

Lincolnshire County Council Lead Local Flood Authority

Preliminary Flood Risk Assessment Preliminary Assessment Report

Final Report (excluding appendices)

18 June 2011

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Flooding at Stamp End, Lincoln – June/July 2007

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Executive Summary

This preliminary assessment report and the preliminary flood risk assessment on which it is based have been prepared by the Lincolnshire Lead Local Flood Authority (LLFA) to meet its requirements under the Flood Risk Regulations 2009. Work has been carried out in accordance with guidance from the Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency using available and readily derivable information, and work to date completes the first two stages of the flood risk management process for Lincolnshire, as contained within the Regulations.

The Lincolnshire PFRA is a countywide preliminary assessment of flood risk from local sources (i.e. surface water, groundwater and ordinary watercourses), specifically to identify any significant flood risk areas that meet the national level significance thresholds provided by Defra. **The PFRA does not identify and/or assess individual local flood risk areas within the county at this stage. This will be done as part of the LLFA Local Flood Risk Management Strategy (LFRMS).**

No new flood risk areas with national level significant harmful consequences have been identified in Lincolnshire. However, as shown on the latest Environment Agency Flood Map for Surface Water (Deep), approximately 2.3% – 2.6% of all property in Lincolnshire has been either flooded in the past or may be at risk of surface water flooding in the future. The anticipated increase in flooding in the future reflects an initial realistic backward look at historical events whilst taking account of the current national scale predicted flood risk over future years.

Using currently available information to assist the LLFA understanding of the term “**significant harmful consequences**”, as used in the Regulations, a number of initial options for establishing “**initial county level significance thresholds**” and hence determining “**candidate county significant indicative local flood risk areas**” have been explored. However, due to current gaps in scientific evidence and knowledge at a local level, this remains “work in progress” and will be considered further to assist the development of the Local Flood Risk Management Strategy in the coming months. More local investigation and information is needed to create a sound and robust scientific evidence base (including appropriate probability, hazard/risk modelling and mapping where necessary), to guide flood risk management decision making in the county at a local level.

The Environment Agency’s national scale surface water flood modelling and mapping outputs have guided the PFRA and the output of this report (along with other local flood risk information). However, this national scale mapping provides a general indication of the broad areas that may be at risk of surface water flooding and is not suitable for use at an individual property scale. Any location shown or referred to in respect of this mapping does not mean that any property

or properties within the location should be regarded as at greater or lesser risk of flooding than any other area; until more detailed work has been undertaken to assess the risk of surface water flooding in the local context.

Importantly, all work carried out to date with regard to the PFRA and this preliminary assessment report provides a valuable contribution to the better understanding of flood risk from local sources affecting communities within the county, and this preliminary work will now be taken forward as part of the development of the Lincolnshire Local Flood Risk Management Strategy.

Contents

Document Control Sheet	2
Executive Summary	3
Contents	5
Tables	8
Figures	9
1 Introduction	10
1.1 Purpose and scope of the report	10
1.2 Aims and objectives	12
1.3 Introduction to the study area	14
2 Lead Local Flood Authority responsibilities	19
2.1 Flood and Water Management Act 2010	19
2.2 PFRA project governance and partnership arrangements	20
2.3 Communication with partners and the public	22
3 Methodology and data review	24
3.1 Methodology of approach and information gathered	24
3.2 Data availability and limitations	30
3.3 Storage systems, information sharing and quality assurance	31
3.4 Future developments	32
3.5 Relevant information held by partners	32
3.6 Relevant information available to the public	32
3.7 Scrutiny and review procedures adopted	32
4 Past flood risk	34

