## Document Revisions

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<th>No.</th>
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<td>09-02-11</td>
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<td>21-02-11</td>
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<td>3</td>
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<td>17-06-11</td>
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North Lincolnshire Council

North Lincolnshire PFRA

North Lincolnshire PFRA

June 2011

Entec UK Limited

Report for
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Executive Summary

Purpose of the Preliminary Flood Risk Assessment

The purpose of this report (including all written work generated by Entec in the course of its production) is to present the findings of a North Lincolnshire Preliminary Flood Risk Assessment (PFRA), undertaken in accordance with the Flood Risk Regulations 2009, for North Lincolnshire Council.

North Lincolnshire Council is a Unitary Authority and as such it is defined as a Lead Local Flood Authority by the Flood Risk Regulations 2009. The PFRA reports on sources of flooding which the LLFA is responsible for under the requirements of the Flood Risk Regulations which are: ordinary watercourses, surface water, groundwater, artificial sources and flooding which results from the interaction of local sources and sources (tidal and main river) which the Environment Agency is responsible for.

The PFRA uses locally agreed significance thresholds (i.e. not the significance thresholds applied by Defra and Welsh Assembly Government as part of the national assessment) to assess the consequences of past and future flooding in North Lincolnshire. The consequence of flooding has been assessed in the PFRA through a review of the number of receptors (as defined by the Environment Agency’s National Receptor Dataset) within the locally agreed past and future flood risk extents. The Environment Agency, as part of the national assessment, has not identified a Flood Risk Area in North Lincolnshire. The PFRA reviewed the local sources of flooding and through an assessment of the potential consequences of this flooding, concluded that there were no areas in North Lincolnshire which reached the national thresholds for the identification of Flood Risk Areas (i.e. 30,000 people at risk in one area).

The PFRA report uses a count of the number of people at risk, or the number of critical services at risk of future flooding to identify a ranked listing of Locally Significant Flood Risk Areas. It is recommended that a Local Flood Risk Management Strategy is developed to assess and manage local flood risks.

This report and the information contained within are only to be used for the purpose for which it was intended. The report’s purpose is to document past and future flood consequences, using available third party datasets, and to assess the delineation of National Flood Risk Areas from a North Lincolnshire perspective. The report and associated mapping must always be issued together so as to avoid anyone misunderstanding the purpose of the figures. This PFRA report and associated mapping are not spatial planning tools and are thus not intended to supersede any of the Strategic Flood Risk Assessment (SFRA) outputs, findings or recommendations.

In the course of preparing the PFRA Entec has made use of, and incorporated into this report, data which has been supplied by third parties (“Third Party Data”). Entec has taken reasonable steps to verify the validity of the Third Party Data, however, Entec will have no liability whatsoever for the quality, completeness and/or accuracy of such Third Party Data. Any data supplied for use in this PFRA should be used only for the purpose that this report is intended to fulfil i.e. the North Lincolnshire Preliminary Flood Risk Assessment.
Furthermore, the data tables, maps and analysis set out within this report may be subject to copyright owned by a third party and should not be reproduced and/or used in any other assessments or documentation, without the prior approval of the copyright owner i.e. the Environment Agency, Severn Trent Water or Anglian Water.
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Annex 2 Records of future floods and their consequences (preliminary assessment report spreadsheet)
Appendix A PFRA Meeting Minutes and Confirmation of Approach
## Glossary

<table>
<thead>
<tr>
<th><strong>Abbreviation</strong></th>
<th><strong>Definition</strong></th>
</tr>
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<tbody>
<tr>
<td><strong>ASTSWF</strong></td>
<td>Areas Susceptible to Surface Water Flooding. The Environment Agency produced this data set, it includes areas identified as being more susceptible, of an intermediate susceptibility and more susceptible to surface water flooding. This dataset is sometimes referred to as the 1st Generation Surface Water Map.</td>
</tr>
<tr>
<td><strong>AEP</strong></td>
<td>Annual Exceedance Probability</td>
</tr>
<tr>
<td><strong>CAD</strong></td>
<td>Computer Aided Design. This is a software package used for producing plans and drawings</td>
</tr>
<tr>
<td><strong>Defra</strong></td>
<td>Department for environment food and rural affairs</td>
</tr>
<tr>
<td><strong>ESRI ArcGIS</strong></td>
<td>Economic and Social Research Institute software - Geographical Information Systems</td>
</tr>
<tr>
<td><strong>FLFRE</strong></td>
<td>Future Local Flood Risk Extent. The locally agreed dataset for assessing future local flood risks</td>
</tr>
<tr>
<td><strong>FMfSW</strong></td>
<td>Flood Map for Surface Water. An Environment Agency dataset otherwise known as the second generation surface water flood map.</td>
</tr>
<tr>
<td><strong>HLFRE</strong></td>
<td>Historic Local Flood Risk Extent. The locally agreed dataset for assessing historic local flood risks</td>
</tr>
<tr>
<td><strong>LLFA</strong></td>
<td>Lead Local Flood Authority as defined by the Flood Risk Regulations 2009</td>
</tr>
<tr>
<td><strong>Local Flood Risk Areas</strong></td>
<td>Areas assessed as having a locally significant flood risk – specific to North Lincolnshire</td>
</tr>
<tr>
<td><strong>Local Significance Thresholds</strong></td>
<td>Thresholds applied to identify Local Flood Risk Areas – specific to North Lincolnshire</td>
</tr>
<tr>
<td><strong>National Flood Risk Areas</strong></td>
<td>Areas defined by the Environment Agency which exceed the national thresholds</td>
</tr>
<tr>
<td><strong>NRD</strong></td>
<td>National Receptor Dataset</td>
</tr>
<tr>
<td><strong>PFRA</strong></td>
<td>Preliminary Flood Risk Assessment</td>
</tr>
<tr>
<td><strong>SFRA</strong></td>
<td>Strategic Flood Risk Assessment – Mandatory evidence base to support the Local Development Framework.</td>
</tr>
<tr>
<td><strong>SWMP</strong></td>
<td>Surface Water Management Plan</td>
</tr>
<tr>
<td><strong>WAG</strong></td>
<td>Welsh Assembly Government</td>
</tr>
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</table>
1. Introduction

1.1 Scope

This report presents the Preliminary Flood Risk Assessment (PFRA) findings with regards to local flood risk for North Lincolnshire Council. The PFRA is a requirement of the Flood Risk Regulations 2009. The Council is a Unitary Authority and therefore designated as Lead Local Flood Authority (LLFA) by the Flood Risk Regulations 2009. The flood risk sources for which North Lincolnshire Council is responsible for assessing based on available information are:

- Ordinary Watercourses;
- Surface water flooding;
- Groundwater flooding; and
- Artificial systems – i.e. canals and sewers.

The Environment Agency is responsible for flood risk from main rivers, the sea or large raised reservoirs.

As outlined in the Environment Agency’s guidance, this study will only use existing information, the PFRA will not include any hydraulic modelling or development of new flood risk outlines or datasets. Entec is not responsible for the accuracy or quality of third party data used in the study.

1.2 Aims and Objectives

The PFRA process aims to identify Flood Risk Areas which are areas with a significant risk of flooding. Defra and the Welsh Assembly Government (WAG) have identified significance criteria and thresholds for defining national Flood Risk Areas. The North Lincolnshire PFRA applies local significance thresholds to identify Local Flood Risk Areas. The local significance thresholds are different to the national Defra and WAG thresholds used in the national assessment. The Environment Agency has undertaken a national exercise to identify indicative Flood Risk Areas of national significance, and has identified 10 areas across England. None of these areas falls within North Lincolnshire, the nearest identified Flood Risk Areas being Hull. For identified national Flood Risk Areas, flood hazard and risk mapping needs to be produced by June 2013. The PFRA process allows LLFAs to identify any additional indicative FRAs, or if applicable modifications to the indicative Flood Risk Areas. Guidance on identifying these is provided in the Defra document “Selecting and reviewing Flood Risk Areas for local sources of flooding - Guidance to Lead Local Flood Authorities”.

The PFRA process provides a means of gathering, collating and assessing flood risk data to identify FRAs, and undertake the hazard/risk mapping and the production of flood risk plans. The assessed data is to be used to inform
the Flood Risk Management Plans (FRMPs) which LLFAs are required to produce by June 2015. The PFRA is a rolling 6 year cycle of assessment, and data collection of flood events will form a key part of the next cycle.

1.3 Introduction to the Study Area

North Lincolnshire covers an area of 846km², south of the Humber Estuary. The study area is split between the coastal floodplain along the northern sea front, with the floodplains of the rivers Trent and Torne to the west (including the raised Isle of Axholme), and higher hilly areas of north-south orientated limestone and Chalk hills to the east, which are separated by the low-lying valley of the River Ancholme. The limestone ridge rises to over 70m, whilst the Chalk wolds rise to over 100m AOD. In comparison levels may be as low as 2m AOD alongside the River Ancholme and within the coastal floodplain. Flood risk is primarily concentrated in the low-lying areas of the study area, which are defended by flood defence embankments and artificial drainage systems. It is reported that some of these artificial systems become tide-locked at high tide and/or are assisted by artificial pumping. At risk are low-lying parts of settlements and the high-value agricultural land located in this area. The M180/A180 roads and key railway lines pass through the area to and from Immingham docks.

However, flood risk is not just confined to low-lying areas. Groundwater flooding associated with the re-emergence of ephemeral winterbourne watercourses has been recorded in the higher Chalkland parts of the area, e.g. Barrow-upon-Humber.

1.4 Lead Local Flood Authority Responsibilities

The Flood Risk Regulations implement the European Flood Directive, which was designed to ensure a consistent management approach to flood risk across Europe. In England, the Environment Agency has overall responsibility for flood risk from tidal and Main River sources and for assessing these sorts of flooding by PFRA. LLFAs are responsible for undertaking the PFRA process for other sources of flooding, such as: Ordinary Watercourses, groundwater, surface water, sewers and artificial infrastructure such as canals.

PFRA are being undertaken across Europe under the EU Floods Directive (2007/60/EC). They are a high-level screening exercise aimed at identifying historic and future (potential) flood risk. If National Flood Risk Areas are present then these should be reviewed and the local flood risk information should be used to assess if a new National Flood Risk Area should be proposed. The depth of reporting at the local level should be commensurate with this aim.

Entec has been commissioned by North Lincolnshire to undertake the PFRA process which assesses flood risk from ordinary watercourses, surface water, artificial sources and groundwater. This document details the background, process and outcomes of the PFRA process.
1.5 Report Contents

The report is divided into the following sections, based on the PFRA guidance issued by the EA on the 7th December 2010:

1. Introduction – scope, aims and objectives, Study area introduction, LLFA responsibilities;
2. Data – supplied data, limitations, systems and quality control;
3. Past floods – significant harmful consequences definition, past flood summary and mapping;
4. Future Floods – summary, Local Surface water flood risk information, groundwater flood risk information, future flood mapping, Climate change and impact of development. PFRA mapping;
5. Review of Indicative Flood Risk Areas;
6. Identification of Flood Risk Areas;
7. Next Steps; and
8. References.
2. Data

2.1 Supplied Data – from LLFA and Partners

North Lincolnshire Council established relationships with relevant data holding stakeholders through partnership working approaches prior to the commencement of the PFRA process. The key project stakeholders are North Lincolnshire Council and the Environment Agency. In addition to the Environment Agency, data has been provided by Anglian Water, Severn Trent Water, Lindsey Marsh Drainage Board administrators, North East Lindsey Internal Drainage Board, the Shire Group administrators and British Waterways. Existing data has been obtained in digital format.

Table 2.1 details the collated data for the North Lincolnshire PFRA. The collated data are mapped in Figures 2.1 to 2.12. This data has then been processed to produce mapping of possible past and future flooding consequences (See Sections 3 and 4). Table 2.2 details the Figures produced to present this data and it details what these figures show. Table 2.3 details the data generated as part of the PFRA process by Entec.

