normally be applied to the different elements of the scheme individually. Specific advice on different types of development are provided in Development Plans and local guidance notes in both council areas.

Step 4 – In view of the type of development and the degree of flood risk, is an Exception Test required?

7.33 If the Sequential Test is passed (or is not required) the need for an Exception Test needs to be considered based on the Table overleaf. This is a combination of Tables D2 and D3 from NPPG, which should be referred to if further information or clarification is required.

Step 5 – Does the development meet all elements of the Exception Test?

7.34 If it is required, the Exception Test must address the following points:-

7.35 It must demonstrate that the development proposal provides wider sustainability benefits to the community that outweigh flood risk. The applicant is required to produce a Sustainability Statement or complete a Sustainability Checklist which will assess the development proposal against both council Core Strategy DPD Sustainability Appraisal Objectives

7.36 The FRA accompanying the planning application must show that the development will be safe without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.

7.37 Mitigation measures that may be employed to help make the development safe are described in Appendix F.

7.38 Table 7.2 below shows development which is allowed not allowed within each flood risk zone and whether an Exception Test is required or not.

Flood Risk Zone	Development Allowed	Development Not Allowed
1 Low Probability	All uses, subject to FRA – Essential infrastructure; Highly Vulnerable (e.g. hospitals, mobile home sites); More Vulnerable (e.g. dwellings, landfill sites); Less Vulnerable (e.g. general industrial, transport infrastructure); Water Compatible (e.g. water based recreation, amenity open space, docks, marinas and wharves). Exception Test not required.	No constraints due to river, tidal or coastal flooding
2/3(a) Medium or High Probability	Less Vulnerable, Water Compatible, subject to FRA. Exception Test needed for More Vulnerable and Essential Infrastructure.	Highly Vulnerable; More Vulnerable and Essential Infrastructure if Exception Test cannot be met or there are alternative sites in SFRA Flood Zone 1
3(b) Functional Floodplain	Water Compatible, subject to FRA. Exception Test needed for Essential Infrastructure.	Highly Vulnerable, More Vulnerable, Less Vulnerable; Essential Infrastructure if Exception Test cannot be met or there are alternative sites in SFRA Flood Zones 1 or 2/3(a)

Table 7.2 - Exception Test guide

Flood Risk Assessments accompanying planning applications

7.39 The NPPF requires that a site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

7.40 General guidance on the scope and content of a FRA is given in NPPF and NPPG on Flood Risk and Coastal Change and can be found at https://www.gov.uk/guidance/flood-risk-assessment-standing-advice. More detailed guidance can be obtained from the Environment Agency's Standing Advice. In principle every FRA should be appropriate to the scale and nature of the development and should address both:-

- The risk to the development itself, from whatever cause
- The risk to others, from whatever cause including surface or flood water from or displaced by the development.

7.41 The FRA will need to show that organisations affected by surface water draining from the development (e.g. the Internal Drainage Board, the Water Company or the council's Drainage Team) have been consulted on and agree with the proposals.

Applications not complying with these requirements will be refused.

7.42 To speed up the application process, pre-application discussions between developers and the Environment Agency (for flood risk issues) and the council's Drainage Team (for drainage issues) are encouraged. The procedure may be summarised as follows:-

Pre-application

- Initial inquiry for information on flood risk issues to the Environment Agency (EA), on drainage issues and surface water information to the council's Drainage Team (CDT). (Note- Surface water issues may have been addressed through works which have been carried out therefore contact the Local drainage team will provide the most up to date information) There may be charges from the EA for pre application discussions;
- Submission of draft section of FRA covering flood risk or drainage issues to EA or CDT as appropriate;
- Comments by EA/CDT (following site visits, meetings if appropriate);
- Submission of final section of FRA covering drainage issues to EA/CDT.
- Application
- Submission of planning application with FRA to planning authority;
- Planning authority consults with EA/CDT;
- EA/CDT considers all relevant issues and responds to planning authority.

Approvals and refusals of planning applications

7.43 The Local Planning Authorities are expected to approve the flood risk aspects of any planning applications falling within the green boxes of the matrix, provided it complies with the comments contained in the relevant box. They are also expected to refuse any applications that do not comply with this advice. The Environment Agency confirms it will support such decisions to the full. It should be noted that if a development proposal is satisfactory with regard to flood risk it may still be unacceptable to the Environment Agency with regard to other material considerations.

7.44 If the Local Planning Authority is considering granting planning permission contrary to the standing advice, the Environment Agency will be notified of the reasons for doing this and given an opportunity to make further representations.

Reservoir Development

7.45 The following sections provide some advice on what to consider in the two most common scenarios: development of a new reservoir and development downstream of or adjacent to an existing raised reservoir.

Development of a new reservoir

7.46 Anyone proposing the development of a new reservoir that will have an above ground capacity of 25,000m³ or more must consider the potential flood risk downstream of the new reservoir, in the event of dam failure leading to an uncontrolled release of water.

7.47 Developers will also need to provide the Environment Agency's Reservoir Safety Team with a notice of their intention under Section 21 of the Reservoirs Act, not less than 28 days before work on-site is due to start.

7.48 Applicants will also need to appoint a qualified civil engineer ('construction engineer') under Section 6 of the Reservoirs Act to design and supervise the construction work. Details of suitably qualified engineers can be found here It is recommended that developers complete a dam breach analysis and reservoir flood map, although this is not a requirement of the Reservoirs Act.

Development downstream of or adjacent to an existing reservoir

7.49 Reservoir Flood maps have been created have been created based upon simulated dam breach scenarios. Reservoir flood maps for large raised reservoir can be found here

7.50 Dam breach flooding happens when a dam impounding a reservoir breaches, causing water stored in the reservoir to be released through the breach and flooding areas downstream of the dam. The dam breach scenario simulated on the maps is a “credible worst case” scenario. This represents a “generic” dam failure that can be adopted across the country. But you need to bear in mind that there are many different potential dam failure scenarios which could also happen. The RFMs do not show the risk to individual properties of dam breach flooding, and they do not in any way reflect the structural integrity of the dam or the chance of it failing. The maps do not indicate or relate to any particular probability of dam breach flooding.

7.51 Reservoirs in England have an extremely good safety record. Since 1930, they have been protected by safety legislation (the Reservoirs Act 1975 and previously the Reservoirs (Safety Provisions) Act 1930), to ensure that they are inspected regularly and to reduce the risk of flooding. The structural failure or collapse of a dam or reservoir is very unlikely to happen. There has been no loss of life in the UK from reservoir failure since 1925.

7.52 An assessment of the risk of inundation from the reservoir must be submitted in support of any planning application (this will normally include the need for breach analysis). This should include not only the risks posed to the development but also if the development within the reservoir's flood extent could change its risk designation to high-risk.

7.53 Given the potential legal and cost implications of development downstream of a 'not high-risk' reservoir, it is also recommended that applicants notify the reservoir owner of the planning application.

Environmental Permitting Regulations

7.54 The Environmental Permitting (England and Wales) Regulations 2016 requires that if the development of the site involves any activity within specified distances of main rivers, a flood risk activity permit may be required in addition to planning permission. For non-tidal main rivers, a flood risk activity permit may be required if the development of the site is within 8 metres of a river, flood defence structure or culvert. For tidal main rivers, a flood risk activity permit may be required if the development of the site is within 16 metres of a river, flood defence structure or culvert. . For more information on Environment Permits please visit https://www.gov.uk/guidance/flood-risk-activities-environmental-permits

8 Appendix C North & North-East Lincolnshire Flood Risk Advice Matrix - Available Here

9 Appendix D Flood Risk Guidance for Each Area

Introduction

9.1 The planning guidance in this SFRA for developers and others preparing planning applications for submission to the North and North East Lincolnshire Planning Authorities relates finished floor levels and other features of development proposals to the critical flood level (CFL) at the proposed site, in order for developments to be safe in accordance with national planning guidance.

9.2 By CFL we mean the flood level on which mitigation measures should be based. This may be a flood level predicted as a product of flood risk modelling, appropriate site specific assessment or engineering judgement.

9.3 This appendix and the Flood Risk Advice Matrix set out in Appendix C show how the CFL and appropriate mitigation measures (finished floor levels, flood resilience etc) should be determined for each proposed development. Different approaches are used for different flood compartments as shown on the Interactive Map and in the matrix.

9.4 This SFRA Review updates the SFRA Flood Zones and approaches to CFLs for the various flood compartments.

9.5 This guidance supplements that available within the Planning Practice Guidance, Flood risk and coastal change section and on the Environment Agency's website.

A flood risk assessment (FRA) is required for all development proposals in SFRA Flood Zone 2/3 and for proposals in Flood Zone 1:

- involving sites of 1 hectare (ha) or more
- involving sites less of than 1ha that could be affected by sources of flooding other than rivers and the sea (for example surface water runoff, groundwater, reservoirs), where their development would introduce a more vulnerable use.

9.6 All FRAs should consider all potential sources of flood risk.

9.7 Surface water runoff from new development sites must be managed sustainably such that flood risk is not increased on site or elsewhere. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate.

Eastern Coastal Area

Coastal areas in North and North East Lincolnshire at tidal flood risk, covered by Environment Agency tidal hazard mapping - Compartments 1T1-5 and 2T1-3

9.8 Flood hazard modelling was carried out by the Environment Agency in 2009 for these compartments, with the resulting mapping published in 2010. This shows the consequences should a breach or overtopping of our defences occur, including the likely flood depths, velocities and overall hazard to the proposed site. Maps were produced for 'present day' (2006) and 'climate change' (2115) scenarios, and for the 0.5% annual probability and extreme 0.1% annual probability scenarios.

9.9 The Environment Agency is satisfied that these details (depth/velocity /hazard) remain valid and represent the best available information at the time of publication of this SFRA; however, they will be subject to review as new data becomes available.

9.10 Flood risk standing advice based on the breach mapping was included in the November 2011 SFRA. The standing advice has been updated in this SFRA to reflect changes in responsibilities over the intervening period (for example regarding surface water drainage proposal assessment). Minor amendments have also been made based on experience of applying the advice. The advice is set out on page 1 of the Flood Risk Advice Matrix. Mitigation requirements are determined by the flood depth for the site shown on the breach mapping for 2115 scenario (0.5% annual probability event unless otherwise advised.)

9.11 As, or if, the data is superseded, the matrix will be amended accordingly.

9.12 It is recommended that those preparing FRAs obtain site specific extracts of the hazard mapping from the Environment Agency to inform the FRA.

North East Lincolnshire areas at fluvial risk – Compartments 1F1-5

9.13 Local Standing Advice has not been produced for these areas due to the complexity of issues needing to be considered when assessing the impacts of fluvial flooding. The Environment Agency does have modelled data on all of the main rivers in North East Lincolnshire which can be obtained and used in a site specific FRA to assess the risks to and from the development site.