4.1	When floods have occurred and their consequences	34
4.2	Consideration of significant harmful consequences, significance thresholds and past floods	36
5	Future flood risk	38
5.1	Description of future floods and their consequences	38
5.2	Locally agreed surface water information, local drainage capacity and interaction of flooding sources	39
5.3	Consideration of future floods with significant harmful consequences	43
5.4	Climate change and long term developments	43
5.5	Climate change impacts on local flood risk	45
5.6	New or proposed major developments likely to increase local flood risk	45
6	Review of indicative Flood Risk Areas	46
6.1	Review of indicative Flood Risk Areas provided by the Environment Agency	46
7	Identification of Flood Risk	49
7.1	Amendments to indicative Flood Risk Areas	49
7.2	Current assessment and understanding of preliminary local flood risk to the county as a whole	49
7.3	Indicative maps showing areas across the county at potential risk of flooding from local sources:	51
	<ul style="list-style-type: none">• Recorded historical local flooding• Extract from the Environment Agency Flood Map for Surface Water (deep)• Initial areas where potential flood risk requires further investigation as part of the local strategy• Areas susceptible to groundwater flooding• Environment Agency Standard Notice	
8	Next steps	66

8.1	Proposed measures to support the PFRA in 6 years time	66
8.2	Development of the Local Flood Risk Management Strategy	67
9	Key references	69
10	Glossary	70
11	Abbreviations	74
12	Annexes	75
13	Appendices	76

Tables

1	Lincolnshire Flood Risk and Drainage Management Groups	14
2	Pen portraits of Sub-Regions	16
3	Partner organisations involved in the Lincolnshire Partnership Framework	21
4	Serious flood events in Lincolnshire	34
5	Summary of property numbers flooded in June/July 2007	35
6	Factors influencing the consideration of significant harmful consequences	36
7	Defra indicators and threshold values	46
8	Whole county property, ward and parish % flooded figures	50
9	Further options for consideration of significance thresholds and county significant indicative local flood risk areas	50
10	Whole county property, ward and parish % flooded figures (Including all historic flooded properties)	51

Figures

1	PFRAs and the Flood Risk Regulations	12
2	Map showing the Lincolnshire PFRA study area and FR&DM Groups	14
3	Map showing the Lincolnshire PFRA study area in the context of the Anglian River Basin District	15
4	Extreme flood risk outline from sea, tidal and river sources (Flood Zone 3)	17
5	Lincolnshire partnership framework groups	21
6	Outline logical approach used for consideration of Local Flood Risk Areas in developing the PFRA and Local Flood Risk Management Strategy	26
7	Central Lincoln FR&DMG Locally Agreed Surface Water Information	39
8	South Kesteven FR&DMG Locally Agreed Surface Water Information	40
9	East Lindsey FR&DMG Locally Agreed Surface Water Information	40
10	Boston and South Holland FR&DMG Locally Agreed Surface Water Information	40
11	River Network Map showing areas of potential flooding Interactions	42
12	Indicative flood risk areas for England (based on administrative boundaries)	47
13	Places in Lincolnshire above Environment Agency flood risk thresholds	48

1 Introduction

Defra Guidance requirements:

- *Scope of the report; local flood risk (i.e. not including flooding only from main rivers, the sea or large raised reservoirs);*
- *Aims and objectives; identifying Flood Risk Areas and supporting local flood risk management strategy; and*
- *Introduction to the study area.*

1.1 Purpose and scope of the report

The Flood and Water Management Act 2010, establishes that flood risk will be managed within a framework of National Strategies for England and Wales and Local Strategies for each Lead Local Flood Authority area which includes Lincolnshire.

The National Strategies will set out principles for how flood risk should be managed and will provide strategic information about different types of flood risk and which organisations are responsible for their management. The National Strategies will be developed by the Environment Agency and approved by Parliament.

Lincolnshire Lead Local Flood Authority has responsibility for developing a Local Flood Risk Management Strategy for the area covering local sources of flooding (i.e. surface water, groundwater and ordinary watercourses). The strategy will set out the local organisations with responsibility for flood risk in the area, partnership arrangements to ensure co-ordination between these, an assessment of flood risk and plans and actions for managing the risk.

In addition, the Flood Risk Regulations 2009 are European legislation and are compatible with the Flood and Water Management Act. The Preliminary Flood Risk Assessment stage of the regulations (i.e. the focus of this report), will serve as an initial assessment for the LLFA local strategy and maps and plans etc. will inform it.