Table 2.1 North Lincolnshire PFRA Data

<table>
<thead>
<tr>
<th>Data</th>
<th>Supplier</th>
<th>Date Supplied to Entec</th>
<th>Description</th>
<th>Comments Regarding use in PFRA</th>
</tr>
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<tr>
<td>Digital River Network – Main River, offline and online</td>
<td>Environment Agency</td>
<td>January 2011</td>
<td>Centrelines of Main Rivers and Ordinary Watercourses.</td>
<td>Used to show locations of watercourses, and to generate buffer zones for watercourses without any mapped flood extents (i.e. the majority of Ordinary Watercourses).</td>
</tr>
<tr>
<td>Flood Zones 3 and 2</td>
<td>Environment Agency</td>
<td>January 2011</td>
<td>Modelled Flood Extents for Fluvial (greater than 1% AEP, and between 1% and 0.1% AEP) and Tidal sources (greater than 0.5% and between 0.5% and 0.1% AEP) respectively.</td>
<td>Primarily concentrates on flooding from sources which the EA are responsible for (i.e. Main River, tidal). Provides some detail on flood extents along Ordinary Watercourses.</td>
</tr>
<tr>
<td>Areas Susceptible to Ground Water Flooding (ASGWF)</td>
<td>Environment Agency</td>
<td>January 2011</td>
<td>Classifies the risk of groundwater emergence by 1km grid cells in 4 bands (&lt;25%, 25 to 50%, 50 to 75%, &gt;75%).</td>
<td>Not used in this assessment – it is a broad-scale tool, and the surface water mapping is considered to better show the low topographical points where groundwater emergence is most likely.</td>
</tr>
<tr>
<td>FMFSW - Surface Water Flood Mapping (3.33%/0.5% AEP shallow/deep layers)</td>
<td>Environment Agency</td>
<td>January 2011</td>
<td>Modelled extents of areas where significant depths of water flow or pond during storm events (3.33% and 0.5% AEP events provided).</td>
<td>Used to assess areas at risk of surface water flooding and also for indicating areas potentially susceptible to groundwater flooding.</td>
</tr>
<tr>
<td>Data</td>
<td>Supplier</td>
<td>Date Supplied to Entec</td>
<td>Description</td>
<td>Comments Regarding use in PFRA</td>
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</tr>
<tr>
<td>Areas Susceptible to Surface Water Flooding (ASISWF mapping – less, intermediate and more)</td>
<td>Environment Agency</td>
<td>January 2011</td>
<td>Modelled extents of areas where significant depths of water flow or pond during storm events.</td>
<td>This data set includes three outlines which defines areas which are assessed to be less susceptible, an intermediate susceptibility or that are more susceptible to surface water flooding.</td>
</tr>
<tr>
<td>Historic Flood Extents</td>
<td>Environment Agency</td>
<td>January 2011</td>
<td>Known extents of previous fluvial/tidal flooding</td>
<td>Provides a good guide to areas that have previously suffered significant flooding. (Nature of dataset means it will not cover all areas of historic flooding).</td>
</tr>
<tr>
<td>Historic flooded properties and flood extents for June/July 2007 pluvial flooding</td>
<td>North Lincolnshire Council</td>
<td>January 2011</td>
<td>Properties known to have suffered from flooding in June/July 2007. Known extents of previous pluvial flooding</td>
<td>Additional flood extents to supplement EA data. Provides a good area wide indication of the localities at risk. This information was collated during Parish Roadshows carried out in each Parish by North Lincolnshire Council.</td>
</tr>
<tr>
<td>Records of flood alleviation works carried out post summer 2007</td>
<td>North Lincolnshire Council</td>
<td>January 2011</td>
<td>To identify which of the flooding historic flooding locations/issues no longer present a risk as remedial works have been undertaken</td>
<td>This dataset was provided in a spreadsheet and an analysis of the data suggests that about one third of the reported historic flooding incidents have been rectified by works completed by the Council.</td>
</tr>
<tr>
<td>National Receptor Database (NRD)</td>
<td>Environment Agency</td>
<td>January 2011</td>
<td>The NRD is used in the PFRA to evaluate the impacts of past and future flooding from public health, economic and environmental perspectives.</td>
<td>The data have been used without modification or validation.</td>
</tr>
<tr>
<td>Canal and structures location</td>
<td>British Waterways</td>
<td>January 2011</td>
<td>Indicates where infrastructure is located. Potential for conveyance of flood flows, or collapse of embankments.</td>
<td>Significant failure of assets is relatively rare.</td>
</tr>
<tr>
<td>DG5 database of historic flooding incidents</td>
<td>Anglian Water</td>
<td>January 2011</td>
<td>Recorded incidence of sewer flooding from water companies network</td>
<td>Only indicates reported historical issues. Action may have been taken to rectify these, similarly areas of potential (future) flood risk may not be identified. Point data imported into GIS.</td>
</tr>
<tr>
<td>DG5 database of historic flooding incidents</td>
<td>Severn Trent Water</td>
<td>January 2011</td>
<td>Recorded incidence of sewer flooding from water companies network</td>
<td>Only indicates reported historical issues. Action may have been taken to rectify these, similarly areas of potential (future) flood risk may not be identified. Point data imported into GIS.</td>
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Table 2.2 PFRA Available Data Figures

<table>
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<tr>
<th>Figure Number and Name</th>
<th>Figure Description</th>
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<tbody>
<tr>
<td>Figure 2.1 Ordinary Watercourse Flooding</td>
<td>Shows locations of Ordinary Watercourses, and areas of the Environment Agency’s Flood Zone3 and 2 associated with these.</td>
</tr>
<tr>
<td>Figure 2.2 Sewer Flooding</td>
<td>Locations of historic sewer flooding incidents as supplied by Anglian and Severn Trent Water</td>
</tr>
<tr>
<td>Figure 2.3 Surface Water Flooding – 3.33% AEP (1 in 30 year) – shallow and deep</td>
<td>Extent of pluvial flooding for the 3.33% AEP event (2nd generation surface water maps)</td>
</tr>
<tr>
<td>Figure 2.4 Surface Water Flooding – 0.5% AEP (1 in 200 year) – shallow and deep</td>
<td>Extent of pluvial flooding for the 0.5 AEP event (2nd generation surface water maps)</td>
</tr>
<tr>
<td>Figure 2.5 Canals</td>
<td>Location of canals and associated infrastructure</td>
</tr>
<tr>
<td>Figure 2.6 Groundwater Flooding Susceptibility</td>
<td>Areas most prone to potential groundwater flooding</td>
</tr>
<tr>
<td>Figure 2.7 Historic Flooding – North Lincolnshire Council Data (surface water)</td>
<td>Locations/extents of historic pluvial flooding</td>
</tr>
<tr>
<td>Figure 2.8 Historic Flooding – Environment Agency Data</td>
<td>Extents of historic fluvial/tidal flooding</td>
</tr>
<tr>
<td>Figure 2.9 “deep” Merged ASTSwF “more” and SWfFM 0.5% AEP</td>
<td>Combination of 1st and 2nd generation surface water maps – the 1st generation is considered to show the surface water flood risk better in low-lying areas. This represents the worst effected areas (i.e. more/deep).</td>
</tr>
<tr>
<td>Figure 2.10 “shallow” Merged ASTSwF “less” and SWfFM 0.5% AEP</td>
<td>Combination of 1st and 2nd generation surface water maps – the 1st generation is considered to show the surface water flood risk better in low-lying areas. This represents all potentially effected areas (i.e. less/shallow).</td>
</tr>
<tr>
<td><strong>This flood extent on this figure has been taken forward as the Local Surface Water flood risk extent</strong></td>
<td></td>
</tr>
<tr>
<td>Figure 2.11 Flood Defence Schemes completed by North Lincolnshire Council</td>
<td>Locations where flood defence/drainage improvements have been made by North Lincolnshire Council</td>
</tr>
<tr>
<td>Figure 2.12 Zone of Interaction</td>
<td>Areas of flood zone 3 where ordinary watercourses pass through – i.e. whilst the extent may represent severe flooding from the adjacent Main River, flooding on a more limited scale could occur in this area from Ordinary Watercourses.</td>
</tr>
</tbody>
</table>
### Table 2.3 PFRA Generated Data

<table>
<thead>
<tr>
<th>Data</th>
<th>Methodology</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>Ordinary Watercourses – Flood Zones 3 and 2</td>
<td>Environment Agency Flood Zones were edited using ESRI ArcGIS software to remove the areas of flood risk associated with Main Rivers. However, the majority of Ordinary Watercourses have no existing flood mapping, therefore a 10m buffer either side of the watercourse centreline was used to produce a 20m wide polygon along the lengths or Ordinary Watercourse where existing flood mapping was not available (10m relates to the typical maintenance easement). This produces a ‘quasi flood zone’ for ordinary watercourses.</td>
<td>Where an Ordinary Watercourse passes through flood zone areas associated with a main river, this is termed an ‘Area of Interaction’.</td>
</tr>
<tr>
<td>Locally agreed sources of surface water</td>
<td>A series of different options for predicting future surface water flood risks were prepared by Entec and reviewed by the Council. The options included:</td>
<td>It was agreed that the local sources of future surface water flood risk should be defined by the ASTSWF ‘more’ option within areas covered by Flood Zone 2 and by the 0.5% AEP ‘deep option’ of the FMfSW for all areas in Flood Zone 1. Council Confirmation provided in Appendix A</td>
</tr>
<tr>
<td></td>
<td>• The FMfSW 0.5% AEP (1 in 200 year) – deep (Figure 2.4);</td>
<td></td>
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<tr>
<td></td>
<td>• The FMfSW 0.5% AEP (1 in 200 year) – shallow (Figure 2.4);</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The FMfSW 0.5% AEP (1 in 200 year) deep in Flood Zone 1 and the ASTSWF more option in Flood Zone 2 (Figure 2.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The FMfSW 0.5% AEP (1 in 200 year) shallow in Flood Zone 1 and the ASTSWF less option in Flood Zone 2 (Figure 2.10); and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The FMfSW 0.5% AEP (1 in 200 year) deep in Flood Zone 1 and the ASTSWF intermediate option in Flood Zone 2 – not mapped.</td>
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<tr>
<td></td>
<td>The Council used local knowledge of past flood events and knowledge of the local systems to select the most appropriate data set for representing future local surface water flood risk.</td>
<td></td>
</tr>
<tr>
<td>Future Local Flood Risk Extent (FLFRE)</td>
<td>To assess the consequence and significance of future local flood risks a ‘Future Local Flood Risk Extent’ was created using locally agreed sources of flooding, this includes:</td>
<td>Approach agreed by Stakeholder group at meeting on the 19th January 2011 – Minutes presented in Appendix A</td>
</tr>
<tr>
<td></td>
<td>• The locally agreed sources of surface water flooding;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The 20m buffered Ordinary watercourses flood extent;</td>
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<tr>
<td></td>
<td>• The modelled flood Zone 2 extents for Ordinary watercourses, (where available); and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• The recorded flood extents from the summer 2007 event, as supplied by North Lincolnshire Council.</td>
<td></td>
</tr>
<tr>
<td>Historic Local Flood Risk Extent (HLFRE)</td>
<td>To assess the consequence and significance of past flood events a ‘Historic Local Flood Risk Extent’ was created using locally agreed sources of flooding, this includes:</td>
<td>Approach agreed by Stakeholder group at meeting on the 19th January 2011 – Minutes presented in Appendix A</td>
</tr>
<tr>
<td></td>
<td>• The recorded flood extents from the summer 2007 event, as supplied by North Lincolnshire Council.</td>
<td></td>
</tr>
</tbody>
</table>

All datasets were produced in January 2011

### 2.2 Data Limitations

Data for use in the PFRA was easily available and accessible. Table 2.1 illustrates the range of data that was collated and sources of their information. The Environment Agency’s GeoStore facility was a very successful mechanism for the Council to obtain the necessary information. Water company DG5 data was supplied by both
Severn Trent and Anglian Water, a data licence agreements had to be signed for this data. Water company licence agreements were signed by David Harrison at North Lincolnshire Council. Historically it has been difficult to capture local records of surface water flooding for use in studies like Strategic Flood Risk Assessments (SFRAs). In North Lincolnshire, on the other hand, this information was readily available. Following the summer 2007 flood events, the Council undertook a series of workshops at the parish level to capture areas impacted (i.e. flood extents) and the properties affected (i.e. a property count). This information was supplemented by information from the three main Internal Drainage Boards and issued, by the Council, to Entec in January 2011 for inclusion in the PFRA.