Trent Valley Area

Isle of Axholme, Keadby and adjacent areas – Compartments 3F2, 3F4, 3F5, 3F6

9.14 The November 2011 SFRA recommended a critical flood level of 4.1mAOD for all sites in these compartments providing they were not within 500m of the River Trent. This was an estimated based on engineering judgement due to a lack of hydraulically modelled data being available, with a conservative approach applied. The Isle of Axholme is a large basin which relies heavily on a pumped regime to manage and maintain water levels, thus protecting thousands of properties. The main sources of flood risk associated within the Isle of Axholme (IoA) include overtopping and/or breach of the Tidal River Trent defences, the tidal influence from the Humber estuary, overtopping and breach of the defences on the Lower River Don and pump failure in the extensive inland pumped drainage networks such as the Three Rivers, which were all assessed by the Environment Agency as part of the IoA Strategy.

9.15 Since the CFL of 4.1mAOD (with a 300mm of freeboard added to take finished floor levels to 4.4mAOD) was set back in 2011 the EA now has better understanding of risks as a consequence of new modelling including the Tidal River Trent Modelling, River Torne modelling and wider Isle of Axholme modelling.

9.16 The Environment Agency has reviewed all new data available and shared this with North Lincolnshire Council. As a result the Council proposes amending the CFL to 3.8m AOD, with finished floor levels of residential development being set 300mm above this. The Environment Agency support this approach.

9.17 However, this approach alone is not sufficient for development proposals within 500m of the River Trent defences. Applications should be accompanied by a site specific FRA appropriate to the scale and nature of the proposals, showing they will not be adversely affected by rapid flowing water from a potential breach. The Environment Agency has carried out flood risk modelling of the Trent and can supply a range of data to inform the assessment. Additional breach assessment and/or consideration of more recent climate change allowance guidance may be required depending on the location, scale and nature of the proposed development. Residential development in this area is not encouraged by North Lincolnshire Council.

Lincolnshire Lakes Area Action Plan Area – Compartment 3T3

9.18 The Lincolnshire Lakes Area Action Plan has been prepared and was adopted by North Lincolnshire Council in May 2016. A Level 2 Assessment is being completed for this area, which is due to be published in 2022. This provides the information needed to derive a critical flood level for developments in the area. Potential flood levels were modelled in proximity to each proposed 'village' based on a range of scenarios. The figures and advice in the FRA should be used to determine appropriate mitigation levels and types for all forms of development within the site area, depending on flood risk vulnerability classification (see the Flood Risk Response Advice Matrix in Appendix C).

Alkborough (Humber estuary) – Compartment 3T1

9.19 The village of Alkborough lies directly east of the Alkborough Flats flood alleviation area and does benefit from EA maintained flood defences offering a 1 in 200 year standard of

protection. Alkborough Flats is an area designated to accommodate flood water from the river Trent and the Humber Estuary and thus considered Flood Zone 3b. In this compartment a Level 1 Assessment only has been carried out. Applicants should contact the Environment Agency if considering any development in this compartment. The main settlement lies fully within flood zone 1.

Other areas – Compartments 3F1, 3F3, 3T2

9.20 In these compartments a Level 1 Assessment only has been carried out and no significant development is envisaged. Where development is proposed, the critical flood level should be determined through a site specific flood risk assessment (FRA). Flood risk product data should be obtained from the Environment Agency to inform this.

Ancholme Valley Area

Brigg and Ancholme catchment - Compartments 2F1, 2F2, 2F3, 2F4, 2F5

9.21 The critical flood level should be determined through a site specific flood risk assessment (FRA). Flood risk product data should be obtained from the Environment Agency to inform this.

9.22 For Brigg, a critical flood level of 2.7m AOD has been agreed with the Environment Agency based on previous site specific assessment and understanding of the hydrology of the area. 300mm 'freeboard' should be applied for residential development, giving a finished floor level of 3.0m AOD. A lower level may be appropriate in locations away from the centre of Brigg, subject to the findings of a detailed FRA.

Environment Agency Standing Advice

9.23 In view of the particular development and flood risk issues in North and North East Lincolnshire, the Environment Agency has developed and a local Flood Risk Advice Matrix, agreed with the Councils. This advises developers on data and information to be used in assessing risk (as set out in the previous section) and on mitigation requirements, depending on location, scale and vulnerability of development.

9.24 The advice is more detailed for the Eastern Coastal areas covered by the Environment Agency hazard mapping, where this should be used to inform mitigation, reducing the need for site specific analysis.

9.25 The matrix should be used when preparing any planning application that is to be submitted to North or North-East Lincolnshire Planning Authorities.

9.26 The matrix also indicates where the Authorities should assess individual applications against the advice (green cells), and where they should continue to consult the Environment Agency (red cells).

9.27 Note that although development falling within the green cells can be decided without reference to the Environment Agency on flood risk grounds, consultation may still be required in relation to other environmental issues.

9.28 The Matrix is included as Appendix C (Available Here)

Environment Agency contacts for flood risk product requests and advice

9.29 For flood risk products for sites in the Lincolnshire and Northamptonshire Water Management Area (SFRA Eastern Coastal and Ancholme compartments) please email: lnenquiries@environment-agency.gov.uk.

9.30 For flood risk products for sites in East Midlands Area (SFRA Trent compartments) please email: EMDenquiries@environment-agency.gov.uk.

9.31 For pre-application advice for all development proposals please email: lnplanning@environment-agency.gov.uk. Preliminary advice is free of charge; additional

detailed advice, meetings and review of draft FRAs can be arranged through the discretionary cost-recovered service.

Approvals and refusals of planning applications

9.32 The Local Planning Authorities are expected to approve the flood risk aspects of any planning applications falling within the green boxes of the matrix, provided they comply with the comments contained in the relevant box. They are also expected to refuse any applications that do not comply with this advice, unless appropriate amendments are submitted. The Environment Agency confirms it will support such decisions to the full. It should be noted that if a development proposal is satisfactory with regard to flood risk it may still be unacceptable to the Environment Agency with regard to other material considerations.

9.33 If the Local Planning Authority is considering granting planning permission contrary to the standing advice, the Environment Agency will be notified of the reasons for doing this and given an opportunity to make further representations.

10 Appendix E Flood Resistance and resilience measures

10.1 Developers are also advised to refer to the DCLG document 'Improving the flood performance of new buildings: flood resilient construction'. This document aims to provide guidance to developers and designers on how to improve the resilience of new properties in low or residual flood risk areas by the use of suitable materials and construction details. These approaches are appropriate for areas where the probability of flooding is low (e.g Flood Zone 1) or areas where flood risk management or mitigation measures have been put in place.

11 Appendix F Ancholme Valley Flood Compartments

11.1 Please note this section has not been updated in the review due to the level of detail therefore the information is based on 2011. The current best available information/up to date datasets can be requested from the Environment Agency, please email: lnenquiries@environment-agency.gov.uk

General Description Of Area

Location, extent and development potential

11.2 The Ancholme Valley Area stretches from the high ground outcropping at South Ferriby Cliff, west of Barton-upon Humber, to the high ground at Whitton and south as far as Waddingham in the Ancholme Valley. The shoreline of the Humber Estuary forms the northern boundary while the NLC boundary forms the southern boundary. The watersheds dividing the River Ancholme catchment from the catchments draining east to the estuary and from the River Trent catchment act as the eastern and western boundaries respectively.

11.3 The main centres of population in the area are Winterton, Broughton and Brigg. Winterton and Broughton are both on high ground well above the floodplain but much of Brigg is in the bottom of the Ancholme Valley, about 14 km from its outfall at South Ferriby on the Humber. A number of villages (or parts of them) also lie within the floodplain, including Winteringham, South Ferriby, Wrawby and Hibaldstow. There are some industrial and commercial facilities at Brigg and cement works at South Ferriby. The remainder of the area is largely devoted to agriculture.

11.4 North Lincolnshire Council's Local Plan, published for consultation in September 2000, identified a number of potential sites for development in Brigg. The Environment Agency advised that it would object to any development in the floodplain and the council therefore appointed WS Atkins Ltd to carry out a Strategic Flood Risk Assessment in preparation for the Local Plan Inquiry. The council modified its proposals in the light of this assessment and the Inspector accepted the revised proposals in his report dated January 2003.

Main sources of flood risk

11.5 There are two main sources of flood risk in the River Ancholme area, a combination of large waves and high water levels in the Humber Estuary and high river flows in the River Ancholme.

11.6 There are two sections of fluvial floodplain within the area, a relatively small one associated with the Winterton Beck that discharges to the estuary at Winteringham Haven, and the main one associated with the River Ancholme that has a gated outfall at South Ferriby. Both sections contain complex drainage systems that are managed by the Ancholme IDB.

11.7 There are twenty-one main river watercourses within the area, as listed in Table I.2 and shown on Map 9. Throughout the study area the River Ancholme is embanked and acts as a highland carrier (carrying drainage flows from high ground further upstream at levels that are above the local ground level). Two separate main river watercourse systems (for the left and right bank respectively) drain the low-lying land beside the lower reaches of the river to the estuary, again discharging through gated outfalls at South Ferriby. Further upstream more highland carriers drain the uplands on either side of the Ancholme Valley, receiving gravity or pumped flows from the IDB drainage system and discharging them to the River Ancholme. They are all classified as main river watercourses.

11.8 Four watercourses lying within the River Ancholme Area are classified as OWs. They are listed in Table 11.1, lie within the tidal or fluvial floodplain, as currently defined, are managed by the Ancholme IDB and are shown on the interactive map

Ref No	Name of watercourse	Watercourse type	Discharging to
M1	East Drain Lower	Highland carrier	Humber Estuary
M2	Land Drain	Highland carrier	East Drain Lower
M3	Bonby Catchwater	Highland carrier	Land Drain
M4	Worlaby Catchwater	Highland carrier	Land Drain
M5	Little Carr Drain	Floodplain drain	Land Drain
M6	Wrawby Catchwater	Floodplain drain	Land Drain
M7	West Drain	Floodplain drain	Humber Estuary
M8	Appleby Mill Beck	Floodplain drain	West Drain
M9	Ella & Moor Beck	Floodplain drain	West Drain
M10	New River Ancholme	Highland carrier	Humber Estuary
M11	Spring Dyke	Highland carrier	New River Ancholme
M12	Scawby Catchwater	Highland carrier	New River Ancholme
M13	Hibaldstow Catchwater	Highland carrier	New River Ancholme
M14	Hibaldstow North Drain	Floodplain drain	Hibaldstow Catchwater
M15	Redbourne Old River	Highland carrier	New River Ancholme
M16	Redbourne Catchwater	Highland carrier	Redbourne Old River
M17	Sallow Row Drain	Highland carrier	New River Ancholme
M18	North Kelsey & Grasby Beck	Highland carrier	New River Ancholme
M19	Froghall Drain	Floodplain drain	Kettleby Beck
M20	Kettleby Beck	Highland carrier	New River Ancholme
M21	Winterton Beck	Floodplain drain	Humber Estuary

Table 11.1 Main river watercourses; Ancholme Valley Area

Ref No	Name of watercourse	Watercourse type	Discharging to
S1	Fullseas & Marsh Drains	Gravity outfall	Humber Estuary
S2	West Drain (IDB)	Pumped outfall	New River Ancholme
S3	Island Carr North	Pumped outfall	New River Ancholme
S4	Scawby Brook	Gravity outfall	New River Ancholme

Table 11.2 Ordinary Watercourses (OWs); Ancholme Valley Area

11.9 The responsibility for draining all the low-lying land within the River Ancholme area lies with the Ancholme IDB. Its drainage system is complex and, except near the estuary, much of it is pumped. The areas near the estuary are currently drained by gravity but siltation at the outfalls is becoming a serious problem and the IDB considers in due course most of them will need to be pumped. The IDB boundaries and pumping stations are shown on the Interactive Map 9 and the pumping stations are listed in Table 11.3.