This Preliminary Assessment Report (PAR) should be considered in the context of the Lincolnshire Local Flood Risk Management Strategy and it is a “stepping stone” to enable preliminary and appropriate consideration of local sources of flood risk across the county. It provides a high level summary of potentially significant local flood risk, based on available and readily derivable information and should not be considered as having a high degree of accuracy, due to the national scale scientific modelling used. In accordance with the Defra guidelines,

no new information has been developed for the PFRA. However, new preliminary analysis of existing information has been carried out.

This document is “fit for purpose” for the national assessment of significant local flood risk areas in accordance with Defra’s “significance” thresholds. Information contained within this report should only be applied at a county level and NOT at a more local property scale as further investigation and other work is required as part of the development of the Lincolnshire Local Flood Risk Management Strategy (LFRMS).

The scope of this report is as set out in the document “Preliminary Flood Risk Assessments – Final Guidance for Lead Local Flood Authorities – 7th December 2010 – Environment Agency”. It covers flood risk sources from ordinary watercourses, surface water, groundwater and flooding from canals and small impoundment reservoirs. Flooding from the sewerage system is also included when caused by rainwater entering or affecting the system. Instances where local sources are impacted by interactions with flooding from Main River, reservoirs and the sea have also been considered and included where appropriate.

The PFRA work summarized in this report was carried out in three phases:

- Build on the Lincolnshire Flood Risk and Drainage Management Framework established by the partners;
- Establish a logical framework and systems for the collation, storage and maintenance of data on flooding sources, pathways and receptors; and
- Using PFRA guidance, prepare the final PFRA report (PAR) and identify any national significant level flood risk areas in Lincolnshire.

This Preliminary Assessment Report (PAR) complies with the requirements defined in Regulation 12 of the Flood Risk Regulations 2009.

1.2 Aims and objectives

The PFRA work carried out embraces Stage 1, Stage 2 and Stage 2a of the flood risk management process shown in Figure 1 below.