Whilst all the records of past flooding are detailed (from both the water companies and the Council) the data sets only represent a relatively recent representation of past flooding. Indeed the Council’s records do not extend further back than the summer 2007 events. The Shire Group report\(^1\) on the Summer 2007 floods states that the storm affecting the area on the 25\(^{th}\) June 2007 produced rainfall equivalent to a 150 year plus storm – a total of 49.6mm of rainfall (rain gauge not named) was recorded on the 25\(^{th}\) of June, this followed 15.8mm of rainfall on the 23\(^{rd}\) June. The June 2007 storm is considered to have been a regional event and because of the magnitude of this event North Lincolnshire Council view this event as a ‘live test’ of what happens in this area during extreme rainfall events. Information gathered on the June 2007 floods allows the Council to decide upon the composition of the ‘Locally Agreed Sources of Surface Water’ (Section 4.2) with a great deal of confidence.

The extent of historic flooding captured by North Lincolnshire Council represents only those areas where flooding was reported. Therefore all areas which flooded in this event may not be present within the PFRA dataset as not all flooding incidents will have been reported.

The Flood Zone extents do not extend to cover all the Ordinary Watercourses in the district. The national flood map does not identify the local flood risks associated with Ordinary Watercourses within the floodplains of larger Main Rivers. The PFRA Stakeholder Group therefore had to agree a means of capturing this risk zone: it was agreed that a 10m buffer either side of the Ordinary Watercourse centreline should be applied.

### 2.3 Data Systems Applied

Supplied data has been collated in a Geographical Information System (GIS), with GIS layers imported directly into the software package and point data supplied in spreadsheet format converted into GIS format by use of the supplied grid references for presenting the point flood risk data spatially. The v9.3.1 ArcGIS software package has been used by Entec to undertake this process for ordinary sources of flood risk.

- Spatial data as GIS layers/feature classes within Personal Geodatabases; and

---

1 Ancholme, Scunthorpe and Messingham Internal Drainage Boards, Member of the Shire Group – Report on Storm Damage and Flooding the Followed June 2007 (JBA Consulting)
Spreadsheets of georeferenced point data.

### 2.4 Assessing the Significance of Past and Future Floods

The significance of past and future floods within North Lincolnshire has been assessed using a robust numeric approach which uses locally agreed flood extents, the Environment Agency’s National Receptor Dataset and locally agreed significance thresholds. Within the PFRA there are three different significance thresholds that are applied:

- National thresholds for assessing significant flood risk to identify national Flood Risk Areas, as defined by Defra and WAG, for the purpose of assessing if there are any areas in North Lincolnshire which exceed the national thresholds and thus which need defining as a Flood Risk Area.
- Local significance thresholds (agreed locally) to assess where there were locally significant consequences of past flooding; and
- Local significance thresholds (agreed locally) to assess where future flooding is predicted to result in locally significant consequences.

#### 2.4.1 The Method Applied

In line with the national assessment approach undertaken by the Environment Agency, the district was divided into 1km grid squares. The 1km grid represents the smallest analysis unit throughout the PFRA. An ESRI ArcMap VBA (Visual Basic Applications) tool was built by Entec’s software engineers to calculate the number of receptors within both the past and future flood extents, within each of the 1km squares. All the results of this analysis are stored in Personal Geodatabases (i.e. Grid_processing_Past_310111.mdb and Grid_processing_Future_290111.mdb), which have been issued to the Council with supporting ESRI mxd files.

Owing to the nature of the datasets available to the PFRA, the assessments of past and future flooding are not comparable with each other or with the Defra and WAG guidance as different thresholds are applied. These differences are outlined below:

- **Past Flooding** – utilised North Lincolnshire Council’s recorded flood extent mapping relating to the summer 2007 events – see figure 2.7. With regards to past flooding, the assessment of significance seeks to identify those areas where the historic flood event resulted in locally significant consequences. The thresholds for identifying locally significant past local flooding are presented in Table 2.4.

- **Future Flooding** – uses a flood extent which is comprised of: the locally agreed sources of future surface water flooding (see Table 2.3 and Section 4.2 for details); the ordinary watercourse flood extents (see Table 2.3 and Section 4.3); and North Lincolnshire Council’s recorded flood extent mapping which relates to the summer 2007 event – See Figure 2.7. With regards to future flooding, the assessment of significance seeks to identify those areas where it is predicted that there will be locally significant consequences. The thresholds for identifying locally significant future flood risk
are presented in Table 2.5. The thresholds have been set so that discrete areas of potentially significant future flood risk can be identified.

The available guidance on assessing the significance of flood risks was prepared for the purposes of selecting and reviewing national Flood Risk Areas. This general approach (i.e. counting the number of receptors within a given area) has been adopted in the PFRA.

The Defra and WAG guidance advocates the assessment of the consequence of flooding to be undertaken for three types of receptor, these being: Human Health, Economic Activity and the Environment. The receptors included within each category are outlined in Tables 2.4 and 2.5. The ‘Clusters of Places above the Flood Risk Threshold in England’ map (Drawing C2 date 15/12/2010 – Environment Agency) defines the flood risk threshold, used at the national level, as being a 1km square which has the following at risk:

- More than 200 people; or
- More than 1 critical service; or
- More than 20 non-Residential properties.

These national thresholds are not carried over into the PFRA assessment of locally significant past and future flooding. Nonetheless, the presentation of the number of people and critical services at risk in Figures 4.5 and 4.6 include these national thresholds within the key (i.e. the red squares). The data has been mapped in this way so as to identify how many of the 1km squares in North Lincolnshire exceed the national thresholds. Section 6.3 uses locally defined ‘Local Cluster Criteria’ to identify locally significant flood risk areas. These Local Cluster Criteria should not be confused with the National Cluster Criteria which were used to identify the nationally significant Flood Risk Areas.

It was clear early on in the PFRA process that the national thresholds were not going to be met within North Lincolnshire, as such the focus shifted towards assessing the significance of local flood risk with a view to informing future Local Flood Risk Strategies. To undertake an assessment of locally significant consequences of past and future flooding, local significance thresholds had to be agreed. The local thresholds for past and future flooding are presented in Tables 2.4 and 2.5. The thresholds are different because the extent of the past and future local flood risk envelopes are very different. This approach is applicable as the significance of past and future floods are assessed separately throughout the PFRA, as required by the Final PFRA Guidance (December 2010).

## Table 2.4  Receptors and Thresholds – Past Flooding

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Criteria (where appropriate)</th>
<th>Local Threshold of significance (per 1km square)</th>
<th>Presentation on Maps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human Health</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People</td>
<td>= properties * 2.34</td>
<td>≥10</td>
<td>&gt;200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100-200</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50-100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-50</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1-5</td>
</tr>
<tr>
<td>Critical Services</td>
<td></td>
<td>≥1 site</td>
<td>&gt;20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1-5</td>
</tr>
<tr>
<td><strong>Economic Activity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Residential</td>
<td></td>
<td>≥1 unit</td>
<td>N/A</td>
</tr>
<tr>
<td>Agri-landscape</td>
<td>Area of Grade 1</td>
<td>≥50,000m² (5ha) = 5% of the square</td>
<td>N/A</td>
</tr>
<tr>
<td>Agri-landscape</td>
<td>Area of Grade 2</td>
<td>≥50,000m² (5ha) = 5% of the square</td>
<td>N/A</td>
</tr>
<tr>
<td>Roads</td>
<td>Motorways and A roads</td>
<td>≥20m</td>
<td>N/A</td>
</tr>
<tr>
<td>Rail</td>
<td></td>
<td>≥10m</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Designations and Heritage Designations including:</td>
<td>Count performed on the number of different designation types included within the flood extent. Not the actual number of designations</td>
<td>&gt;1</td>
<td>N/A</td>
</tr>
<tr>
<td>International, National and Local Wildlife Designations; Miscellaneous Designations; Policy Designations; World Heritage Sites; Scheduled Ancient Monuments; Listed Buildings; Parks and Gardens; and Country Parks</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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June 2011
### Table 2.5  Receptors and Thresholds – Future Flooding

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Criteria (where appropriate)</th>
<th>Local Threshold of significance (per 1km square)</th>
<th>Presentation on Maps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human Health</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People</td>
<td>= properties * 2.34</td>
<td>≥20</td>
<td>&gt;200</td>
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<td></td>
<td></td>
<td></td>
<td>100-200</td>
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<td></td>
<td>1-5</td>
</tr>
<tr>
<td>Critical Services</td>
<td></td>
<td>≥1 site</td>
<td>&gt;20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10-20</td>
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<td>5-10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1-5</td>
</tr>
<tr>
<td><strong>Economic Activity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Residential</td>
<td></td>
<td>≥10 unit</td>
<td>N/A</td>
</tr>
<tr>
<td>Agri-landscape Area of Grade 1</td>
<td>≥100,000m² (10ha) = 5% of the square</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Agri-landscape Area of Grade 2</td>
<td>≥100,000m² (10ha) = 5% of the square</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Roads Motorways and A roads</td>
<td></td>
<td>≥200m</td>
<td>N/A</td>
</tr>
<tr>
<td>Rail</td>
<td></td>
<td>≥100m</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Designations and Heritage Designations including: International, National and Local Wildlife Designations; Miscellaneous Designations; Policy Designations; World Heritage Sites; Scheduled Ancient Monuments; Listed Buildings; Parks and Gardens; and Country Parks</td>
<td>Count performed on the number of different designation types included within the flood extent. Not the actual number of designations</td>
<td>≥1</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The results of the assessment are presented in Sections 3 and 4 of this PFRA Report.
To delineate the flood zones associated with Ordinary Watercourses, the existing January 2011 Environment Agency Flood Zones have been clipped to remove the flood extents associated with Main Rivers.

In addition a 10m buffer has been added to the centreline of all Ordinary Watercourses (both online and offline). This gives a 20m wide band along all of these watercourses. This is used as crude method of determining the adjacent areas most likely to be at risk from these watercourses.

Notes:

(a) there are no modelled flood extents for the majority of Ordinary Watercourses, this should not be taken as indicating that there is no known flood risk,

(b) where Ordinary Watercourses cross the floodplain of Main Rivers no flood extent is shown for Ordinary Watercourses since the Main River flooding is dominant.

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Notes:
This mapping data is based on historic sewer flooding data provided by Anglian Water and Severn Trent Water. It should be noted that the cause of the flooding may have since been rectified.

The data provides a broad guide to the areas that may be at risk, although the actual areas at risk will be dictated by actual hydrological conditions during any flood event.

The data as presented is not property specific.

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Notes:
This mapping data is based on the Environment Agency 1 in 30 year (3.3% AEP) shallow and deep Surface Water Flood Extent mapping.

The data provides a broad guide to the areas that may be at risk, although the actual areas at risk will be dictated by actual hydrological conditions during any flood event, and specific micro-topography (i.e. road kerbs), and the interactions between surface water flows, watercourses and the piped drainage system.

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Figure 2.3
Surface Water Flooding 3.33% AEP (1 in 30 year) surface water
Figure 2.4
Surface Water Flooding
0.5% AEP (1 in 200 year surface water)

Notes:
This mapping data is based on the Environment Agency 1 in 200 year (0.5% AEP) shallow and deep Surface Water Flood Extent mapping.
The data provides a broad guide to the areas that may be at risk, although the actual areas at risk will be dictated by actual hydrological conditions during any flood event, and specific micro-topography (i.e. road kerbs), and the interactions between surface water flows, watercourses and the piped drainage system.
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Notes:
- Where a canal is embanked above ground level the potential exists for embankment failure. This is however, a relatively rare event, the risks of which are managed through regular inspection and maintenance.

In addition, culverts carrying watercourses beneath a canal may be prone to blockage, or of limited capacity relative to peak flood flows. In some cases the canal itself may act as a flow route for flood flows (although water level control sluices normally act to balance water levels).