11.10 The IDB aims to provide a standard of between 10% and 5% annual probability of occurrence (1:10 and 1:20 years return period) for agricultural land throughout the system but this includes a freeboard of at least 1m below local ground level (to prevent the land from being waterlogged). As a result the standard provided to property (which is not affected by flooding until the water level rises above local ground level) is generally in the range 2.0% and 1.0% annual probability (1:50 to 1:100 years return period). The IDB has to approve the drainage arrangements of all significant new development within its boundaries or affecting its watercourses. In principle the site runoff characteristics should remain unchanged, although

the IDB may accept the receiving drainage system being improved so it can accept the increased discharge, at the developer's expense. It is understood that the design standard for these improvements is the event having a 1.0% annual probability of occurrence.

Ref No	Pumping Station	Discharging to
P1	Appleby	New River Ancholme
P2	Broughton	New River Ancholme
P3	Hibaldstow	New River Ancholme
P4	Redbourne Hayes	New River Ancholme
P5	North Kelsey	New River Ancholme
P6	Thirty Foot	New River Ancholme
P7	Cadney	New River Ancholme
P8	Candley	Froghall Drain
P9	Bently	New River Ancholme
P10	Island Carr	New River Ancholme
P11	Worlaby	New River Ancholme

Table 11.3 - Drainage pumping stations; Ancholme Valley Area

Flood compartments

11.11 To allow more detailed assessment, the area shown as Flood Zone 3 on Flood Risk Map 2 has been divided into flood compartments taking into account the topography, type of defence, drainage arrangements and land use. These compartments are shown on the interactive map and listed in Table 11.4 with the sources of flood risk they include. Further information about each compartment is given the following sections.

Compartment reference	Compartment name	Sources of flood risk
2T1	South Ferriby (East)	Humber Estuary New River Ancholme East Drain Lower Fulseas & Marsh Drains
2T2	South Ferriby (West)	Humber Estuary New River Ancholme West Drain
2T3	Winterton	Humber Estuary Winterton Beck
2F1	Lower Ancholme Right Bank	New River Ancholme Land Drain Bonby Catchwater Worlaby Catchwater Little Carr Drain Wrawby Catchwater Humber Estuary
2F2	Lower Ancholme Left Bank	New River Ancholme West Drain Appleby Mill Beck Ella & Moor Beck Spring Dyke West Drain (IDB) Humber Estuary
2F3	Island Carr	Island Carr North
2F4	Middle Ancholme Right Bank	New River Ancholme North Kelsey & Grasby Beck Froghall Drain Kettleby Beck
2F5	Middle Ancholme Left Bank	New River Ancholme Castlethorpe Drain Scawby Catchwater Hibaldstow Catchwater Hibaldstow North Drain Redbourne Old River Redbourne Catchwater Sallow Row drain Scawby Brook

Table 11.4 - Flood compartments; Ancholme Valley Area

Note:- The reference prefix denotes the primary source of flood risk in the compartment; T = Tidal;
F = Fluvial,
although note that all compartments north of Brigg are at risk from both tidal and fluvial flooding

Tidal Flood Compartments

2T1: South Ferriby (East)

Description of site

11.12 This compartment is about 2.5 km long and 1.5 km wide at its widest point. Its estuary frontage runs from high ground at South Ferriby Cliff to the outfall of the River Ancholme at Ferriby Sluice. From the estuary it extends south to a low ridge of land that LIDAR maps produced by the Environment Agency show running east-west between the New Ancholme River, which forms the western boundary, and high ground to the east. It is assumed that this ridge would limit flooding from the estuary extending further south. Ground levels in the area indicate that some of the land is below +2.0 mOD.

11.13 The compartment contains low-lying properties in South Ferriby and a section of the A1077, connecting Scunthorpe and Barton-upon Humber. Otherwise, the land is devoted to agriculture.

Sources of flood risk

11.14 The primary source of flood risk to this compartment is a combination of large waves and high water levels in the Humber Estuary. Table 6.6 lists selected combinations having a 0.5% annual probability of occurrence and shows the highest water level at South Ferriby as +5.52 mOD (with a base date of 1991). Current guidance suggests sea levels could rise by 1.201m and wave heights increase by 10% by 2115.

11.15 In addition to this tidal source there are three fluvial sources of flood risk, the New River Ancholme itself, the East Drain Lower and the Fulseas & Marsh Drain (which is a SOW managed by the Ancholme IDB). The New River Ancholme is embanked along part of its length within the compartment, carries water draining from land south of Brigg and discharges by gravity through Ferriby Sluice. The East Drain Lower is also embanked and drains the low-lying land north of Brigg. It also receives drainage flows from the escarpment edge. In this compartment it runs beside the River Ancholme and discharges through a tidal sluice beside Ferriby Sluice. The Fulseas & Marsh Drain carries water from land within the compartment and discharges to the estuary by gravity through a sluice at South Ferriby, the outfall channel of which currently suffers from siltation.

11.16 The Environment Agency's studies of the River Ancholme system have concentrated on conditions at Brigg and further upstream, where they suggest that the existing defences provide a standard of between 1:10 years and 1:20 years (i.e. 10% to 5% annual probability of flooding). The standard provided below Brigg is difficult to assess since it will depend on what happens above the town; if the upstream defences fail the land there will flood reducing the risk further downstream. If they do not fail, however, the flooding will be transferred downstream. Overall, the annual probability of flooding downstream of Brigg probably lies between 10% and 2.0%, which is significantly below the 1.0% limit required by NPPG. The East Drain Lower was modelled in 2009 as part of the Grimsby and Ancholme Flood Map Improvements Study.

11.17 The Fulseas & Marsh Drain is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

11.18 The estuary flood defences consist of a combination of earth embankments and brick walls with crest levels varying between +5.3 and +6.3 mOD. They are generally in good condition (Grade 2) although some relatively short lengths are in fair or poor condition (Grades 3 and 4 respectively). Parts of the defence are sufficiently high to prevent overtopping during events with a 0.5% annual probability, as required by NPPF/NPPG Flood Risk and Coastal Change, but significant lengths are not and in places overtopping could occur during an event with less than 10% annual probability of occurring.

11.19 The New River Ancholme provides a standard of protection that is well below the 1.0% annual probability of occurring required by NPPG Flood Risk and Coastal Change. The banks are generally revetted and about 25% of the revetment is in good condition (Grade 2) but the remainder is poor (Grade 4) or worse. The East Drain Lower embankments are in fair condition (Grade 3) or better.

11.20 A Tidal Flood Alleviation Scheme (FAS) is being delivered by the Environment Agency and North Lincolnshire Council in partnership to better protect circa 160 properties, local businesses and CEMEX within the settlement of South Ferriby. This is being achieved by creating a new front line flood defence, cross bank around CEMEX and new flood barriers across the highway to provide a resilient 0.5% AEP flood defence following the tidal surge in December 2013. It is anticipated to be completed by 2021.

2T2: South Ferriby (West)

Description of site

11.21 The estuary frontage of this compartment extends from the outfall of the River Ancholme at Ferriby Sluice to the outfall of the Winterton Beck at Winteringham Haven, a distance of about 5 km. From the estuary it extends south about 3 km along the Ancholme Valley to the ridge of higher ground running from Maltby Farm to the New Ancholme River, which forms the compartment's eastern boundary. This ridge is assumed to limit flooding from the estuary extending further south. Ground levels in the area indicate that some of the land is below +2.0 mOD.

11.22 The compartment contains a cement works at Ferriby Sluice and some isolated farm buildings together with a section of the A1077, connecting Scunthorpe and Barton-upon Humber. The remaining land is devoted to agriculture.

Sources of flood risk

11.23 The primary source of flood risk to this compartment is a combination of large waves and high water levels in the Humber Estuary. Table 6.6 lists selected combinations having a 0.5% annual probability of occurrence and shows the highest water level at South Ferriby as +5.52 mOD (with a base date of 1991). Current guidance suggests sea levels could rise by 1.201m and wave heights increase by 10% by 2115.

11.24 In addition to this tidal source there are three fluvial sources of flood risk, the New River Ancholme itself, the West Drain and the Winterton Beck. The New River Ancholme is embanked along part of its length within the compartment, carries water draining from land south of Brigg and discharges by gravity through Ferriby Sluice. The West Drain carries drainage flows from low-lying land west of the River Ancholme and north of Brigg. It discharges through a tidal sluice beside Ferriby Sluice. The Winterton Beck carries drainage flows from the Winterton Valley, which extends south as far as the north-eastern part of Scunthorpe.

11.25 The Environment Agency's studies of the River Ancholme system have concentrated on conditions at Brigg and further upstream, where they suggest that the existing defences provide a standard of between 1:10 years and 1:20 years (i.e. 10% to 5% annual probability of flooding). The standard provided below Brigg is difficult to assess since it will depend on what happens above the town; if the upstream defences fail the land there will flood reducing the risk further downstream. If they do not fail, however, the flooding will be transferred downstream. Overall, the annual probability of flooding downstream of Brigg probably lies between 10% and 2.0%, which is significantly below the 1.0% limit required by NPPG. The West Drain and the Winterton Beck were modelled in 2009 as part of the Grimsby and Ancholme Flood Map Improvements Study.

11.26 The Ancholme IDB drainage system currently discharges by gravity, either to the West Drain or directly to the estuary. The system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

11.27 The estuary flood defences consist of earth embankments with crest levels varying between +5.5 and +6.2 mOD. The embankments are generally in fair to good condition (Grade 3 to 2) but there has been significant erosion at the toe opposite the western end of Read's Island. (refer also to the update under 'Existing Defences' covered under Flood Compartment 2T1). Toe piling has been installed but is being undermined and further measures will be required in the near future. Parts of the defence are sufficiently high to prevent overtopping during events with a 0.5% annual probability, as required by , NPPF/NPPG but significant lengths are not and in places overtopping could occur during an event with less than 10% annual probability of occurring.