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Environment Agency Guidance on Areas Susceptible to Groundwater Flooding states that, the use of this single predictive groundwater data set is likely to be sufficient for PFRA where no local information exists, as the majority of local flood risk will come from surface water flooding. Unless an area identified as 'susceptible to groundwater flooding' is also identified as 'at risk from surface water flooding', it is unlikely that this location would actually experience groundwater flooding to any appreciable depth and therefore the consequences of such flooding would be significant.

In the PFRA Groundwater flood risk has been based on the Environment Agency's Surface Water flood map. This highlights the main low points in topography, where groundwater would most likely emerge.

Areas Potentially vulnerable from Groundwater Flooding based on local topographic depressions identified by the FMfSW 0.5% AEP (1 in 200 year) extent

Notes:

- Areas classified as groundwater flood emergence are based on the Environment Agency's Surface Water flood map.
- The areas identified are those where groundwater would most likely emerge from local topographic depressions identified by the FMfSW 0.5% AEP (1 in 200 year) extent.
- The classification system used is as follows:
  - < 25%
  - >= 25% - <50%
  - >= 50% - <75%
  - >= 75%

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Notes:
Historic flood data provides a broad guide to the areas that may be at risk of flooding in the future. However, the actual areas at risk will be dictated by actual hydrological conditions during any flood event.

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Key:
- North Lincolnshire Boundary
- Main River Flood Zone 2
- Flooded Properties
- Historic Flood Extents

Figure 2.7
Historic Flooding
North Lincolnshire Council Data

North Lincolnshire PFRA

Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty’s Stationery Office. © Crown Copyright. AL100001776

H:\Projects\28766 North Lincs pFRA\GIS\mxd\28766-W07.mxd

March 2011

Scale: 1:102,000 @ A2
Notes:
Historic flood data provides a broad guide to the areas that may be at risk of flooding in the future. However, the actual areas at risk will be dictated by actual hydrological conditions during any flood event.
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Notes:
This mapping data is based on a combination of the Environment Agency’s Surface Water Flood Mapping 1 in 200 year (0.5% AEP) deep (for areas in Flood Zone 1) and Areas Susceptible to Surface Water Flood ‘more’ extent mapping (for areas in Flood Zone 2).

The data provides a broad guide to the areas that may be at risk, although the actual areas at risk will be dictated by actual hydrological conditions during any flood event, and specific micro-topography (i.e. road kerbs), and the interactions between surface water flows, watercourses and the piped drainage system.

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Notes:

This mapping data is based on a combination of the Environment Agency’s Surface Water Flood Mapping 1/200 year (0.5% AEP) shallow (for areas in Flood Zone 1) and Areas Susceptible to Surface Water Flood "less" extent mapping (for areas in Flood Zone 2).

The data provides a broad guide to the areas that may be at risk, although the actual areas at risk will be dictated by actual hydrological conditions during any flood event, and specific micro-topography (i.e. road kerbs), and the interactions between surface water flows, watercourses and the piped drainage system.

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Figure 2.11  Flood Defence Schemes recently completed by North Lincolnshire Council

Flood Defence Scheme Details

1 - Barton, Barrow Road, Flood Defence Bund
2 - Belton, King Edward Street, Jeffrey Lane Phase 1
3 - Belton, King Edward Street, Jeffrey Lane Phase 2
4 - Brigg, Wrawby Road, Drainage system and bund
5 - Brigg, Bigby High Road, Ditch clearance and new gully connection & bund
6 - Brigg, Cotton Lane, Brigg, Ditch clearance
7 - Crowle, Main Street (Ealand), Upgraded drainage system
8 - East Halton, Town Street, Ditch clearance
9 - Elsham, Hall Lane, Piped system upgrade
10 - Gunness, Laburnham Avenue, Additional gullies and drainage
11 - Haxey, Low Burnham, Beck, Flood alleviation scheme
12 - Haxey, A161 Station Road, Piped system upgrade
13 - Haxey, Ermine, Drains & associated improvement schemes
14 - Haxey, village improvement scheme, Flood relief scheme in progress
15 - Haxey, village improvement scheme, Flood relief scheme in progress
16 - Keadby, Chesswick Avenue, Ditch clearance and piped system
17 - Kirton Lindsey, Cornwall Street/Moat House Road/Clay Lane, Upgraded piped system and new outfall
18 - Kirton Lindsey, Station Road, Piped system upgrade and drainage
19 - Kirton Lindsey, Stone Cottage, Cleatham, Improved drainage system
20 - Mablethorpe, Old Parish drain, Clearance and upgrade
21 - North Killingholme, Haven Road, Ditch clearance associated with highway scheme
22 - South Killingholme, School Road, New piped drain
23 - South Killingholme, Clarkes Road, Ditch clearance and piped system upgraded
24 - Winteringham, Ermine Street, Culvert upgrade
25 - Winterton, Crakedale Road, Ditch clearance and culvert upgrades
26 - West Halton, Water Lane, Bridge/Culvert improvement

Data Disclaimer:

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3. Past Floods

3.1 Significant Harmful Consequences – Local Definition

Section 2.4 describes the mechanisms for assessing the consequence and significance of past flood events. The thresholds applied in Table 2.4 have been agreed locally and are considered by North Lincolnshire Council to well represent their understanding of local flood risks. In this earlier work undertaken by the Council, data relating to the summer 2007 flood events was collated on a parish by parish basis and using this information the Council assigned a flood risk priority ranking – Figures 3.6 to 3.9 map this parish level data on the basis of number of issues raised, the number of key issues, the number of properties affected and the number of properties flooded. Figure 3.7 illustrates ‘properties flooded’ this captures those properties which were reported to have experienced internal flooding within the residential quarters above ground floor level. Figure 3.7 illustrates ‘properties affected’, this captures all the ‘properties flooded’ and those properties which were reported to experience flooding of ancillary external units/buildings.

‘Significant harmful consequences’ of past flood events are defined in North Lincolnshire from human health, economic and environment perspectives, if any one of the thresholds identified in Table 2.4 are exceeded for a given 1km grid square then that 1km grid square is identified as being an area of significant flood risk in the past. Owing to the nature of the receptors the distribution of the ‘areas of significance, between the three types of receptor is different. The local significance thresholds for past flooding in North Lincolnshire are:

- **Human Health** – if 10 or more people or at least 1 critical service is flooded;
- **Economic** – if 1 or more non-residential property, or 5ha of Grade 1 or 2 Agricultural land or 20m of A road or Motorway or 20m of railway line are flooded; and
- **Environmental** – if at least 1 designation is either wholly or partially flooded.

Flood events which are asssed to have resulted in consequences of this order are defined in this PFRA as being ‘locally significant’ at the 1km grid square level in North Lincolnshire.

Please note that the thresholds applied for the assessment of past flooding consequences is not the same as those applied for the assessment of future flooding – see Section 2.4.

3.2 Past Floods Summary

Table 3.1 below details the recorded local flood events as defined by North Lincolnshire Council, Anglian Water and Severn Trent Water. The data indicates that the typical consequence of each flood event was the flooding of a single or group of properties (the data aggregation makes it difficult to specify the exact numbers). The data shows there are large numbers of properties that were flooded following the summer storm events of 2007– several events
have been noted with large numbers of properties flooding on the same summer day. The exact consequences will be property specific, depending on whether the flooding was internal or external, and the amount of flooding within the property. This type of flooding appears to have been of short duration, but will have caused notable disruption in the areas affected, North Lincolnshire Council have provided details of flood extents from the June 2007 event which indicate that in some settlements parts of the main road were flooded (i.e. low points, or areas where the piped drainage of adjacent watercourse’s capacity was insufficient). A key issue with these events, and in particular the June 2007 event is the overstretching of response teams, given the number of properties flooded within a very short time by this type of intense pluvial flood event. For the purposes of the PFRA it was agreed that the summer 2007 storms should be treated as one storm event as there is no data which distinguishes between different events. The Shire Group Report on the June 2007 floods\(^3\) defined the rainfall event as having a 1 in 150 year return period.

### Table 3.1 Historic Flood Risk Sources

<table>
<thead>
<tr>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>June/July 2007</td>
<td>Severe pluvial flooding across large parts of North Lincolnshire. Flooding reported in: Scunthorpe, Barrow on Humber, Barton on Humber, New Holland, Goxhill, Crowle, Ealand, Brigg, East Halton, Thornton Curtis, Saxby All Saints, Bonby, Winteringham, Winterton, Wrawby, Broughton, Scawby, Howsham, Luddington and Haldenby, Eastoft, Keadby, Belton, South Killingholme, North Killingholme, Ulceby, Barnetby le Wold, Elsham, Worlaby, Roxby, Appleby, Redbourne, Kirton in Lindsey, Walcot, Garthorpe, West Halton, Normalby, Thealby, Burton upon Stather, Asmcot, Gunnness, Burningham, Bottesford, Messingham, West Butlerwick, Epworth, Wroth, Westwoodside, Low Burnham, Graizelound, Haxey, and Owston Ferry. [The events involved both internal and external flooding]</td>
</tr>
<tr>
<td>Anglian Water DG5 database - (no dates given)</td>
<td>Combinations of internal and external flooding to properties in: Barrow upon Humber, Barton upon Humber, Brigg, Elsham, Goxhill, Hibaldstow, North Killingholme, Saxby All Saints, Scawby, South Killingholme, Winterton, Wrawby The events below are both internal and external and relate to locations both within North Lincolnshire and in its surrounding areas (identified by italics). DG5 data is not based on political boundaries.</td>
</tr>
<tr>
<td>Severn Trent Water DG5 database - (various dates given)</td>
<td>The events below are both internal and external and relate to locations both within North Lincolnshire and in its surrounding areas (identified by italics). DG5 data is not based on political boundaries.</td>
</tr>
<tr>
<td>1990</td>
<td>1 property in Tickhill (not in North Lincs)</td>
</tr>
<tr>
<td>1991</td>
<td>1 property in Messingham</td>
</tr>
<tr>
<td>1992</td>
<td>5 properties: Scunthorpe/Yaddlethorpe</td>
</tr>
<tr>
<td>1993</td>
<td>6 properties: East Butlerwick, Messingham, Burton Stather, Kirton Lindsey, and Scunthorpe.</td>
</tr>
<tr>
<td>1994</td>
<td>No events in spreadsheet</td>
</tr>
<tr>
<td>1995</td>
<td>1 property in Burton Stather</td>
</tr>
<tr>
<td>1996</td>
<td>11 properties in: Messingham, Keadby, Burton Stather, Ealand and Finningley</td>
</tr>
<tr>
<td>1997</td>
<td>52 properties in: Gunnness, Aukley, Branton, Tickhill, Wadworth and Scunthorpe. [17(^{th}) and 31(^{st}) August – summer thunderstorm?] 31 of these properties flooded on the 31(^{st}) in Scunthorpe.</td>
</tr>
</tbody>
</table>

\(^3\) Ancholme, Scunthorpe and Messingham Internal Drainage Boards, Member of the Shire Group – Report on Storm Damage and Flooding the Followed June 2007 (JBA Consulting)
<table>
<thead>
<tr>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>16 properties: Belton, East Lound, Haxey, Epworth, Westwoodside, Gunness, Scunthorpe and Burton Stather (associated with event on 14/06/98)</td>
</tr>
<tr>
<td>1999</td>
<td>53 properties: Scunthorpe, Belton, Kirton Lindsey, Westwoodside, Bottesford (associated with heavy rainfall event? 24 properties on 03/07/99 and 14 on 25/08/99)</td>
</tr>
<tr>
<td>2000</td>
<td>5 properties: Scunthorpe and East Lound</td>
</tr>
<tr>
<td>2001</td>
<td>15 properties: Scunthorpe, Crowle, Westwoodside, Burton Stather and Messingham</td>
</tr>
<tr>
<td>2002</td>
<td>2 properties: Scunthorpe and Kirton Lindsey</td>
</tr>
<tr>
<td>2003</td>
<td>4 properties: Crowle, Belton and Braithwell</td>
</tr>
<tr>
<td>2004</td>
<td>24 properties: Crowle, Belton, Epworth, Kirton Lindsey, Epworth, Messingham, East Lound, Haxey, Westwoodside</td>
</tr>
<tr>
<td>2005</td>
<td>4 properties: Haxey, Bottesford and Scunthorpe</td>
</tr>
<tr>
<td>2006</td>
<td>13 properties: Keadby, Scunthorpe, Messingham, Branton and Crowle</td>
</tr>
<tr>
<td>2007</td>
<td>32 properties: Messingham, Althorpe, Epworth, Amcotts, Crowle, Haxey, Ealand, Westwoodside, Burton Stather, Scunthorpe, Auckley, Kirton Lindsey (28 properties were flooded on the 25/06/07)</td>
</tr>
<tr>
<td>2008</td>
<td>3 properties: Belton, Epworth and Crowle</td>
</tr>
<tr>
<td>2009</td>
<td>1 property in Crowle</td>
</tr>
<tr>
<td>2010</td>
<td>No events in spreadsheet</td>
</tr>
<tr>
<td>2011</td>
<td>No events in spreadsheet</td>
</tr>
</tbody>
</table>

It should be noted that this data is indicative only – some events may not have been recorded, and other events may have been removed from the DG5 database as their cause was subsequently rectified. The events do though emphasise the impact of summer thunderstorms on local flood risk.

### 3.3 Locally Significant Past Flood Risk

Table 3.2 shows Past Flooding figures produced and the locations for the most significant impacts of past flooding on key receptors. These figures show the degree of impact of past flooding consequences on a 1km-by-1km cell basis according to the thresholds indicated in Table 2.4. Limited information is available on conveyance routes etc, so the figures focus on flood extents and point locations. The nature of the flooding mechanisms is to be explored in the development of a Local Flood Risk Management Strategy.
Table 3.2 Locations of Significant Past Flooding Events

<table>
<thead>
<tr>
<th>Figure Number</th>
<th>Past Flooding Consequences</th>
<th>Key Areas Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Human Health</td>
<td>Severe (i.e. above threshold) impacts were limited, and spread across the study area; Scunthorpe, Haxey, Scawby, Brigg, Barnetby-le-Wold, Ulceby, East Halton, Goxhill, Barrow upon Humber and Barton on Humber being key locations for consequences.</td>
</tr>
<tr>
<td>3.2</td>
<td>Economic</td>
<td>Severe (i.e. above threshold) impacts were limited, and spread across the study area with particular concentrations in the Barton upon Humber/Goxhill area, on the Isle of Axholme, west of Scunthorpe (Ashby Parklands, Gunness and Burringham), and at Scawby/Brigg.</td>
</tr>
<tr>
<td>3.3</td>
<td>Environmental/Heritage</td>
<td>No areas identified.</td>
</tr>
<tr>
<td></td>
<td>Designation</td>
<td></td>
</tr>
<tr>
<td>3.4</td>
<td>People at Risk</td>
<td>Severe (i.e. in highest threshold bands) impacts occurred at: Barrow upon Humber, Barton upon Humber, Goxhill, and South-west Scunthorpe (Manor Park/Ashby Parklands).</td>
</tr>
<tr>
<td>3.5</td>
<td>Critical Services</td>
<td>Severe (i.e. in highest threshold bands) impacts occurred at: Luddington, Scawby and East Halton.</td>
</tr>
<tr>
<td>3.6</td>
<td>NLC 2007 Flood Data – Properties Flooded</td>
<td>Highest number of properties flooded: Barton upon Humber, followed by Scunthorpe, Keadby, Belton, Goxhill and East Halton.</td>
</tr>
<tr>
<td>3.7</td>
<td>NLC 2007 Flood Data – Properties Affected</td>
<td>Highest number of properties affected: Barton upon Humber and Scunthorpe, followed by Brigg, Barrow upon Humber, Crowle, Keadby, Belton, Goxhill and East Halton.</td>
</tr>
<tr>
<td>3.8</td>
<td>NLC 2007 Flood Data – Flood Issues Raised</td>
<td>Most in: Scunthorpe, followed by Brigg, Belton, Barton upon Humber, Goxhill, Messingham and Kirton in Lindsey.</td>
</tr>
<tr>
<td>3.9</td>
<td>NLC 2007 Flood Data – Key Flood Issues</td>
<td>Most in: Barton upon Humber and Goxhill, East Halton, Scawby, Brigg, Barnetby le Wold, Belton and Crowle.</td>
</tr>
</tbody>
</table>

A copy of the PFRA spreadsheet reporting on records of past floods and their significant consequences is included in Annex 1. The spreadsheet is the component of the PFRA process that will form the main PFRA response to be collated by the Environment Agency, for the national PFRA response for the European Commission.
Methodology:
(See Section 3 of PFRA Report)
Locally Significant (i.e. red cells) indicates that one of the following thresholds are exceeded:

- Number of properties * 2.34 is ≥10
- Critical Services ≥1

in the flood risk extent within a given 1km grid cell

(critical services are: hospitals, police, ambulance and fire stations, schools, water treatment works, electricity installations and prisons)

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Methodology:

(See Section 3 of PFRA Report)

Locally Significant (i.e. red cells) indicates one or more of the following thresholds are exceeded:

- Non-Residential:  $\geq 1$
- Agri-landscape Area of Grade 1:  $\geq 50,000m^2$ (5ha)
- Area of Grade 2:  $\geq 50,000m^2$ (5ha)
- Transport
  - Motorways and A roads:  $\geq 20m$
  - Rail:  $\geq 10m$

in the flood risk extent within a given 1km grid cell

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Figure 3.3 Past Flooding Consequences - Environment and Heritage

Methodology:
(See Section 3 of the PFRA Report)
Locally Significant (i.e. red cells) indicates one or more of the following thresholds is exceeded:
> 1 environmental or heritage designations in the flood risk extent within a given 1km grid cell

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Methodology:
Each cell's value is calculated based on:
Number of properties * 2.34
in the flood risk extent within a given 1km grid cell

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Methodology
Each cells value is calculated based on:

Critical Services
(critical services are: hospitals, police, ambulance and fire stations, schools,
water treatment works, electricity installations and prisons)

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Figure 3.5
Past Flooding Consequences - Critical Services at Risk

North Lincolnshire PFRA
Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright. AL100001776

Key:
- North Lincolnshire Boundary

**Number of Properties Flooded**
- 0 - 3
- 4 - 10
- 11 - 20
- 21 - 35
- 36 - 50

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**Methodology**
Based on data collected by NLC during post June 2007 parish meetings

**Figure 3.6**
Past Flooding
Consequences - Summer 2007 Floods
by Parish - Properties flooded

North Lincolnshire PFRA

February 2011
Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty’s Stationery Office. © Crown Copyright. AL100001776

Key:
North Lincolnshire Boundary

Number of Properties Affected

0 - 5
6 - 14
15 - 27
28 - 44
45 - 78

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Methodology:
Based on data collected by NLC during post June 2007 parish meetings

Figure 3.7
Past Flooding
Consequences - Summer 2007 Floods
by Parish - Properties affected
Data Disclaimer:
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Methodology:
Based on data collected by NLC during post June 2007 parish meetings

Figure 3.8
Past Flooding Consequences - Summer 2007 Floods by Parish - Number of Issues Raised
Methodology

Based on data collected by NLC during post June 2007 parish meetings

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Figure 3.9
Past Flooding Consequences - Summer 2007 Floods by Parish - Number of key issues
4. Future Flood Risk

4.1 Summary

Table 4.1 details the information sources used to assess the potential consequences of future floods from local sources in North Lincolnshire. The flood extents recorded by the Council during the Parish Roadshows, which were undertaken following the June 2007 flooding, are included within this future flood risk envelope as these flood are areas are known to flood during extreme rainfall events. The various datasets were combined using ESRI GIS systems into one flood extent, which is called the “Future Local Flood Risk Extent” (FLFRE), details are provided in Figure 4.1.

Table 4.1  Data Included within the Future Local Flood Risk Envelope

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinary Watercourses</td>
<td>Areas of the Environment Agency Flood Zone 3 extent associated with Ordinary Watercourses. A 10m buffer either side of watercourse centre lines.</td>
</tr>
<tr>
<td>Locally agreed Sources of Surface water Flooding</td>
<td>The surface water flood extent as shown on Figure 2.10.</td>
</tr>
<tr>
<td>Historic Flooding</td>
<td>Historic flood extents of the June 2007 pluvial flooding supplied by North Lincolnshire Council.</td>
</tr>
</tbody>
</table>

Section 2.1 indicates that groundwater flooding is effectively the same areas as would be affected by surface water flooding. Sewer flooding locations have not been included in the extent.

4.2 Locally Agreed Surface Water Flooding Information

As part of the PFRA several sources of surface water flood information have been collated and reviewed. In addition to the Environment Agency’s two surface water mapping datasets (see Table 2.1), the reviewed datasets include:

- North Lincolnshire Council has collated two datasets on surface water flooding. One dataset contains the location of properties which suffered pluvial flooding in June/July 2007, whilst the second indicates the extents of pluvial flooding over this period. Flood extents were developed through interactive sessions where flood extents were mapped by residents, in each Parish. This information was gathered during the post June 2007 Parish Roadshows undertaken by the Council to gather local information. Given the intensity of the June 2007 rainfall events, and because the whole of the study area experienced the same spread of heavy rainfall, this data is considered to provide a very useful tool for identifying areas/properties at risk. Based on this information, all parishes within North Lincolnshire were then ranked according to the known level of flood risk, see Figure 3.6, 3.7, 3.8 and 3.9 (past flooding);
The Environment Agency AStSWF data, otherwise known as the ‘first generation maps’ for which a less, intermediate and more susceptible areas to surface water flooding are defined; and

The Environment Agency FMfSW, otherwise known as the ‘second generation maps’, which included both ‘deep’ and ‘shallow’ flood extent predictions for the 3.33% and 0.5% AEP rainfall events.

These sources were agreed by North Lincolnshire Council to represent the only available surface water flooding predictions for North Lincolnshire. More detailed surface water flood mapping associated with strategies such as Surface Water Management Plans (SWMPs) is not available in North Lincolnshire.

A discussion was held between stakeholders and local flood risk managers (i.e. North Lincolnshire Council and the Environment Agency) to determine the most appropriate data source for representing future local surface water flood risks. It was established early in the process that the North Lincolnshire Council flood extent data should be included because this represents recorded flooding following an extreme rainfall event. It was agreed that the extents of the FMfSW (shallow and deep) did not well reflect the Council’s or the Environment Agency’s opinion of potential flood risks in low-lying areas like the River Trent floodplain. The extent of Flood Zone 2 was agreed as being a good representation of the extent of low lying areas.

Outside of Flood Zone 2, the Council felt that the FMfSW 0.5% AEP deep flood extent was the most appropriate flood extent to use in the assessment.

The Environment Agency suggested that the AStSWF may provide a better representation within these low lying areas. Figures 2.9 and 2.10 illustrate two combinations of the AStSWF and the FMfSW across the district, which present different predicted flood extents in the low lying areas. North Lincolnshire Council reviewed these maps and confirmed on the 26-01-11 that the ‘less’ susceptible and ‘intermediate’ susceptibility versions of the AStSWF overestimate the extent of surface water flood risks in North Lincolnshire, for the purposes of assessing local significance of future flooding.

4.3 Ordinary Watercourses

Areas of flood extent in the Environment Agency’s Flood Zone 3 and 2 clearly associated with Ordinary Watercourses were clipped to form a new GIS layer representing the modelled floodplain associated with Ordinary Watercourses. In North Lincolnshire, there are relatively few Ordinary Watercourses that have extensive flood mapping. In addition to the existing modelled data, the centrelines for online (i.e. connected to Main Rivers) and offline Ordinary Watercourses were buffered for 10m either side to give a 20m corridor, considered to be the area at highest risk from flooding associated with the watercourses. The buffered layer was merged with the clipped flood extents layer. This approach was confirmed by Council and Environment Agency on the 19th January 2011.
4.4 **Canals**

Only limited sections of canals (see Figure 2.5) are present within the study area (the Stainforth and Keadby Canal, part of the Sheffield and South Yorkshire Navigation). British Waterways have indicated that they have no records of historical flooding associated with this section of canal. The canal and adjacent land has therefore not been included in the assessment. The area through which the canal passes falls within the Environment Agency’s Flood Zone 3 and 2 associated with the River Trent/Torne confluence north of the Isle of Axholme.