11.28 The New River Ancholme provides a standard of protection that is well below the 1.0% annual probability of occurring required by NPPG Flood Risk and Coastal Change. The banks are generally revetted and about 25% of the revetment is in good condition (Grade 2) but the remainder is poor (Grade 4) or worse.

2T3: Winterton

Description of site

11.29 This compartment is about 4 km wide and extends up the valley of the Winterton Beck for a distance of about 7 km. Its estuary frontage runs from Winteringham Haven to Whitton, where high ground reaches the shoreline. Ground levels in the area indicate that the land is generally at about +4.0 mOD.

11.30 The lower parts of the villages of Whitton and Winteringham lie within the compartment, as do a number of isolated farm buildings. The remaining land is devoted to agriculture.

Sources of flood risk

11.31 The primary source of flood risk to this compartment is a combination of large waves and high water levels in the Humber Estuary. Table 6.6 lists selected combinations having a 0.5% annual probability of occurrence and shows the highest water level at Whitton as +5.54 mOD (with a base date of 1991). Current guidance suggests sea levels could rise by 1.201m and wave heights increase by 10% by 2115.

11.32 There is in addition one fluvial source of flood risk, the Winterton Beck, which carries drainage flows from the north-eastern part of Scunthorpe. There has been major landscaping work in this area, making it difficult to identify the watershed between the vallies of the Winterton Beck and the Bottesford Beck, which drains to the River Trent. For the purposes of this study the watershed has been taken as the A1077.

11.33 The Winterton Beck was modelled in 2009 as part of the Grimsby and Ancholme Flood Map Improvements Study and updated modelling was completed in 2019. The Ancholme IDB drainage system currently discharges by gravity, either to the Winterton Beck or directly to the estuary near Whitton Ness. The IDB has applied for grant aid to build a pumping station at the Whitton outfall. The system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

11.34 The estuary flood defences consist of earth embankments with crest levels varying between +6.1 and +6.9 mOD. The embankments are generally in good condition (Grade 2). Although most of the defences are sufficiently high to prevent overtopping during events with a 1.0% annual probability of occurrence they do not achieve the 0.5% annual probability required by NPPG Flood Risk and Coastal Change for tidal defences.

Fluvial Flood Compartments

2F1: Lower Ancholme Right Bank

Description of site

11.35 This compartment extends from the landward boundary of Compartment 2T1 southwards as far as the town of Brigg, a distance of some 11.5 km. The New River Ancholme forms the western boundary. Ground levels in the area indicate that in places the land is below +1.0 mOD.

11.36 The M180 motorway crosses the compartment north of Brigg and forms the northern limit of NLC's development boundary for the town. The majority of the land within the compartment south of this limit is either already developed or has been scheduled for development in the NLC Local Plan. Land north of the motorway contains isolated farm buildings and is devoted to agriculture.

Sources of flood risk

11.37 The main sources of flood risk in this compartment are the New River Ancholme, which carries water draining from land south of Brigg, and the local drainage system on the right bank of the river, although there is also a risk of tidal flooding from the Humber Estuary. This system includes 5 lengths of main river, the Land Drain (which is the primary drain, into which the others discharge, and carries the flow to the estuary at South Ferriby) and the Bonby Catchwater, Worlaby Catchwater, Little Carr Drain and Wrawby Catchwater (each draining a sub-area of the compartment). The Land Drain and the Bonby and Worlaby Catchwaters are embanked over at least part of their length and act as high-level carriers.

11.38 The Environment Agency 's 2009 study of the River Ancholme system suggests that the existing defences at Brigg and further upstream provide a standard of between 1:10 years and 1:20 years (i.e. 10% to 5% annual probability of flooding). The study also indicates that the 1:100 years peak water level (1.0% annual probability of flooding) through Brigg is +2.64 mOD. The standard provided below Brigg is difficult to assess since it will depend on what happens above the town; if the upstream defences fail the land there will flood reducing the risk further downstream. If they do not fail, however, the flooding will be transferred downstream. Overall, the annual probability of flooding downstream of Brigg probably lies between 10% and 2.0%, which is significantly below the 1.0% limit required by NPPF/NPPG Flood Risk and Coastal Change – Flood Zone and Flood Risk Tables (Note 25) No assessment of the risk from the Land Drain and its tributaries has been made recently.

11.39 Some of the Ancholme IDB drainage system discharges to the Land Drain (or a tributary) by gravity but much of it is pumped to the New River Ancholme. The system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

11.40 Downstream of the M180 motorway bridge the New Ancholme River is partly embanked and these embankments are generally in good condition (Grade 2). The embankments to the Land Drain and the Bonby and Worlaby Catchwaters are also generally in good condition, with some lengths in fair condition (Grade 3).

11.41 The condition and standard of the defences within the compartment at Brigg (upstream of the motorway bridge) has been assessed by W S Atkins1as part of their flood risk assessment for the NLC Local Plan Inquiry. They determined that the defences along the New Ancholme River are in good to fair condition (Grades 2 and 3) and will contain a water level of +2.8 mOD in the river with adequate freeboard. They also undertook a breach analysis of the land south of the motorway bridge and confirmed that the depth of flooding will not exceed 0.23m and the peak flow velocity will not exceed 0.26 m/s.

2F2: Lower Ancholme Left Bank

Description of site

11.42 This compartment extends from the landward boundary of Compartment 2T2 southwards as far as the A18 road (Bridge Street) by the town of Brigg, a distance of some 11.5 km. The New River Ancholme forms the eastern boundary. Ground levels in the area indicate that in places the land is below +1.0 mOD.

11.43 The M180 motorway crosses the compartment about 1 km north of the A18. The NLC Local Plan shows an area about 500 m by 150 m between the two roads, of which part has already been developed and the remainder is allocated for development. The rest of the compartment contains only isolated farm buildings and is devoted to agriculture.

Sources of flood risk

11.44 The main sources of flood risk in this compartment are the New River Ancholme, which carries water draining from land south of Brigg, and the local drainage system on the left bank of the river, although there is also a risk of tidal flooding from the Humber Estuary. This system includes 3 lengths of main river, the West Drain, Appleby Mill Beck and Ella & Moor Beck. The West Drain is the primary watercourse and carries the flow to the estuary at South Ferriby. The other two watercourses discharge to the West Drain. There is also a short length of main river, the Spring Dyke, which lies between the M180 and the A18 and drains to the New Ancholme River by gravity.

11.45 The Environment Agency's 2009 study of the River Ancholme system suggests that the existing defences at Brigg and further upstream provide a standard of between 1:10 years and 1:20 years (i.e. 10% to 5% annual probability of flooding). The study also indicates that the 1:100 years peak water level (1.0% annual probability of flooding) through Brigg is +2.64 mOD. Updated modelling is due in 2020.The standard provided below Brigg is difficult to assess since it will depend on what happens above the town; if the upstream defences fail the land there will flood reducing the risk further downstream. If they do not fail, however, the flooding will be transferred downstream. Overall, the annual probability of flooding downstream of Brigg probably lies between 10% and 2.0%, which is significantly above the 1.0% limit required by NPPF/NPPG Flood Risk and Coastal Change. The West Drain and its tributaries were modelled in 2009 as part of the Grimsby and Ancholme Flood Map Improvements Study.

11.46 Some of the Ancholme IDB drainage system discharges to the Land Drain (or a tributary) by gravity but much of it is pumped to the New River Ancholme, through either the Broughton or the Appleby Pumping Stations. The system is understood to be capable of accommodating the 2.0% annual probability even if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

11.47 Downstream of the M180 motorway bridge the New Ancholme River is partly embanked and these embankments are generally in good condition (Grade 2). The other main river watercourses contain only short lengths of embankment, most of which are in fair condition (Grade 3).

11.48 The condition and standard of the defences within the compartment upstream of the motorway bridge has been assessed by W S Atkins (2000 flood risk study) as part of their flood risk assessment for the NLC Local Plan Inquiry. They determined that the defences along the New Ancholme River are in good to fair condition (Grades 2 and 3) but do not consistently meet the 1.0% annual probability flood level in the river of +2.8 mOD with adequate freeboard.

2F3: Island Carr

Description of site

11.49 This compartment is the island on the western side of Brigg that lies between the channels of the New and the Old River Ancholme. It is approximately 1 km long and 0.5 km wide at its widest point. Ground levels in the area indicate that in places the land is below +2.0 mOD.

11.50 The northern part of the compartment lies within the NLC's development boundary for Brigg. Much of this area is already developed, mainly for industrial purposes, and the NLC Local Plan shows a relatively small area close to the A18 allocated for housing and a larger area allocated for mixed use development. The southern part of the compartment (which is crossed by the Gainsborough to Grimsby railway line) is devoted to agriculture.

Sources of flood risk

11.51 The main sources of flood risk in this compartment are the two River Ancholme channels. The Environment Agency's studies indicate that the 1:100 years peak water level (1.0% annual probability of occurrence) through Brigg is +2.64 mOD.

11.52 Drainage from the compartment is difficult. The northern part is pumped to the Old River Ancholme through the Ancholme IDB's Island Carr pumping station but the southern part of the site relies on drainage by gravity.

Existing defences

11.53 The condition and standard of the compartment's defences has been assessed by W S Atkins as part of their flood risk assessment for the NLC Local Plan Inquiry. They determined that the defences along the New Ancholme River are in good to fair condition (Grades 2 and 3) and do consistently meet the 1.0% annual probability flood level in the river of +2.8m AOD with adequate freeboard. There are multiple defences protecting the compartment, however, and these defences are not consistent in either form or type. As a result the possibility of failure is higher than would be the case with a uniform defence system.

2F4: Middle Ancholme (Right Bank)

Description of site

11.54 This compartment lies south of Brigg and east of the New River Ancholme and is limited partly by topography and partly by the NLC boundaries. As a result, although the compartment is hydraulically a single unit, a strip of land across it falls within Lindsey District council. This strip divides the area within the NLC boundaries into two parts, a small one on the town's outskirts and a considerably larger one further south.

11.55 The boundaries of the small area by the town are the Old River Ancholme, the NLC boundary and high ground at the edge of Flood Zone 3. The northern boundary of the larger area further south is the Kettleby Beck, its eastern boundary is the Kettleby Beck and the Sear by & Howsham Drain (operated by the Ancholme IDB) and its southern boundary is the North Kelsey Beck. Its western boundary is the New River Ancholme. There is, however, a significant area of high ground within these boundaries that is not at risk of flooding (i.e. lies within Flood Zone 1) and is therefore excluded from the assessment.

11.56 The smaller area is about 0.5 km by 1 km and is partly urbanised. Although some of it lies within the NLC's development boundary for Brigg the Local Plan shows no sites allocated for development within it. The larger area is about 3 km by 6 km, is used for agriculture and contains isolated farm buildings. Ground levels in the area indicate that in places close to the River Ancholme the land is below +2.0 mOD.