4.5 **Zones of Interaction**

A Zone of Interaction (Figure 2.12) has been defined indicating areas which are at risk of flooding from Main Rivers, but through which Ordinary Watercourses pass. In these areas, flood risk will mainly be associated with the Main River. However, Ordinary Watercourses can still cause localised flooding within these envelopes, for instance as a result of a localised convective storm over a small catchment. In addition, Ordinary Watercourse tributaries may become ‘locked’ as high-flows in the downstream Main River block the drainage of an Ordinary Watercourse. Figure 2.12 identifies the main floodplains of the Trent, Torne and Ancholme as well as the tidal floodplain as the key components of the Zone of Interaction.

4.6 **Groundwater Flooding Information**

Environment Agency Guidance on Areas susceptible to Groundwater Flooding (Figure 2.6) states that, the use of this single predictive groundwater data set is likely to be sufficient for PFRA where no local information exists, as the majority of local flood risk will come from surface water flooding. Unless an area identified as ‘susceptible to groundwater flooding’ is also identified as ‘at risk from surface water flooding’, it is unlikely that this location would actually experience groundwater flooding to any appreciable depth and therefore it is also unlikely that the consequences of such flooding would be significant.

Based on the advice of the Environment Agency, the FMfSW extents (1 in 200 year shallow) has been used to delineate areas at risk of groundwater flooding. This layer has been used in preference to the available groundwater information, since the existing groundwater flood risk information is either relatively broad scale and does not identify risk in sufficient detail, only indicating what percentage of each 1km grid square is susceptible to groundwater flood emergence. The surface water flood map effectively highlights all of the lowest points in an area’s topography – i.e. the key low points where groundwater would be most expected to issue.

In the North Lincolnshire area, the mapping clearly picks up winterbourne type valleys on the chalk hills of the Lincolnshire Wolds i.e. the upper valley of The Beck, from which the large volumes of issuing groundwater caused extensive groundwater flooding in Barrow upon Humber after the June/July 2007 rainfall.
The 0.5% AEP shallow FMfSW mapping has been used since this gives the broadest risk zones around low points, providing a buffer to balance the fact that this mapping was not specifically produced for groundwater flood risk delineation.

Figure 2.8 shows the indicative extent of areas at high risk of groundwater flooding. The two key messages from this figure are: a) the number of ephemeral valleys (winterbournes) in the chalk and limestone ridges, and b) low lying areas within the main areas of floodplain.

4.7 The Future Local Flood Risk Extent – FLFRE

To assess future flood risk in North Lincolnshire, a composite flood risk envelope of local sources of flooding was compiled and agreed. The data set used includes:

- The locally agreed sources of surface water flooding;
- The 20 buffered Ordinary watercourses flood extent;
- The modelled flood Zone 2 extents for Ordinary watercouses, (where available); and
- The recorded flood extents from the summer 2007 event, as supplied by North Lincolnshire Council.

This approach was agreed at a Stakeholder group at meeting held on the 19th January 2011 – Minutes presented in Appendix A. The FLFRE is illustrated in Figure 4.1.

4.8 Locally Significant Future Flood Risk Mapping

The following figures have been produced to indicate potential future flood risk and consequences:

- Figure 4.1 Future Flooding – Local Flood Risk Extent
- Figure 4.2 Future Flooding Consequences – Human Health
- Figure 4.3 Future Flooding Consequences – Economic
- Figure 4.4 Future Flooding Consequences – Environmental
- Figure 4.5 Future Flooding Consequences – People at Risk
- Figure 4.6 Future Flooding Consequences – Critical Services

Table 4.2 shows Future Flooding figures produced and the locations for the most significant impacts of potential future flooding on key receptors. The extent of future flooding has been defined based on available potential local flood risk source extent information (see: Section 4.1). These figures show the potential consequences of future
flooding at the 1km-by-1km cell basis, according to the ‘local significance thresholds’ detailed in Table 2.5. A traffic-light colour scheme is used to illustrate the potential number of people and critical services that have been assessed as being at risk of future flooding. The upper threshold on Figures 4.5 and 4.6 represents the threshold applied (at the 1km square level) by the Environment Agency as part of the national assessment. Limited detailed information is available on conveyance routes etc, so the figures focus on flood extents and point locations.

Table 4.2 Locations of Significant Potential Future Flooding Events

<table>
<thead>
<tr>
<th>Figure Number</th>
<th>Future Flooding Consequences</th>
<th>Key Areas Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Local Flood Risk Extent</td>
<td>Indicates potential risk to larges parts of the low-lying areas of the borough: River Trent and Torne corridor, River Ancholme corridor, and the northern Humber coastal frontage, significant valley features within the north-south running raised limestone and chalk hills.</td>
</tr>
<tr>
<td>4.2</td>
<td>Human Health</td>
<td>Large numbers of above threshold cells identified in Scunthorpe particularly (especially east Scunthorpe), Barrow upon Humber and Barton upon Humber/Goxhill, and also Keadby, Scawby/Brigg.</td>
</tr>
<tr>
<td>4.3</td>
<td>Economic</td>
<td>Large numbers of above threshold cells identified in Crowle/Ealand, Graiselound, east Scunthorpe(i.e. steelworks), Scawby/Brigg &amp; M180, Redbourne, Barrow upon Humber, Barton upon Humber/Goxhill/East Halton, and Ulceby/Croxton.</td>
</tr>
<tr>
<td>4.4</td>
<td>Environmental/Heritage Designation</td>
<td>Large numbers of above threshold cells identified north west of the Isle of Axholme (lower River Torne), Crowle Waste, Flixborough/Crosby, the whole Humber tidal frontage, Broughton Common, Manton Warren, Elsham Park.</td>
</tr>
<tr>
<td>4.5</td>
<td>People at Risk</td>
<td>Severe (i.e. in highest threshold bands) impacts identified at: Scunthorpe, Barrow upon Humber, and Barton upon Humber. Other high risk cells identified at: Winterton.</td>
</tr>
<tr>
<td>4.6</td>
<td>Critical Services</td>
<td>Severe (i.e. in highest threshold bands) impacts identified at: Scunthorpe east (steelworks) only. Other areas of key risk include: Ealand, Bagmoor (nr Normanby), Broughton and Brigg.</td>
</tr>
</tbody>
</table>

4.9 Detailed Records of Future Flooding (spreadsheet)

A copy of the PFRA spreadsheet reporting on future floods and their significant consequences is included in Annex 2. The spreadsheet being the component of the PFRA process that will form the main PFRA response to be collated by the Environment Agency for the national PFRA response for the European Commission.
4.10  Climate Change

Box 1 details the potential long term impacts of future Climate Change

<table>
<thead>
<tr>
<th>Box 1</th>
<th>The Impacts of Climate Change</th>
</tr>
</thead>
</table>

### The Impacts of Climate Change

The impact of climate change on local flood risk is relatively poorly understood. Several national flood maps have informed the preliminary assessment report - specifically the Flood Map for Surface Water (surface runoff), Areas Susceptible to Surface Water Flooding (surface runoff), Areas Susceptible to Groundwater Flooding (groundwater) and Flood Map (ordinary watercourses). These do not show the impact of climate change on local flood risk.

There was consensus amongst climate model projections presented in the IPCC fourth assessment report for northern Europe suggesting that in winter high extremes of precipitation are very likely to increase in magnitude and frequency. These models project drier summers with increased chance of intense precipitation — intense heavy downpours interspersed with longer, relatively dry periods (Solomon et al., 2007).

#### UKCP09

United Kingdom Climate Projections 2009 (UKCP09) provides the most up to date projections of future climate for the UK (http://ukclimateprojections.defra.gov.uk/). In terms of precipitation, the key findings are:

- **By the 2080s, under Medium emissions, over most of lowland UK**
  - Central estimates are for heavy rain days (rainfall greater than 25 mm) to increase by a factor of between 2 and 3.5 in winter, and 1 to 2 in summer.
- **By the 2080s, under Medium emissions, across regions in England & Wales**
  - The central estimate (50% probability) for winter mean precipitation % change ranges from +14 to +23
  - Central estimate for summer mean precipitation % change ranges from -18 to -24.

Certain key processes such as localised convective rainfall are not represented within this modelling so there is still considerable uncertainty about rarer extreme rainfall events for the UK. We can be more certain that heavy rainfall will intensify in winter compared to summer. The proportion of summertime rainfall falling as heavy downpours may increase. The impact of these changes on local flood risk is not yet known.

#### Appraisal Guidance

Current project appraisal guidance (Defra, 2006) provides indicative sensitivity ranges for peak rainfall intensity, for use on small catchments and urban/local drainage sites. These are due to be updated following the UKCP09 projections above. They describe the following changes in peak rainfall intensity; +5% (1990-2025), +10% (2025-2055), +20% (2055-2085) and +30% (2085-2115). This was reviewed by the Met Office in 2008 using UKCP09 models (Brown et al., 2008). They suggest that, on the basis of our current understanding, these levels represent a pragmatic but not a precautionary response to uncertainty in future climate impacts. In particular for a 1 in 5 year event, increases in precipititation intensity of 40% or more by the 2080s are plausible across the UK at the local scale.
4.11 Impact of Major Developments

Box 2 below details the National guidance on preventing future increases in flood risk due to development.

<table>
<thead>
<tr>
<th>Box 2</th>
<th>Long Term Developments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Long Term Developments</strong></td>
</tr>
</tbody>
</table>
|       | In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."
|       | Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria), but should be recorded here so that they can be reviewed in the future. |

N.B.: The Environment Agency notes that this standard text on long term developments may also need to be updated due to changes in the planning system – for example once the implications of the Localism Agenda have been realised in Local Planning Policy.
Notes:
The Local Flood Risk Extent (LFRE) comprises:
1. Modelled Ordinary Watercourse Flood Zone 3
2. 10m centreline buffer (i.e. 20m wide)
3. Areas of historic surface water flooding (NLC records)
4. Agreed surface water map
*ASDWF “near” for Flood Zone 2 areas and SHFM 0.01% AEP (1 in 200 year) shallow for Flood Zone 1 areas

The Flood Zones used/derived are the current Environment Agency datasets

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Figure 4.2
Future Flooding
Consequences - Human Health

Methodology:
(See Section 4 of the PFRA Report)
Locally Significant (i.e. red cells) indicates that one of the following thresholds are exceeded:

- Number of properties * 2.34 is ≥20
- Critical Services ≥1

in the flood risk extent within a given 1km grid cell

(critical services are: hospitals, police, ambulance and fire stations, schools, water treatment works, electricity installations and prisons)

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Figure 4.3
Future Flooding
Consequences - Economic

Methodology:
See Section 4 of the PFRA Report
Locally Significant (i.e. red cells) indicates one or more of the following thresholds are exceeded:
Non-Residential: ≥10
Agri-landscape
Area of Grade 1: ≥100,000m² (10ha)
Area of Grade 2: ≥100,000m² (10ha)
Transport
Motorways and A roads: ≥200m
Rail: ≥100m
In the flood risk extent within a given 1km grid cell

Economic Activity - Locally Significant

No
Yes

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Figure 4.4
Future Flooding Consequences - Environment and Heritage

Methodology:
(See Section 4 of the PFRA Report)
Locally Significant (i.e. red cells) indicates one or more of the following threshold is exceeded:
- ≥1 environmental or heritage designations in the flood risk extent within a given 1km grid cell

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Figure 4.5
Future Flooding
Consequences - People at Risk

Methodology:
Each cells value is calculated based on:
Number of properties * 2.34
in the Local Future Flood Risk Extent
within a given 1km grid cell

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owner i.e. the Environment Agency, Severn
Trent Water or Anglian Water.
Methodology

Each cell's value is calculated based on:

- Critical Services ≥1
- in the Local Future Flood Risk Extent within a given 1km grid cell

(critical services are: hospitals, police, ambulance and fire stations, schools, water treatment works, electricity installations and prisons)

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5. Review of Indicative Flood Risk Areas

In January 2011, the Environment Agency issued the Indicative Flood Risk Areas for England. These are presented in Drawing Number IFRAA_E3 (dated 14-12-2010). The mapping does not identify any Indicative Flood Risk Areas in North Lincolnshire which need to be reviewed as part of the PFRA process. The Final PFRA Guidance – Annex A, issued by the Environment Agency does not require any additional information to be included in this section.
6. **Identification of Flood Risk Areas**

6.1 **Amendments to indicative Flood Risk Areas**

No Indicative Flood Risk Areas have been identified by the Environment Agency, as such there has not been a requirement for this PFRA to suggest amendments. The Final PFRA Guidance – Annex A, issued by the Environment Agency does not require any additional information to be included in this section.