Sources of flood risk

11.57 The main sources of flood risk in this compartment are the New River Ancholme, which is embanked and carries water from further south, and the local drainage system. This includes two main river watercourse systems, the Kettleby Beck with its tributary the Froghall Drain,

and the North Kelsey & Grasby Beck. Both of these systems are embanked in their lower reaches and act as high-level carriers, discharging to the New River Ancholme by gravity.

11.58 The Environment Agency's studies of the River Ancholme system suggest that the 1:100 years peak water level (1.0% annual probability of flooding) through Brigg is +2.64 mOD. The studies also indicate that upstream of Brigg the existing defences provide a standard of between 1:10 years and 1:20 years (i.e. 10% to 5% annual probability of occurrence). The Kettleby and the North Kelsey & Grasby Becks were modelled in 2009 as part of the Grimsby and Ancholme Flood Map Improvements Study.

11.59 Some of the Ancholme IDB drainage system discharges by gravity to the upper reaches of the two becks but the remainder is pumped, either to the Kettleby Beck or to the New River Ancholme. The system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

11.60 The New and Old Ancholme river defences within the compartment and standard of the compartment's defences are generally in good to fair condition (Grades 2 and 3), although some toe boarding is noted as being in poor condition (Grade 4). The defences to the Kettleby and North Kelsey & Grasby Becks are generally in mixed condition, with some lengths good (Grade 2) and some fair (Grade 3).

2F5: Middle Ancholme (Left Bank)

Description of site

11.61 This compartment lies south of Brigg and west of the New River Ancholme. Its northern boundary is the A18 road (Bridge Street) by Brigg and its southern boundary is the NLC's southern border, which here follows the Sallow Row Drain. Hydraulically, its eastern boundary is the New River Ancholme but for convenience it is taken as the Old River Ancholme south of the North Kelsey Beck outfall, since this is also the NLC boundary there. The western boundary is the Zone 2 boundary shown on the Environment Agency's Flood Maps. The compartment is about 8.5 km long and 3.5 km wide at its widest point.

11.62 The Gainsborough to Grimsby railway line crosses the compartment about 1 km south of its northern end. This marks the southern limit of the NLC's development boundary for Brigg, although the Local Plan shows no sites allocated for development in this area (which already includes some industry and housing). Further south the land is used for agriculture and, apart from the village of Hibaldstow, contains only isolated farm buildings. Ground levels in the area indicate that much of the land close to the River Ancholme is below +2.0 mOD.

Sources of flood risk

11.63 The main sources of flood risk in this compartment are the New River Ancholme, which is embanked and carries water from further south, and the local drainage system. This includes four main river watercourse systems, the Scawby Catchwater, the Hibaldstow Catchwater and its tributary the Hibaldstow North Drain, the Redbourne Old River and its tributary the Redbourne Catchwater, and the Sallow Row Drain. These systems are all embanked in their lower reaches and act as high level carriers, discharging to the New River Ancholme by gravity. The Scawby Brook, a SOW managed by the Ancholme IDB, also discharges to the New River Ancholme by gravity.

11.64 The Environment Agency's studies of the River Ancholme system suggest that the 1:100 years peak water level (1.0% annual probability of flooding) through Brigg is +2.64 mOD. The studies also indicate that upstream of Brigg the existing defences provide a standard of between 1:10 years and 1:20 years (i.e. 10% to 5% annual probability of occurrence). Environment Agency data shows that the lowest ground level in Hibaldstow is above +5.0 mOD, so the village is not at risk of flooding from the River Ancholme. The risk from the Hibaldstow Catchwater and North Drain has recently been assessed, leading to the conclusion that, contrary to earlier belief, it is less than 1.0% annual probability. The Scawby

Catchwater, Redbourne and Sallow Row drainage systems were modelled in 2009i as part of the Grimsby and Ancholme Flood Map Improvements Study.

11.65 Apart from the Scawby Brook, most of the Ancholme IDB drainage system is pumped to the New River Ancholme. The system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

11.66 The New and Old Ancholme river defences within the compartment and standard of the compartment's defences are generally in good to fair condition (Grades 2 and 3), although some toe boarding is noted as being in poor condition (Grade 4). The defences to the main river sections of the local drainage systems are also in mixed condition, with some lengths good (Grade 2) and some fair (Grade 3).

12 Appendix G Trent Valley Flood Compartments

12.1 Please note this section has not been updated in the review due to the level of detail therefore the information is based on information from 2011. The current best available information/up to date datasets can be requested from the Environment Agency from emdenquiries@environment-agency.gov.uk.

General Description of Area

Location, extent and development potential

12.2 The Trent Valley Area extends from Whitton Ness on the Humber in the north to the NLC boundary about 4 km south of Haxey, a total distance of some 30 km. The watershed along the Lincolnshire Edge dividing the River Ancholme and River Trent catchments forms the eastern boundary while the NLC boundary forms the northern and western boundary except for a short section between Whitton Ness and Trent Falls, where the boundary is the estuary shoreline.

12.3 The main centre of population in the area is the heavily industrialised town of Scunthorpe. Much of this is on relatively high ground but it extends east as far as the low-lying ground that forms the River Trent floodplain. There are a number of villages, wharves and industrial areas along the river, notably at Burton Stather, Flixborough, Gunness, Keadby, Althorpe East and West Butterwick, Burringham and Owston Ferry. Further west, the flat, low-lying floodplain extends well beyond the NLC boundary. Originally marshland, this area was reclaimed in the 16th and 17th Centuries and is very fertile but relies on an extremely complex drainage system, almost entirely pumped, to maintain water levels low enough for arable agriculture to take place. There are a number of villages and small towns within the marsh, generally located on local high spots. The Isle of Axholme is particularly significant in this respect, reaching an elevation of 35mOD and supporting the settlements of Belton, Epworth and Haxey. Further north, Crowle stands on a noticeable high point but the small villages of Eastoft and Garthorpe are only a few metres above the surrounding marsh level.

12.4 There are plans for a major development, the Lincolnshire Lakes and some other housing allocations (these are listed in Appendix D in relation to critical flood levels), on low-lying beside the River Trent to the west of Scunthorpe but most other development near the town is likely to be on relatively high ground above the floodplain. There may be some pressure for development along the banks of the River Trent as the wharves and industrial facilities there expand. No other parts of the area are allocated for major development.

Main sources of flood risk

12.5 There are two main sources of flood risk in the Trent Valley area, high water levels in the River Trent and failure of the network of watercourses and pumping stations that together drain the marshland surrounding the river.

12.6 Water levels in the lower section of the River Trent (north of Keadby) are dominated by tidal conditions and so are related to water levels in the Humber Estuary. Work carried out for the

HFRMS indicates that the water levels, with given probabilities of occurrence in the river, are as shown in Table J.1. The base date for these figures in 1991 and current guidance indicates that allowance should be made for sea levels to rise by 1.201m and wave heights increase by 10% by 2115.

12.7 Further upstream water levels during extreme events are due to a combination of tidal and fluvial conditions. An extensive study of the Trent flood defences was carried out during the 1960s and 1970s and included a detailed assessment of extreme water levels. The river defences were then raised to provide a consistent standard of 1:100 years, equivalent to a 1% annual probability of flooding and have since been maintained to these levels.

12.8 There are three sections of fluvial floodplain within the area, the main one being beside the River Trent with smaller ones beside the Bottesford Beck and the River Eau respectively. The Bottesford Beck collects water from much of the eastern part of Scunthorpe, flowing initially south and then turning west to discharge to the Trent by gravity. The River Eau drains high land further south and much of its indicative floodplain lies outside the NLC boundary. Both the Bottesford Beck and the River Eau are embanked where they cross the Trent floodplain and so act as highland carriers.

12.9 The main river watercourses within the area are listed in Table 12.1 (there are no OWs) and shown on the Interactive Map. Those on the right bank of the Trent are discussed above. On the left bank there are four principal watercourse groups connected to the Trent. The most northerly of these is the Stainforth & Keadby Canal, which is managed by British Waterways. This connects the River Don with the River Trent and is separated from the river at either end by a set of locks. There is no flow in the canal but it is embanked for part of its length and there is consequently a potential risk of flooding if the embankment fails since the water it contains will drain out. The two Soak Drains (one on either side of the canal) are both main river watercourses.

Ref No	Name of watercourse	Watercourse type	Discharging to
M1	River Trent	Tidal river	Humber Estuary
M2	Bottesford Beck	Highland carrier	River Trent
M3	River Eau	Highland carrier	River Trent
M4	North Soak Drain	Pumped drain	River Trent
M5	South Soak Drain	Pumped drain	River Trent
M6	North Level Engine Drain	Pumped drain	Hatfield Waste Drain
M7	Hatfield Waste Drain	Pumped drain	River Trent
M8	River Torne	Pumped drain	River Trent
M9	South Level Engine Drain	Pumped drain	River Trent
M10	Warping Drain	Pumped drain	River Trent
M11	River Idle	Pumped drain	River Trent

Table 12.1 - Main river watercourses; Trent Valley Area

12.10 South of the canal three main river watercourses (the Hatfield Waste Drain, the River Torne and the South Level Waste Drain, each of which has some lengths of tributary watercourses which are also designated as main river) come together and run parallel with each other to the Keadby pumping station, where the flow is pumped to the River Trent. A number of pumping stations, some operated by the Environment Agency and some by the adjacent IDB, pump water into these watercourses.

12.11 South of the Isle of Axholme is the Warping Drain, which is about 9 km in length but now only collects the discharge from one small pumping station so has a very low flow. It is embanked in places, however, so there is a potential risk of flooding if an embankment fails, and the flow is pumped to the River Trent. Further south again is the River Idle, most of which is outside the study area except for a short section where it forms the NLC boundary. This is an embanked watercourse draining high ground to the south and west of the study area as well as collecting

local drainage flows from Environment Agency and IDB pumping stations. The River Idle flows to West Stockwith where it is pumped to the River Trent.

12.12 The responsibility for draining the low-lying land within the Trent Valley Area, and managing the extremely complex drainage system that does this, is shared by the 12 IDBs listed in Table 12.2. They are collected together into two groups, as shown on the table, one (the Shire Group) of IDBs managed by Grantham Brundell & Farran (GBF, part of JBA Consulting) and one (the Isle of Axholme Group) of those managed by the Lindsay Marsh Drainage Board (LMDB). The areas managed by GBF and LMDB are shown on the interactive map.

Name of IDB	Location
Managed by JBA Scunthorpe & Gainsborough	
Doncaster East	
Isle of Axholme & North Notts WLMB	Right bank & Left bank
	Left bank
	Left bank
Managed by LMDB (Isle of Axholme)	
Adlingfleet & Whitgift	Left bank
Althorpe	Left bank
Crowle	Left bank
South Axholme	Left bank
West Axholme	Left bank
West Butterwick	Left bank

Table 12.2 - Internal Drainage Boards (IDBs); Trent Valley Area

12.13 The pumping stations that discharge to the main watercourses are listed together with operating authority and the receiving watercourse in Table 12.3 and shown on the interactive map. Only pumping stations within the study area are included, others operated by the same authorities lie just outside the area but are not included in the list.

12.14 The HFRMS indicates that the River Trent's tidal flood defences provide a standard of protection that is currently better than 0.5% annual probability of occurrence while its fluvial defences are designed to provide a standard of 1.0% annual probability against fluvial events. The standards provided by the internal drainage system are not as good as this, however. The Environment Agency indicates that the Bottesford Beck and River Eau offer a standard of about 3.0% annual probability (a return period of 30 years) while the River Idle provides a standard of about 2.0% annual probability (return period of 1 in 50 years). The watercourses of the Three Rivers system generally give a standard of about 10% (return period of 1 in 10 years) although this rises to about 3.0% for the River Torne and the South Level Engine drain if freeboard is taken into account.

Ref No	Operating authority	Pumping Station	Discharging to
P1	Environment Agency	Belton Grange	Hatfield Waste Drain
P2		Bull Hassocks	South Level Engine Drain
P3		Candy Farm (North)	River Torne
P4		Candy Farm (South)	River Torne
P5		Dirtness	South Level Engine Drain
P6		Goodcop	Hatfield Waste Drain
P7		Keadby	River Trent
P8		Low Bank	River Trent
P9		New Zealand	North Soak Drain
P10		Snow Sewer Drainhead	River Trent
P11		Tunnel Pits (North)	River Torne
P12		Tunnel Pits (South)	River Torne
P13		West Stockwith	River Trent
P14		Woodcarr	Hatfield Waste Drain
P15	IoA IDB	Cow Lane	Adlingfleet Drain
P16	IoA&NN IDB	Althorpe	Three Rivers
P17	IoA&NN IDB	Grange Farm	(River Trent)
P18		Common Carrs	Paupers Drain
P19		Goodnow	North Soak Drain
P20		Paupers Drain	River Trent
P21		Bewcarrs	(River Trent)
P22	IoA &NN IDB	Snow Sewer	Warping Drain
P23	Doncaster East IDB	Blaxton Quarry	River Torne
P24		Cadmans	(South Level Engine Drain)
P25		Franklins	(South Level Engine Drain)
P26		South Thorne Bank	(South Level Engine Drain)
P27	Scunthorpe & Gainsborough IDB	East Butterwick	River Trent
P28		Black Bank	River Trent
P29	Scunthorpe & Gainsborough IDB	Burringham	River Trent
P30		Flixborough	River Trent
P31		Lysaghts	River Trent
P32	IoA & NN IDB	South Street	River Trent
P33		Heckdyke	River Trent
P34		Three Bridges	Warping Drain
P35		Four Bridges	Warping Drain
P36		North Soak Drain	North Soak Drain
P37		Greenham	South Level Engine Drain
P38		Derrythorpe	River Trent
P39		Kelfield	River Trent
P40		Blackdyke	River Trent
P41		Rushcarrs	Rushcarr Drain
P42		Trentside	River Trent
P43		Southfields	River Trent

Table 12.3 - Drainage pumping stations; Trent Valley Area

12.15 The IDBs aim to provide a standard of between 10% and 5% annual probability of occurrence (1:10 and 1:20 years return period) for agricultural land throughout the system but this includes a freeboard of at least 1m below local ground level (to prevent the land from being waterlogged). As a result the standard provided to property (which is not affected by flooding until the water level rises above local ground level) is generally in the range 2.0% and 1.0% annual probability (1:50 to 1:100 years return period). The IDBs have to approve the drainage arrangements of all significant new development within their boundaries or affecting their watercourses. In principle the site runoff characteristics should remain unchanged, although the IDB may accept the receiving drainage system being improved so it can accept the increased discharge, at the developer's expense.

12.16 The above discussion concentrates on sources of flood risk within the Stage 3 area. The part north of the Stainforth & Keadby Canal is, however, also potentially at risk of flooding from two sources outside the area, the River Ouse and the River Don. The implications of this are discussed under the assessment for compartment 3T4.

Flood compartments

12.17 To allow more detailed assessment, the area shown as SFRA Flood Zone 3 on Flood Risk Map 12 has been divided into flood compartments taking into account the topography, type of defence, drainage arrangements and land use. These compartments are listed in Table 12.4 below with the sources of flood risk they include. Further information for each compartment is given in the following sections.

Compartment reference	Compartment name	Sources of flood risk
3T1	Alkborough	Humber Estuary
3T2	Flixborough	River Trent Scunthorpe & Gainsborough IDB
3T3	Gunness	River Trent Bottesford Beck Scunthorpe & Gainsborough IDB
3T4	Garthorpe & Keadby	River Trent (River Ouse) (River Don) Stainforth & Keadby Canal North Soak Drain IoA & NN IDB
3F1	Upper Bottesford Beck	Bottesford Beck
3F2	Messingham	River Trent Bottesford Beck River Eau
3F3	Upper River Eau	River Eau Scunthorpe & Gainsborough IDB
3F4	Three Rivers	River Trent Stainforth & Keadby Canal South Soak Drain North Level Engine Drain Hatfield Waste Drain River Torne Doncaster East IDB
3F5	Isle of Axholme	River Trent River Torne South Level Engine Drain Warping Drain IoA & NN IDB
3F6	River Idle	River Trent Warping Drain South Ancholme IoA & NN IDB

Table 12.4 - Flood compartments; Trent Valley Area

Tidal Flood Compartments

3T1: Alkborough

Description of site

12.18 The village of Alkborough lies directly east of the Alkborough Flats flood alleviation area and does benefit from EA maintained flood defences and offers a 1 in 200 year standard of protection. Alkborough Flats is an area designated to accommodate flood water from the river Trent and the Humber Estuary.

12.19 The main settlement lies fully within flood zone 1 with the nearest property lying approximately 300 metres from flood zone 3.

Sources of flood risk

12.20 The primary source of flood risk to this compartment is high water levels at Trent Falls, the junction between the River Trent and the Humber Estuary. Table 5.11 shows the water level with a 0.5% annual probability of occurrence there to be +5.65 mOD (with a base date of 1991). Current guidance suggests sea levels could rise by 1.201m and wave heights increase by 10% by 2115.

12.21 There are no significant fluvial watercourses flowing through the area. Scunthorpe IDB manage the drainage, which discharges to the estuary by gravity.

12.22 No application for development within Flood Zone 3 would be supported for Alkborough Flats or in the area next to the flood defences. Alkborough Flats is an area designed to store flood water from the Tidal River Trent and the Humber Estuary and is therefore not suitable for any new development. The land in Flood Zone 3 close to the village of Alkborough should also not be designated for development due to its close proximity to these defenses which would place any structure at significant risk in the event of a breach of those defences.

Existing defences

12.23 The flood defences consist of earth embankments, a length of which has been lowered as part of the managed realignment scheme to allow water to flow into the site during an extreme tidal event, where it can be stored until water levels in the estuary fall. The remaining defences have crest levels of about +6.1 mOD and are generally in good condition (Grade 2) although some lengths are fair (Grade 3).

3T2: Flixborough

Description of site

12.24 The main village of Flixborough lies fully within flood zone 1 and lies approximately 1.3km to the east of the Tidal River Trent.

12.25 Flixborough Industrial estate falls fully within flood zone 3a with a significant area of the industrial estate and surrounding area falling within the hydraulically modelled 1 in 20 year outline. Areas shown to fall within the 1 in 20 year outline are generally considered to be classed as flood zone 3b by the EA or land which is designated as functional floodplain.

12.26 However in this case the EA have acknowledged that they have a lack of confidence in these outputs at this point within the hydraulic model and any development proposed within this area should be fully assessed through a site specific flood risk assessment.

Sources of flood risk

12.27 The primary source of flood risk to this compartment is high water levels in the River Trent. Table 5.11 shows the water level with a 0.5% annual probability of occurrence there to be between +5.65 mOD and +5.82 mOD (with a base date of 1991). Current guidance suggests sea levels could rise by 1.201m and wave heights increase by 10% by 2115.

12.28 There are no significant fluvial watercourses flowing through the area. Scunthorpe and Gainsborough IDB manage the drainage, most of which discharges to the estuary by gravity apart from the Flixborough Industrial Estate, which is pumped. The system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

12.29 Any development proposed within or close to the Flixborough Industrial estate would require detailed site specific flood risk assessment (FRA). Some areas within and close to this site fall within Flood Zone 3b which is an area where water would naturally flow during a 1 in 20 year event. Therefore development is not permitted within this area.

Existing defences

12.30 The estuary flood defences consist of earth embankments with crest levels of between +6.1 and +6.3 mOD. They are generally in good to fair condition (Grades 2 and 3) and are sufficiently high to prevent overtopping during events with a 0.5% annual probability, as required by NPPF/NPPG Flood Risk and Coastal Change.

3T3: Gunness

Description of site

12.31 This compartment is on the right bank of the River Trent and extends from the minor road running between Flixborough Stather and Flixborough village to the Bottesford Beck. The Trent and Bottesford Beck defences form its western and southern boundaries respectively. The compartment is about 8.5 km long and 4 km wide at its widest point. Ground levels in the area indicate that some of the land is below +1.0 mOD.

12.32 The compartment contains some industrial development beside the River, particularly at Grove Wharf and Gunness, together with a number of important communication links including the A18 and A1077 main roads, the M180 motorway and the Scunthorpe to Doncaster railway line. It also includes the western fringe of Scunthorpe, where there is both housing and industry. The remainder of the area is used for agriculture.

12.33 This flood compartment also includes the proposed Lincolnshire Lakes development described previously in this document. More detailed work has been produced for the Lincolnshire Lakes development area which provided a detailed Level 2 assessment.

Sources of flood risk

12.34 The primary source of flood risk to this compartment is high water levels in the River Trent. The Environment Agency's indicative flood plain map shows the area north of the M180 motorway as being subject to tidal flooding and the area further south as subject to either tidal or fluvial flooding. Table 5.11 shows the tidal water level at Keadby Bridge with a 0.5% annual probability of occurrence to be +5.82 mOD (with a base date of 1991). Current guidance suggests sea levels could rise by 1.201m and wave heights increase by 10% by 2115. Fluvial flood levels are influenced by tidal conditions as well as by rainfall and catchment characteristics, in particular floodplain storage further upstream. Design levels were produced for the Trent Tidal Reach Improvement Scheme, which was implemented over the period 1960 – 1980 with the aim of providing protection against flooding with a 1.0% annual probability of occurrence.