6.2 **Justification of new Flood Risk Areas**

No new Flood Risk Areas have been identified as the assessment of future and past flooding has not identified any areas which meet the National Thresholds of 30,000 people at risk. Indeed there are only 6700 people identified as being at potential risk of future flooding in the whole of North Lincolnshire – based on the Local Future Flood Risk Extent (See Section 4.2). In this calculation, the number of people has been derived by counting the number of residential properties that fall within the Future Flood Risk Envelope and then multiplying that number by 2.34\(^4\). The number of properties is based upon the property centre point location as defined by the Environment Agency’s National Receptor Dataset. The National Receptor Dataset does not include details of the property boundary or the building footprint. As such, if a property’s centre point is not within the Future Local Flood Extent then it is not counted.

Figures 4.5 and 4.6 illustrate (the red cells) which of the 1km grid squares exceed the national thresholds, but these do not cluster together to form nationally significant areas, as defined by the Defra and WAG thresholds.

6.3 **Locally Significant Flood Risk Areas**

Section 4.8 of this report introduces a series of maps which illustrate the potentially significant consequences of future flood risk at the local level. The PFRA has assessed the local significance of flooding from a human health, economic and environmental perspectives and the red cells in Figures 4.1, 4.2, 4.3 and 4.4 illustrate where the consequences exceed the local significance thresholds.

The purpose of identifying Local Flood Risk Areas in the PFRA is to provide the subsequent Local Flood Risk Management Strategy with a prioritised list of areas where flood risk is locally significant.

To identify locally significant Flood Risk Areas it was agreed that the number of people and critical services potentially at risk should be the key local selection criteria. Figure 6.1 illustrates all 1km grid squares which are

\(^4\) The multiplier of 2.34 is defined by Section 6.3 of Annex 6 of the Final PFRA Guidance (Environment Agency)
predicted to have 10 or more people at risk. North Lincolnshire Council felt that these areas captured the majority of areas where flooding issues have been reported. Whilst the 10 or more people Local Selection Criteria identified areas of potential future risk it identified almost all areas of potential risk, and not necessarily areas of significant local risk.

To identify Locally Significant Flood Risk Areas, in terms of the potential consequences of local flood risk, Local Cluster Criteria were developed. In North Lincolnshire it was agreed that this criteria should comprise all adjacent 1km cells which are predicted to have:

- 20 or more people; or
- 1 or more critical services at risk.

Using the Flood Consequence tool, each selected area has been assigned a ranking which is based on the actual number of people within each local cluster. Table 6.1 presents the results of this analysis, Figure 6.2 illustrates the identified Local Flood Risk Areas. The Local Cluster Criteria identify locally significant flood risk areas. These Local Cluster Criteria should not be confused with the national cluster criteria set by Defra and WAG which were used to identify the nationally significant Flood Risk Areas.

The Local Flood Risk Areas identified in Table 6.1 are defined purely on the basis of numeric assessment using the Flood Consequence Tool. This approach utilises the Future Local Flood Risk Extent and the number of properties and critical services within this extent, as defined by the National Receptor Dataset. Using the local knowledge gathered following the June 2007 floods (Figures 3.6, 3.7, 3.8 and 3.9), the Council have confirmed that the following settlements should be included into this list of Local Flood Risk Areas. These areas are identified on Figure 6.2 and are described as being based on evidence of past flooding with locally significant consequences. The settlements include:

- West Halton;
- Low Burnham;
- Redbourne Village; and
- Owston Ferry

The PFRA has identified the Local Flood Areas using the data made available to the study, it will be the role of the Local Flood Risk Management Strategy to refine the selection of Local Flood Risk Areas and their associated boundaries. It should be recognised that this will likely be an iterative process as new information comes forward and following local consultations. North Lincolnshire Council recognise that the prioritised list identified in this PFRA is a draft list and is subject to change during the more detailed, location specific assessments which will form part of the Local Flood Risk Management Strategy. To this end, some new areas not currently identified on Figure 6.2 might be added (i.e. one or more of those identified on Figure 6.1) and some might be removed.
The management of local flood risks within these areas will be developed through a Local Flood Risk Management Strategy. Further details of the Local Flood Risk Management Plan are presented in Section 7.

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Name</th>
<th>Number of People</th>
<th>Number of Critical Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scunthorpe</td>
<td>2532</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Barrow upon Humber and Goxhill</td>
<td>494</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Barton-Upon-Humber</td>
<td>482</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>Brigg and Scawby</td>
<td>300</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>Winterton</td>
<td>208</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Ulceby</td>
<td>129</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Barnetby le Wold</td>
<td>122</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Kirton in Lindsey</td>
<td>115</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Broughton</td>
<td>110</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Althorpe</td>
<td>105</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>East Halton</td>
<td>87</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Belton</td>
<td>79</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>Crowle</td>
<td>70</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>West Butterwick</td>
<td>37</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>Thealby</td>
<td>35</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td>Kirmington</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>Haxey and East Lound</td>
<td>28</td>
<td>1</td>
</tr>
<tr>
<td>18</td>
<td>Luddington</td>
<td>25</td>
<td>3</td>
</tr>
<tr>
<td>19</td>
<td>Elsham</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>Normanby Hall Country Park</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>21</td>
<td>Redbourne (riverside)</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
Based upon the Ordnance Survey Map with the permission of the Controller of Her Majesty's Stationery Office. © Crown Copyright. AL100001776

Figure 6.1

1km grid squares where there are a 10 or more people at risk

March 2011

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Figure 6.2
Local Flood Risk Areas

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7. **Next steps**

North Lincolnshire Council is already in the process of formulating a Local Flood Risk Management Strategy as part of their LLFRA responsibilities under the Flood Risk Regulations 2009. The objectives of the Local Strategy will include:

- Further development of the local flood risk database through recording and future flood event information;
- Refinement of the selected Local Flood Risk Areas;
- Develop a detailed understanding of the flooding mechanisms in each Flood Risk Areas; and
- Once flooding mechanisms are understood identify mechanisms to manage flood risk, options for consideration will include capital works, revenue and maintenance activities, behavioural change, community schemes and planning guidance/controls.
8. References

Ancholme, Scunthorpe and Messingham Internal Drainage Boards, Member of the Shire Group – Report on Storm Damage and Flooding the Followed June 2007 (JBA Consulting)


Annex 1
Records of past floods and their significant consequences (preliminary assessment report spreadsheet)
Records begin here: 1 In June 2007 an intense storm produced surface water flooding across the majority of North Lincolnshire. Properties and settlements were affected throughout the district. The highest concentrations of floodwaters were observed in the coastal areas and along the rivers that flow through the district. The floodwaters were caused by heavy rainfall which saturated the ground and overwhelmed the drainage systems. The floodwaters drowned properties and businesses in the town.

<table>
<thead>
<tr>
<th>Reference Location</th>
<th>Description</th>
<th>Start date</th>
<th>Days duration</th>
<th>Probability</th>
<th>Main source of flooding</th>
<th>Additional source(s) of flooding</th>
<th>Confidence in main source of flooding</th>
<th>Main mechanism of flooding</th>
<th>Main characteristic of flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Lincolnshire</td>
<td>SE9367810583</td>
<td>2007-06</td>
<td>150</td>
<td>High-Medium</td>
<td>Flash flood</td>
<td>Surface runoff</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Annex 2
Records of future floods and their consequences (preliminary assessment report spreadsheet)
### Field Summary

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
<th>Name of Location</th>
<th>Natural Grid</th>
<th>Location Description</th>
<th>Name</th>
<th>Flood modelled</th>
<th>Probability</th>
<th>Main source of flooding</th>
<th>Additional source(s)</th>
<th>Confidence in main source of flooding</th>
<th>Main Mechanism of flooding</th>
<th>Main morphological changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Topography is derived from LiDAR in larger urban areas, on 1:2 and 3m grids; original North Lincolnshire accuracy ± 1.5m and Georeferenciation (original accuracy ± 1.5m), processed to remove buildings and vegetation, then included in a composite 5m DTU. Manual edits applied where flow paths clearly identified e.g. below bridges.</td>
<td>North Lincolnshire</td>
<td>SE93761083</td>
<td>Flooded areas</td>
<td>Areas Susceptible to Surface Water Flooding (ASWF)</td>
<td>Probability refers to the probability of the rainfall event. This identifies areas which are 'less susceptible' to surface water flooding.</td>
<td>200 Surface runoff</td>
<td>High</td>
<td>Natural exceedence</td>
<td>Natural flood</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Topography derived from LiDAR on 0.25m-2m grids; original accuracy ± 0.15m and 35.5 NEXTMap SAR (on 0.5m grid); original accuracy ± 0.1m, processed to remove buildings &amp; vegetation, then combined on a 0.5m grid basis with an arbitrary height of 5m based on OS MasterMap 2009 building centres, then resampled to a 0.5m grid DTU. Manual edits applied where flow paths clearly identified e.g. below bridges.</td>
<td>North Lincolnshire</td>
<td>SE93761083</td>
<td>Flooded areas</td>
<td>Areas Susceptible to Surface Water Flooding (ASWF)</td>
<td>Probability refers to the probability of the rainfall event. This identifies areas which are 'less susceptible' to surface water flooding.</td>
<td>200 Surface runoff</td>
<td>High</td>
<td>Natural exceedence</td>
<td>Natural flood</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>This data has used the top two susceptibility bands of the British Geological Society (2001) 1:50,000 Groundwater Susceptibility Map, which was developed on a 50m grid from:</td>
<td>North Lincolnshire</td>
<td>SE93761083</td>
<td>Flooded areas</td>
<td>Areas Susceptible to Groundwater Flooding (AStGWF)</td>
<td>Does not describe a probability, but shows places where groundwater emergence more likely to occur.</td>
<td>Groundwater</td>
<td>High</td>
<td>Natural exceedence</td>
<td>Natural flood</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Topography derived from LiDAR on 0.25m-2m grids; original accuracy ± 0.15m, NEXTMap SAR (on 0.5m grid), original accuracy ± 1.5m, processed to remove buildings &amp; vegetation. For local modelling, topography may include ground survey.</td>
<td>North Lincolnshire</td>
<td>SE93761083</td>
<td>Flooded areas</td>
<td>Flood Map for the rivers and sea; flood zone</td>
<td>Flood Map for the rivers and sea; flood zone</td>
<td>Flooded in 1947; total 1 in 200</td>
<td>Ordinary watercourses</td>
<td>Sea, ordinary watercourses</td>
<td>Medium</td>
<td>Natural exceedence</td>
<td>Natural flood</td>
</tr>
<tr>
<td>5</td>
<td>Topography derived from LiDAR on 0.25m-2m grids; original accuracy ± 0.15m, NEXTMap SAR (on 0.5m grid); original accuracy ± 1.5m, processed to remove buildings &amp; vegetation. For local modelling, topography may include ground survey.</td>
<td>North Lincolnshire</td>
<td>SE93761083</td>
<td>Flooded areas</td>
<td>Flood Map for the rivers and sea; flood zone</td>
<td>Flood Map for the rivers and sea; flood zone</td>
<td>Flooded in 1947; total 1 in 200</td>
<td>Ordinary watercourses</td>
<td>Sea, ordinary watercourses</td>
<td>Medium</td>
<td>Natural exceedence</td>
<td>Natural flood</td>
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### ANNEX 2: Records of future floods and their consequences (government assessment report spreadsheet)