12.35 There is only one other main river watercourse that could affect the compartment, the Bottesford Beck. This is an embanked high-level conveyor draining the eastern and southern parts of Scunthorpe and discharging to the River Trent by gravity. The local drainage system is managed by Scunthorpe and Gainsborough IDB. Although there are some gravity outfalls most of the flow is pumped to the River Trent through the Lysaghts and Burringham pumping stations. The system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

12.36 The River Trent flood defences consist largely of earth embankments with short sections of quay wall in the wharf areas. The crest level varies between +6.1 and +6.3 mOD are sufficiently high to prevent overtopping during events with a 0.5% annual probability, as required by NPPF/NPPG Flood Risk and Coastal Change. The defences are generally in good to fair condition (Grades 2 and 3), although some of the quay walls are classified as poor (Grade 4). These walls are generally backed by wide paved areas, however, so the risk of progressive failure leading to widespread flooding during an extreme event is low.

12.37 The Bottesford Beck defences consist entirely of earth embankments, generally in good to fair condition (Grades 2 and 3). They provide a 1:30 years standard of protection (3.0% annual probability of flooding) to the surrounding area.

3T4: Garthorpe & Keadby

Description of site

12.38 This compartment is on the left bank of the River Trent and extends from the NLC boundary to the Stainforth & Keadby Canal. The Trent and the Canal form its eastern and southern boundaries respectively while the NLC boundary forms its remaining boundary. The compartment is about 8 km from north to south and 12 km east to west at its widest point. Ground levels in the area indicate that much of the land is below +2.0 mOD.

12.39 The flat, low-lying land that forms the Trent floodplain extends well beyond the NLC boundary. Originally marshland, this area was reclaimed in the 16th and 17th Centuries and is very fertile but relies on an extremely complex drainage system, almost entirely pumped, to maintain water levels low enough for arable agriculture to take place. There are a number of villages within the marsh, generally located on local high spots. Crowle, for example, stands on a noticeable high point but the small villages of Eastoft, Garthorpe, Luddington and Adlingfleet are only a few metres above the surrounding marsh level. There is a major power station at Keadby but apart from this the area is devoted largely to agriculture.

Sources of flood risk

12.40 In principle this compartment is part of a floodplain that is surrounded by four watercourses (the Trent, Ouse and Don Rivers and the Stainforth & Keadby Canal, which connects the Don and Trent) and is therefore at risk of flooding from them all. In practice the Canal poses only a limited risk since it carries no flow (if it breaches the water stored in the canal would drain out but gates at either end would prevent more water entering the channel). The River Don could affect the western part of the compartment (beyond Crowle) and the River Ouse the northern part. The primary sources of flood risk, however, are the River Trent and the local drainage system.

12.41 Table 5.11 shows the tidal water level in the River Trent with a 0.5% annual probability of occurrence to be between +5.65 and +5.82 mOD (with a base date of 1991). Current guidance suggests sea levels could rise by 1.201m and wave heights increase by 10% by 2115. During such an event the tidal water level in the River Ouse will be similar or slightly higher while levels in the Don will be higher still and may also be influenced by fluvial conditions.

12.42 The only main river watercourse in the area is the North Soak drain, which runs beside the Stainforth & Keadby Canal and collects local drainage flows and pumped discharges from Isle of Axholme and North Notts IDBs. This IDB, with , manages the local drainage within the compartment. Flows from the Garthorpe system are discharged to the River Trent by gravity but the remaining flows are largely pumped, either directly or indirectly, to the Trent or (for some of the Adlingfleet & Whitgift area) to the Ouse. The systems are understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

12.43 The River Trent flood defences consist largely of earth embankments although there are some short lengths of wall near Keadby. The crest level varies between +6.0 and +6.3 mOD so the

embankments are sufficiently high to prevent overtopping during events with a 0.5% annual probability. The defences are generally in good to fair condition (Grades 2 and 3).

12.44 The River Ouse flood defences also consist largely of earth embankments although there are some lengths of sheet-pile and other walls. They are sufficiently high to prevent overtopping during events with a 0.5% annual probability except near Reedness, where the standard is currently estimated to be lower than 2.0% annual probability. The Environment Agency is studying a scheme to improve the standard here. The defences are generally in good to fair condition (Grades 2 and 3).

12.45 Although much of the land lying within Zone 3 is apparently adequately protected against water levels with a 0.5% (tidal) or 1.0% (fluvial) annual probability of occurring in the Trent, nevertheless the very flat and low-lying nature of the land, the complexity of the drainage system, the low standard of protection it affords and the heavy reliance on pumping mean that during an extreme event flooding could be widespread and in locations that are difficult to predict.

Fluvial Flood Compartments

3F1: Upper Bottesford Beck

Description of site

12.46 The Bottesford Beck drains the southern and eastern parts of Scunthorpe. Its lower reaches are embanked and act as a high-level conveyor, carrying the drainage flows across the floodplain to the River Trent. This compartment begins at the limit of compartment 3T3, which covers the River Trent floodplain. It is thus relatively narrow where the watercourse flows down the steep valley across the escarpment before it meets compartment 3T3 but broadens out further upstream where the ground slopes more gently.

12.47 The lower, narrow, part of the compartment includes some properties on the edge of existing developments. Some of the upper part is open ground (where, for example, a golf course is located) but a significant proportion is heavily industrialised, including part of Scunthorpe Steelworks.

Sources of flood risk

12.48 The Bottesford Beck is the only source of flood risk in the compartment. Downstream (in compartment 3T3) the embankments flanking the watercourse provide a 1:30 years standard of protection (about 3% annual probability of occurrence) across the Trent floodplain. The channel within this compartment was improved in the 1980s to accommodate the extra discharge from a major development in the catchment but nevertheless the return period of the event causing the flow to come out of bank (i.e. the onset of flooding) is believed to be quite low, although no model studies to confirm this have been carried out.

12.49 A major source of concern is the sensitivity of the flood risk to future development in the catchment. The outflow from the upper part of the compartment is likely to be constricted, causing flood levels to respond more strongly to changes in flow rate than catchments where the outflow is less constrained. As a result any development within this catchment that increases the rate of runoff will have a greater impact on flood risk than a development in a less sensitive catchment.

12.50 There has been major landscaping work to the north-east of Scunthorpe, making it difficult to identify the watershed between the valleys of the Bottesford Beck and the Winterton Beck, which drains to the Humber Estuary. For the purposes of this study the watershed has been taken as the A1077.

Existing defences

12.51 There are no flood defences (embankments, walls or formal storage areas) within this compartment.

3F2: Messingham

Description of site

12.52 This compartment is on the right bank of the River Trent and extends from the Bottesford Beck (opposite West Butterwick) to the River Eau (which also marks the NLC boundary). These two watercourses form its northern and southern boundaries respectively while the Trent forms its western boundary. The compartment is about 3 km from north to south and 4.5 km from east to west. Ground levels in the area indicate that much of the land is below +2.0 mOD.

12.53 The compartment is largely devoted to agriculture and contains a number of farms, most of which are relatively isolated.

Sources of flood risk

12.54 The primary source of flood risk to this compartment is high water levels in the River Trent. These levels are influenced by tidal conditions as well as by rainfall and catchment characteristics, in particular floodplain storage further upstream. Design levels were produced for the Trent Tidal Reach Improvement Scheme, which was implemented over the period 1960 – 1980 with the aim of providing protection against flooding with a 1.0% annual probability of occurrence.

12.55 The two other main river watercourses that could affect the compartment are the Bottesford Beck and the River Eau. These are both embanked high-level conveyors draining land to the east and discharging to the River Trent by gravity. The flow from the local drainage system, which is managed by Scunthorpe and Gainsborough IDB, is pumped to the River Trent through the East Butterwick and Black Bank pumping stations. The system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

12.56 The River Trent flood defences consist largely of earth embankments that are sufficiently high to prevent overtopping during events with a 1.0% annual probability. The defences are generally in good to fair condition (Grades 2 and 3). The Bottesford Beck and River Eau defences consist entirely of earth embankments, generally in good to fair condition (Grades 2 and 3). They provide a 1:30 years standard of protection (3.0% annual probability of flooding) to the surrounding area.

12.57 There is a flood storage area upstream of the embanked section on the left bank of the River Eau (and therefore outside the NLC boundary and so outside the compartment). This is capable of taking the flow during events of up to 1:30 years return period (and providing this standard of protection to the village of Scotter, further upstream). More severe events will overtop the banks and, by restricting backing up, limit the threat to the village.

3F3: Upper River Eau

Description of site

12.58 Although the NLC boundary and the River Eau diverge upstream of compartment 3F2, the border then turns south and crosses the river again further upstream. The settlement of Kirton-in-Lindsey lies fully within flood zone 1 as defined by the Flood Map for Planning. The nearest main river is the River Eau which is located approximately 2.4km to the west of the western edge of the settlement.

12.59 There is a main river network which lies to the east of the settlement and consists of the Redbourne Catchwater (approx. 5.7km away), Redbourne Old River (approx. 4.9km away) and the Sallowrow Drain (approx. 4km away). These in turn flow to the New River Ancholme main river.

Sources of flood risk

12.60 The River Eau is the only source of flood risk in the compartment. The return period of the event causing the flow to come out of bank (i.e. the onset of flooding) is believed to be less than 1:30

years (3% annual probability), although no model studies to confirm this have been carried out. The Scunthorpe and Gainsborough IDB manages the local drainage.

Existing defences

12.61 There are no flood defences (embankments, walls or formal storage areas) within this compartment.

3F4: Three Rivers

Description of site

12.62 This compartment is on the left bank of the River Trent and lies between the Stainforth & Keadby Canal and the River Torne, which is one of the watercourses that are together known as the Three Rivers. The River Torne forms the compartment's southern boundary to the point where it reaches the NLC boundary. The compartment is about 10 km from east to west and 9 km north to south at its widest point. Ground levels in the area indicate that much of the land is below +2.0 mOD.

12.63 The compartment is within the Trent floodplain and, like the rest of the area, relies on a complex drainage system, almost entirely pumped, to maintain water levels low enough for arable agriculture to take place. The area contains small villages and isolated farms, is extremely flat and very fertile and is devoted largely to agriculture. The M180 motorway, the A18 and A161 main roads and a number of minor roads cross the compartment.

Sources of flood risk

12.64 In principle the main sources of flood risk are the River Trent, the Stainforth & Keadby Canal, which connects the Don and Trent, and four main river watercourses, the South Soak Drain (which flanks the Canal), the North Level Engine Drain, the Hatfield Waste Drain and the River Torne. In practice the Canal poses only a limited risk since it carries no flow (if it breaches the water stored in the canal would drain out but gates at either end would prevent more water entering the channel). The North Level Engine Drain runs beside the Hatfield Waste Drain for much of its length and eventually joins it.

12.65 High water levels in the River Trent are influenced by tidal conditions as well as by rainfall and catchment characteristics, in particular floodplain storage further upstream. The existing defences are intended to provide protection against fluvial flooding with a 1.0% annual probability of occurrence (and are likely to protect against a 0.5% annual probability of tidal flooding). The River Torne is a highland carrier receiving water from the Doncaster area and carrying it across the Trent floodplain to the Keadby pumping station, which discharges to the River Trent. The three other main river watercourses collect local drainage flows discharged or pumped to them from the Doncaster East IDB drainage system, which is responsible for drainage from the land east of a point close to Belton Grange pumping station, and convey them to Keadby pumping station also.

12.66 The main river watercourses provide a nominal 1:10 years (10% annual probability) standard of protection to the surrounding area, although the River Torne's standard rises to 1:30 years (3% annual probability) if freeboard is taken into account. The IDB's system is understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

12.67 The defences along the very short length of the River Trent beside the compartment are in good condition (Grade 2). The River Torne is embanked over part of its length and these defences are generally in good to fair condition (Grades 2 and 3). There are no other significant formal flood defences within the compartment.

12.68 Although much of the land is apparently adequately protected against water levels with a 0.5% (tidal) or 1.0% (fluvial) annual probability of occurring in the Trent, nevertheless the very flat and low-lying nature of the land, the complexity of the drainage system, the low standard of protection it affords and the heavy reliance on pumping mean that during an extreme event flooding could be widespread and in locations that are difficult to predict.

3F5: Isle of Axholme

Description of site

12.69 This compartment is on the left bank of the River Trent and lies between the River Torne, which is one of the watercourses that are together known as the Three Rivers, and the Warping Drain. The River Torne forms the compartment's southern and most of its western boundaries while the River Trent and the Warping Drain form its eastern and southern boundaries respectively. The NLC boundary forms the rest of the external boundary. The compartment contains a large area of land (the Isle of Axholme) that is above the general floodplain level and is therefore excluded from this assessment. The overall compartment dimensions are about 13 km from east to west and the same distance from north to south. Ground levels in the area indicate that much of the land is below +2.0 mOD.

12.70 The compartment is within the Trent floodplain and, like the rest of the area, relies on a complex drainage system, almost entirely pumped, to maintain water levels low enough for arable agriculture to take place. Most of the larger villages (e.g. Epworth and Haxey) are located on high ground out of the floodplain but parts of some of them (e.g. West Woodside and Westgate) have spread onto lower-lying land and some (e.g. Owston Ferry, East and West Butterwick) are almost entirely on the floodplain. The floodplain itself is flat, very fertile and devoted largely to agriculture. The M180 motorway, the A18 and A161 main roads and a number of minor roads cross the compartment.

Sources of flood risk

12.71 The main source of flood risk to the compartment is the River Trent. North of the M180 motorway crossing the flood risk from the Trent is tidal while to the south it is both tidal and fluvial, indicating that high water levels are influenced by tidal conditions and by rainfall and catchment characteristics, in particular floodplain storage further upstream. The existing defences provide protection against tidal flooding with a 0.5% annual probability of occurrence (and are intended to protect against a 1.0% annual probability of fluvial flooding).

12.72 The other sources of flood risk are the other three main river watercourses (River Torne, South Level Engine Drain and Warping Drain) and the local IDB systems (managed by Althorpe, West Butterwick, West Axholme, South Axholme and Hatfield Chase IDBs). The River Torne is a highland carrier receiving water from the Doncaster area and conveying it across the Trent floodplain to the Keadby pumping station, which discharges to the River Trent. The South Level Engine Drain collects local drainage flows discharged or pumped to it from the Isle of Axholme and North Notts and Doncaster East IDB drainage systems and also conveys them to Keadby pumping station. The Warping Drain collects flows pumped to it from the South Axholme IDB (and the Finningly IDB, outside the compartment) and conveys them to the Snow Sewer Drainhead pumping station, which discharges to the River Trent.

12.73 The main river watercourses provide a nominal 1:10 years (10% annual probability) standard of protection to the surrounding area, although the River Torne's standard rises to 1:30 years (3% annual probability) if freeboard is taken into account and flows in the Warping Drain are very low indicatingthat in practice the flood risk is relatively low. The IDBs' systems are understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

12.74 The River Trent flood defences consist largely of earth embankments that are sufficiently high to prevent overtopping during events with a 0.5% (tidal) and 1.0% (fluvial) annual probability of occurrence. The defences are generally in good to fair condition (Grades 2 and 3). The River Torne and the Warping Drain are embanked over part of their length and these defences are also in good to fair condition (Grades 2 and 3), providing protection against flooding from events with a 3% annual probability (possibly better in the case of the Warping Drain).

12.75 Although much of the land is apparently adequately protected against water levels with a 0.5% (tidal) or 1.0% (fluvial) annual probability of occurring in the Trent, nevertheless the very flat and low-lying nature of the land, the complexity of the drainage system, the low standard

of protection it affords and the heavy reliance on pumping mean that during an extreme event flooding could be widespread and in locations that are difficult to predict.

3F6: River Idle

Description of site

12.76 This compartment is on the left bank of the River Trent and lies between the Warping Drain and the southern NLC boundary (which runs along the River Idle for part of its length. The River Trent and the Warping Drain form its eastern boundary. The compartment is 9 km from east to west and 4 km from north to south at its widest part. Ground levels in the area indicate that much of the land is below +2.0 mOD.

12.77 The compartment is within the Trent floodplain and, like the rest of the area, relies on a complex drainage system, almost entirely pumped, to maintain water levels low enough for arable agriculture to take place. The land is flat, very fertile, devoted largely to agriculture and contains no significant villages. The A161 main road crosses it.

Sources of flood risk

12.78 The main source of flood risk to the compartment is the River Trent. High water levels in the Trent at this point are influenced by tidal conditions and by rainfall and catchment characteristics, in particular floodplain storage further upstream. The existing defences provide protection against tidal flooding with a 0.5% annual probability of occurrence and are intended to protect against a 1.0% annual probability of fluvial flooding.

12.79 The other sources of flood risk are the other two main river watercourses (Warping Drain and River Idle) and the local IDB systems (managed by Isle of Axholme and North Notts and Doncaster EastIDBs). The Warping Drain collects flows pumped to it from the IDBs and conveys them to the Snow Sewer Drainhead pumping station, which discharges to the River Trent. The River Idle is a highland carrier draining the greater part of North Nottinghamshire together with parts of Derbyshire and South Yorkshire. It conveys the flow to the West Stockwith Pumping Station, which discharges to the River Trent.

12.80 The IDBs' systems are understood to be capable of accommodating the 2.0% annual probability event if the additional storage provided by the freeboard allowance included in the design is taken into account.

Existing defences

12.81 The River Trent flood defences consist largely of earth embankments that are sufficiently high to prevent overtopping during events with a 0.5% (tidal) and 1.0% (fluvial) annual probability of occurrence. The defences are generally in good to fair condition (Grades 2 and 3). The River Idle is embanked and these defences are also in good to fair condition (Grades 2 and 3). They work in conjunction with flood storage areas further upstream (outside the compartment) to provide protection against flooding from events with a 2% annual probability. The Warping Drain is also embanked and its defences are again in good to fair condition (Grades 2 and 3).

12.82 Although much of the land is apparently adequately protected against water levels with a 0.5% (tidal) or 1.0% (fluvial) annual probability of occurring in the Trent, nevertheless the very flat and low-lying nature of the land, the complexity of the drainage system, the low standard of protection it affords and the heavy reliance on pumping mean that during an extreme event flooding could be widespread and in locations that are difficult to predict.

13 Appendix H- Eastern Coastal Area Flood Compartments

13.1 Developers can get up to date datasets directly from the Environment Agency (requesting for a product 4) which can be provided in an up to date form and specific to a location /enquiry and free of charge, please email LNenquiries@environment-agency.gov.uk

14 Abbreviations and Glossary of Terms

Term	Definition
AOD	Above Ordnance Datum-height above average sea level.
CFL	Critical Flood Level – Light Detection and Ranging (measurement of ground level –airbourne the water level at a site assessed as having a 1 in 100 probability (1%) of flooding from a river or a 1 in 200 year probability (0.5%) of flooding from the sea of occurring each year (also called the Annual Exceedance Probability), with allowance for climate change.
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
Defra	Department for Environment, Food and Rural Affairs
DPD	Development Plan Documents
DTM	Digital Terrain Model (source – Ordnance Survey Terrain 50)
EA	Environment Agency
EU	European Union
FFL	The finished floor levels must be raised above the estimated flood level. Ground floor levels should be a minimum of which ever is higher of 300 millimetres (mm) above the general ground level of the site or 600mm above the estimated river or sea flood level.
Flood Compartment	A part of the floodplain that might be inundated in case of floods (in protected floodplains if the defences fail) but where the inundation cannot spread to the adjacent parts of the floodplain.
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 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.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a 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.

Term	Definition
FRM	Flood Risk Management
FWMA	Flood and Water Management Act
FZ	Flood Zones
GLLEP	Greater Lincolnshire Local Economic Partnership – providing a strategic economic framework and funding source for local growth
Ground Water Flooding	Flood that occurs when groundwater levels rise above ground levels, often following prolonged heavy rainfall
HECAG	Humber Estuary Coastal Authorities Group
HELP	Humber Local Economic Partnership – providing a strategic economic framework and funding source for local growth
HFRMS	Humber Flood Risk Management Strategy (Environment Agency)currently under Review (2017 – 2019) (Environment Agency)
IDB	Internal Drainage Board – water level management of low lying drainage areas within IDDs
IDD	Internal Drainage District – an area managed by IDBs
Indicative Flood Risk Area	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG. (in PFRA)
IoAFRMS	Isle of Axholme Flood Risk Management Strategy
LDF	Local Development Framework
Left Bank	The flood bank of a river on the left hand side looking downstream
LFRMS	Local Food Risk Management Strategy (builds on the Government PFRA)
LIDAR	Light Detection and Ranging - measurement of ground level (topographical contour data) by means of an airborne mapping technique
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
mAOD or mOD	Metres Above Ordnance Datum or Ordnance Datum (base source at sea level, Newlyn, Cornwall - for calculating contour information)
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NELC	North East Lincolnshire Council
NLC	North Lincolnshire Council
NPPF	National Planning Policy Framework
NPPG	National Planning Policy Guidance – specific reference to Government Guidance on Flood Risk and Coastal Change

Term	Definition
Ordinary Watercourse or Significant Ordinary Watercourse (SOW)	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 – Government document (outlines indicative flood risk areas)
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
Reservoir	A large raised structure, raised lake or other area capable of storing at least 25,000 cubic metres of water above natural ground level, created artificially or enlarged. This is defined by the Reservoirs Act, 1975.
Resilience Measures/ Flood 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/ Flood Resistant 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.
Right Bank	The flood bank of a river on the right hand side looking downstream
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.
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 (Environment Agency)
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.
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 (to potentially mirror undeveloped greenfield run – off rates) than some conventional techniques

Term	Definition
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 a SWMP study. The Scunthorpe SWMP (North Lincolnshire) is currently progressing to the option stage (April 2017)
Tidal Flooding	Flooding from the sea or estuary caused by high sea levels, sometimes influenced by high waves, including affecting tidal sections of river courses
WFD	Water Framework Directive
WMB	Water Management Board – alternative name to IDB – water level management of low lying areas within IDDs