<table>
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<tr>
<th>Field ID</th>
<th>Description of assessment method</th>
<th>Probability</th>
<th>Main source of flooding</th>
<th>Additional source(s)</th>
<th>Confidence in main source of flooding</th>
<th>Main Mechanism of flooding</th>
<th>Main morphological changes</th>
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<td>Optional</td>
<td>Optional</td>
<td>Mandatory</td>
<td>Optional</td>
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<td>Optional</td>
<td>Mandatory</td>
<td>Optional</td>
<td>Optional</td>
</tr>
</tbody>
</table>

### Notes
- Probability refers to the probability of the rainfall event. This identifies areas which are 'less susceptible' to surface water flooding.
- For the purpose of flood risk management, models assume that there are no raised flood defences.
- For the purpose of flood risk management, models assume that there are no raised flood defences.
## Annex 2 Future floods

<table>
<thead>
<tr>
<th>Significant consequences to human health</th>
<th>Property count method</th>
<th>Other human health consequences</th>
<th>Significant economic consequences</th>
<th>Number of non-residential properties</th>
<th>Property count method</th>
<th>Other economic consequences</th>
<th>Significant consequences to the environment</th>
<th>Environment consequences</th>
<th>Significant consequences to cultural heritage</th>
<th>Cultural heritage consequences</th>
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<td>Optional</td>
<td>Optional</td>
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<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
<td>Optional</td>
</tr>
<tr>
<td>Yes</td>
<td>2865 Detailed GIS</td>
<td>6700 people at risk</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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</tbody>
</table>

- **Significant consequences to human health**: Yes
- **Significant economic consequences**: Yes
- **Significant consequences to the environment**: Yes
- **Cultural heritage consequences**: Yes
### Annex 2 Future Floods

<table>
<thead>
<tr>
<th>Data owner</th>
<th>Area flooded</th>
<th>Confidence in modelled outline</th>
<th>Model data</th>
<th>Model Type</th>
<th>Hydrology Type</th>
<th>Uplift</th>
<th>Sensitive data</th>
<th>Protective marking</th>
<th>European Flood Event Code</th>
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</thead>
<tbody>
<tr>
<td>JBA Consulting (distributed by Environment Agency under licence)</td>
<td>Low</td>
<td>2009-07</td>
<td>JFLOW-GPU</td>
<td>Depth-duration-frequency curves derived from FEH CD-ROM. From centre of each 5km model, with area reduction factor applied to convert point rainfall estimates to more representative figures. Curve then used to derive 0.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.</td>
<td>Protect</td>
<td>Commercial</td>
<td>UKE00000003F0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment Agency</td>
<td>Medium-Low</td>
<td>2010-11</td>
<td>JFLOW-GPU</td>
<td>Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with area reduction factor applied to convert point rainfall estimates to more representative figures. Curve then used to derive 1.1 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.</td>
<td>Rainfall Hyetograph, EA 1m Composite DTM, OSMM Topography</td>
<td>Unmarked</td>
<td>UKE00000003F0002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment Agency</td>
<td>Low</td>
<td>2010-11</td>
<td>ArcGIS</td>
<td>Uses data which is developed from published BGS groundwater level contours, groundwater levels in BGS WellMaster database and some river levels. No probability is associated with this data.</td>
<td>British Geological Society (BGS) DigMapGB-50 [Susceptibility to Groundwater Flooding],</td>
<td>Unmarked</td>
<td>UKE00000003F0003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment Agency</td>
<td>Medium</td>
<td>2010-11</td>
<td>Varies but mainly JFLOW, ISIS, HEC-RAS, TUFLOW for fluvial, and HYDROF for tidal.</td>
<td>National methodology described in &quot;National Generalised Modelling for Flood Zones - Fluvial &amp; Tidal Modelling Methods - Methodology, Strengths and Limitations&quot;. A national dataset (for England and Wales) of fluvial/flood peak estimates was derived from the Flood Estimation Handbook (FEH) to generate a 1 in 100 chance fluvial flood. Local fluvial modelling uses FEH methods. Peak tide levels from either Dixon &amp; Tawn (CTG) or local data sets to derive 1 in 1000 chance tide levels including surge from POL CSX model.</td>
<td>NextMap SAR DTMs, UKHO Admiralty Charts, 1:50K CEH River Centre Line, CEH FEH Q(T) Grid, POL CSX Peak Extreme Water Levels, POL CS3 Astronomical Tides, UKHO Admiralty Tide Time-Series Calibration Locations, OS 1:10 Boundary Line MHW, Historic</td>
<td>Protect</td>
<td>Commercial</td>
<td>UKE00000003F0004</td>
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<tr>
<td>Environment Agency</td>
<td>Medium</td>
<td>2010-11</td>
<td>Varies but mainly JFLOW, ISIS, HEC-RAS, TUFLOW for fluvial, and HYDROF for tidal.</td>
<td>National methodology described in &quot;National Generalised Modelling for Flood Zones - Fluvial &amp; Tidal Modelling Methods - Methodology, Strengths and Limitations&quot;. A national dataset (for England and Wales) of fluvial/flood peak estimates was derived from the Flood Estimation Handbook (FEH) to generate a 1 in 1000 chance fluvial flood. Local fluvial modelling uses FEH methods. Peak tide levels from either Dixon &amp; Tawn (CTG) or local data sets to derive 1 in 1000 chance tide levels including surge from POL CSX model.</td>
<td>NextMap SAR DTMs, UKHO Admiralty Charts, 1:50K CEH River Centre Line, CEH FEH Q(T) Grid, POL CSX Peak Extreme Water Levels, POL CS3 Astronomical Tides, UKHO Admiralty Tide Time-Series Calibration Locations, OS 1:10 Boundary Line MHW, Historic</td>
<td>Protect</td>
<td>Commercial</td>
<td>UKE00000003F0005</td>
<td></td>
</tr>
<tr>
<td>North Lincolnshire Council</td>
<td>Unknown</td>
<td>2011-01</td>
<td>Developed using GIS applications not hydraulic modelling.</td>
<td>Developed using GIS applications not hydraulic modelling.</td>
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<td>UKE00000003F0006</td>
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<tr>
<td>North Lincolnshire Council</td>
<td>Unknown</td>
<td>2011-01</td>
<td>Developed using GIS applications not hydraulic modelling.</td>
<td>Developed using GIS applications not hydraulic modelling.</td>
<td></td>
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<td>UKE00000003F0007</td>
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</tbody>
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Appendix A
PFRA Meeting Minutes and Confirmation of Approach
Minutes of Meeting

Client: North Lincolnshire Council
Client Reference: NLC PFRA
Our Reference: 28766- Co26
Issued By: John Rampley
Issue Number: 1
Issue Date: 21-01-11
Meeting Date: 19-01-11
Location: Highways Offices
Present at Meeting:
David Harrison (DH)
Rod Chapman (RC)
Ian Russell (IR)
John Ray (JRay)
Rod Beales (RB)
Mervyn Pettifor (MP)
John Rampley (JR)

Apologies for Absence:
Richard Breakspear (Entec)
Nick Jarritt (Entec)
John Hasthorpe (Entec)

Additional Distribution:
North Lincs PFRA

Subject: MINUTES OF MEETING 19-01-11

Notes:
These meeting minutes include the main points from the meeting (19th January 2001 which relate to the PFRA methodology being applied by Entec. It is important to the project team that these minutes are agreed as soon as possible so as to reduce any potential risk to timetable.

Please could I ask that any comments are returned to john.rampley@entecuk.co.uk by the end of the day on the 25th January.

Any specific actions which arose from the meeting are identified at the end of this document.

Minutes:
1. Parish roadshows were undertaken by Dave and Rob, following the summer 2007 floods, with the purpose of capturing local information on the nature and extent of the flooding which occurred.

2. NLC’s flooding records for 2007 were analysed by DH. On the basis of the data collected, DH ranked each parish on the basis of flood risk. This ranking system will be applied in the PFRA to define ‘past flooding’ priority areas.

3. IR and JRay agreed to review draft outputs prior to submission. Review period will be mid February.

4. JRay confirmed that where there are ordinary watercourses within a main river floodplain, that area of main river floodplain should be identified as an ‘area of interaction’. Maps of these areas should be produced. These maps will include the IDB boundaries.
5. A 10m buffer should be applied to the Ordinary Watercourse centreline for all Ordinary Watercourses which do not have modelled flood zones. This 10m buffer will represent a quasi flood extent for these watercourses.

6. Entec are to create a composite map of future surface water risk which includes the ASSWF in the parts of the District covered by Flood Zone 2 and the SWFM in the parts of the district in Flood Zone 1. Two tests will be run, the first will use the ‘less susceptible to surface water flooding’ version of the ASSWF map and the 1:200yr ‘shallow’ version SWFM (i.e. the larger extents). The second approach will utilise the; ‘more susceptible to surface water flooding’ version of the ASSWF and the 1:200yr ‘deep’ version of the SWFM (i.e. the smaller extents). The number of people identified within each will be calculated and NLC will advise as to which version best represents ‘local surface water flood risk’. For the purposes of assessing the significance of surface water in North Lincs, from a national perspective, the ‘less susceptible’ and the ‘deep’ options will be used as this is more aligned to the national assessment methodology.

7. The ‘local flood risk’ within the district (including the zones of interaction) will be defined by a composite flood envelope which includes:
   • The locally agreed surface water flood risk map (see point 6);
   • The modelled Ordinary Watercourse flood extents;
   • The 10m buffer for un-modelled Ordinary Watercourses; and
   • The historic areas of surface water flooding as recorded by NLC.

This does not include the Historic Flood Map (HFM) supplied by the Environment Agency.

8. It was agreed that the groundwater flood map should be included within the PFRA mapping, but that it should not be used to assess consequence.

9. MP – noted that in Lincolnshire, the assumption has been made that the IDB drainage districts will not reach the National Thresholds so there is no requirement to assess the impacts of flooding relating to IDB assets at this stage. The same assumption will be applied in North Lincs.

10. Past and Future flood maps will either be produced on A2 paper or the district will be split into two halves for mapping purposes so as to improve the resolution of the data. Entec are to assess the most suitable option.

11. It was agreed that JR would send round a table of ‘draft’ thresholds for the 3 flood consequence themes, so as to assess significance at a local level, i.e. Human Health, Economic and Environmental/Heritage (table provided at the end of these minutes). These thresholds need to be confirmed by NLC by the 26-01-11 if the first week in February deadline is to be achieved for the draft PFRA report.

12. From a flood consequence/significance perspective, the PFRA output will be three maps illustrating the consequence from a human health, economic and environmental/heritage perspectives, this will be displayed on a 1km grid square basis using a traffic light colouring system. These maps will include the parish rankings (see point 2).
MINUTES OF MEETING 19-01-11

13. It was agreed that there is insufficient data in North Lincs for the frequency of flooding to be used to assess flood risk areas. The approach will remain focused on the number of receptors within the locally agreed flood risk envelope.

14. All the NLC historic data relates to the June 2007 storm event. As such this represents one flood event and thus will be represented in the PFRA ‘past flooding’ spreadsheet as one event.

Actions

- DH – to provide JR with IDB contact details
- JR – contact IDBs to establish if there is any other data that they may have which has not already been captured by NLC
- DH – to circulate details of the Flood Forum meeting being held on the 23rd FEBRUARY 2011
- JR – will seek to ascertain from STW and AW which of the DG5 records no longer present a risk following maintenance works. Please note that this information may not be returned to Entec in time for inclusion in the PFRA.
- DH/RC – to provide details of which recorded flooding incidents have been resolved, i.e. which records do not represent a future risk due to works that have been undertaken.

Next Meeting:

The next meeting is scheduled for the 23/02/10, this is the meeting of the Local Flood Forum and JR will present the findings of the PFRA – scope and duration of presentation to be agreed.

Thresholds for Local Significance:

Table 1 – Thresholds for Local significance

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Criteria (where appropriate)</th>
<th>Local Threshold (per 1km square)</th>
<th>Presentation on Maps</th>
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<tbody>
<tr>
<td>Human Health</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>People</td>
<td>= properties * 2.34</td>
<td>50</td>
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<td></td>
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<td></td>
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<td>t.b.c</td>
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### Environmental

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