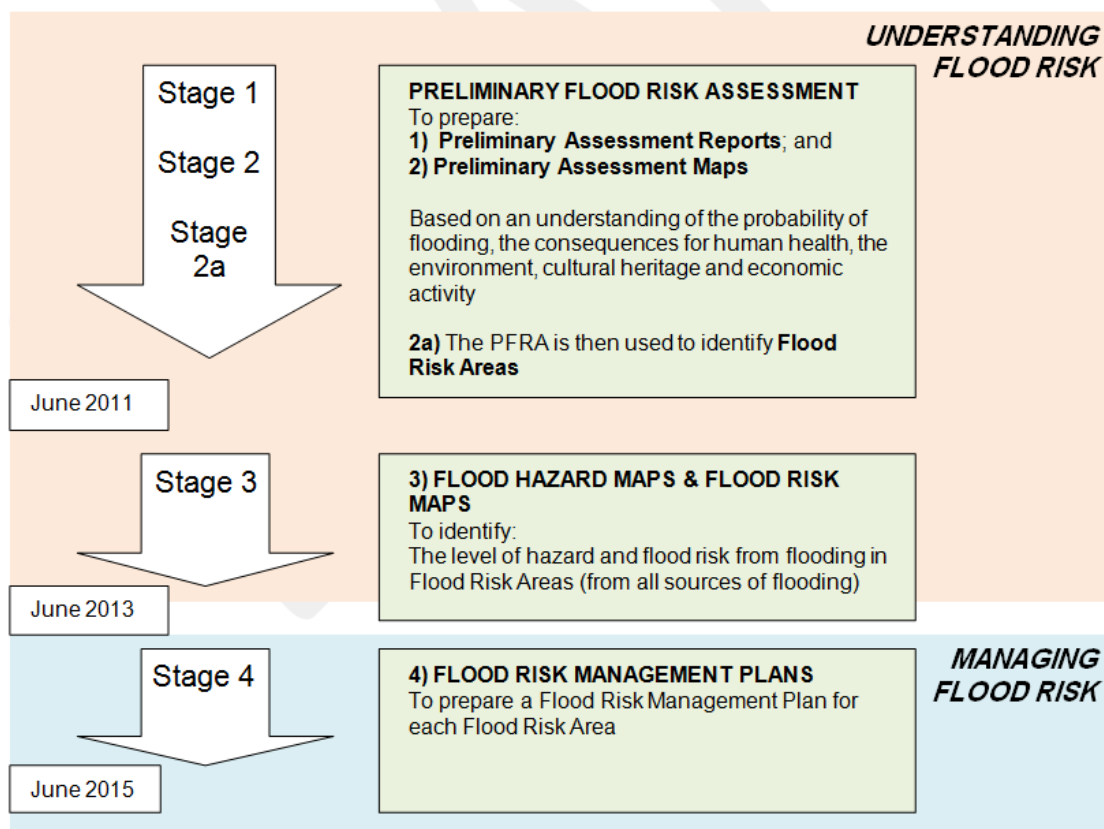


Figure 1 - PFRA and the Flood Risk Regulations

Consideration of Stages 3 and 4 will be carried out as part of the development of the Lincolnshire local strategy.

The primary objective of the PFRA is to:

- Gather local data and information to amend the Indicative Flood Risk Areas where necessary and produce locally significant Flood Risk Areas.

The PFRA identifies relevant past floods and possible future flood risk. It documents recorded past flooding events that have had harmful consequences for human health, economic activity, the environment and cultural heritage; and assesses possible harmful and adverse consequences of future floods. Consideration of the number of

properties, critical infrastructure and essential services flooded; the extent of flooding in the overall community and the frequency flooding occurs is particularly important.

Key objectives of the PFRA:

1. Collect information on historic and future (potential) floods and flood risk;
2. Assemble the information into a PFRA Report (PAR);
3. Use the information in the report to determine where the flood risk may be significant;
4. Identify Flood Risk Areas and support the Local Flood Risk Management Strategy;
5. Deliver the PAR and PFRA maps showing any areas of national level significant flood risk in Lincolnshire,
6. Submit the PAR and (where necessary), any revised national level Flood Risk Area Maps to the Environment Agency;
7. Ensure the PAR is produced in accordance with national guidance, and is fit for purpose for use locally in Lincolnshire (including to inform land use planning considerations and links to Strategic Flood Risk Assessments (SFRAs); and
8. Maximise the use of resources within the Lincolnshire Flood Risk and Drainage Management Framework.

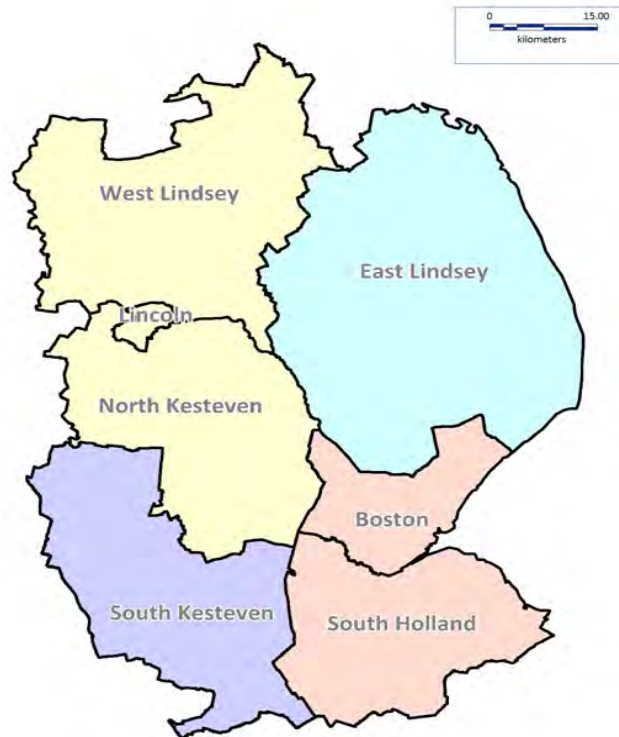
1.3 Introduction to the study area

The PFRA study area covers the whole of the county of Lincolnshire, incorporating the now well established four Flood Risk and Drainage Management Groups (FR&DMG) within the partnership framework. The FR&DMGs are defined by the LDF areas and these are shown in Table 1 below:

<u>Central Lincolnshire FR&DMG</u> <ul style="list-style-type: none"> • West Lindsey District • Lincoln City • North Kesteven District 	<u>East Lindsey FR&DMG</u> <ul style="list-style-type: none"> • East Lindsey District
<u>South Kesteven FR&DMG</u> <ul style="list-style-type: none"> • South Kesteven District 	<u>Boston & South Holland FR&DMG</u> <ul style="list-style-type: none"> • Boston Borough • South Holland District

Table 1 – Lincolnshire Flood Risk and Drainage Management Groups

The study area is shown in Figure 2 below:



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Figure 2 – Map showing the Lincolnshire PFRA study area and FR&DM Groups

The county of Lincolnshire is predominantly rural and has a geographical area of 2,309 sq miles, extending into Anglian (82.4 %), Humber (17.6 %) River Basin Districts as shown in Figure 3 below:



Figure 3 – Map showing the Lincolnshire PFRA study area in the context of the Anglian River Basin District

The overall latest population figure (2009) for Lincolnshire is 697,900 and people are spread over 515 parishes/towns. Pen portraits of Lincolnshire's district/borough areas (sub-regions as detailed in the Lincolnshire Housing Strategy) are shown in Table 2 below:

Lincolnshire Housing Strategy - Draft Baseline Report



Pen Portraits of Sub-Regions (taken from Local Authority & County produced documents)

	Size	Population	Age profile	Migration
COASTAL				
Boston	140 sq miles Key town Boston plus 18 rural parishes Bordered to the east by The Wash, an internationally important coastal conservation area	58,400 in 2007, up 4.8% from 55,750 in 2001	Under 50's are below national average levels - almost 40% of the population over the age of 50	Home to a significant number of guest workers from Europe, particularly Portugal and Eastern Europe
East Lindsey	700 sq miles Key towns Louth and Skegness Includes the Fens and the Wolds, and almost all of tourist coastline	140,100 in 2007, up 7% from 2001 Very rural - 91% of the communities have population under 1000.	Highest proportion of people aged over 65 in the East Midlands Lowest proportion of under 24s in Lincolnshire	In-migration is above national and regional averages -mainly retiring, older people and those with health issues
CENTRAL				
Lincoln	14 square miles The only city in the County Named a UK's Top Ten favourite city (Guardian/Observer Travel awards 2004)	87,800 in 2007, up 9.7% from 2001	15% are 16-24 year olds, largely due to more further education in Lincoln	Designated as a cluster area for asylum seekers. BME population of 7.1%, the highest in the County
North Kesteven	356 sq miles Key towns Sleaford and North Hykeham with 13 larger villages High proportion of agricultural land	104,800 in 2007, up 11% from 2001 North Kesteven is the fastest growing district in the East Midlands and 4th fastest in England and Wales - mainly due to high house building rates and in-migration	Above average population aged 45 and older Below average in the 15 - 29 age group.	
West Lindsey	447 sq miles Key towns Caistor, Gainsborough and Market Rasen - predominantly rural The northwest gateway to Lincolnshire	88,000 in 2007 West Lindsey is the most sparsely populated area within Lincolnshire.		
PETERBOROUGH PARTIAL				
South Holland	287 sq miles Key towns Spalding, Holbeach, Long Sutton, Crowland and Sutton Bridge Many small rural communities Links with economy/housing issues in Cambs, Norfolk and Peterborough	82,600 in 2007, up 8% from 2001 Biggest growth in the 'active pensioner' over 65 group		Small BME population but growing due to EU migrants for seasonal agricultural work
South Kesteven	365 square miles, with Grantham being the main urban centre	131,100 in 2007, up 5% from 2001.	Over 65s increasing at a higher rate than younger age groups	Small BME population but increasing numbers from Eastern Europe

Table 2 – Pen portraits of Sub-Regions (taken from Local Authority and County produced documents)

Flood risk sources in Lincolnshire are principally:

- Sea and tidal estuaries/havens
- Rivers and watercourses
- Heavy rainfall, surface water run-off and over-flowing sewers
- Groundwater
- Canals
- Reservoirs

The extreme flood risk outline from sea, tidal and river sources (Flood Zone 3) is shown on the Environment Agency's map in Figure 4 below.

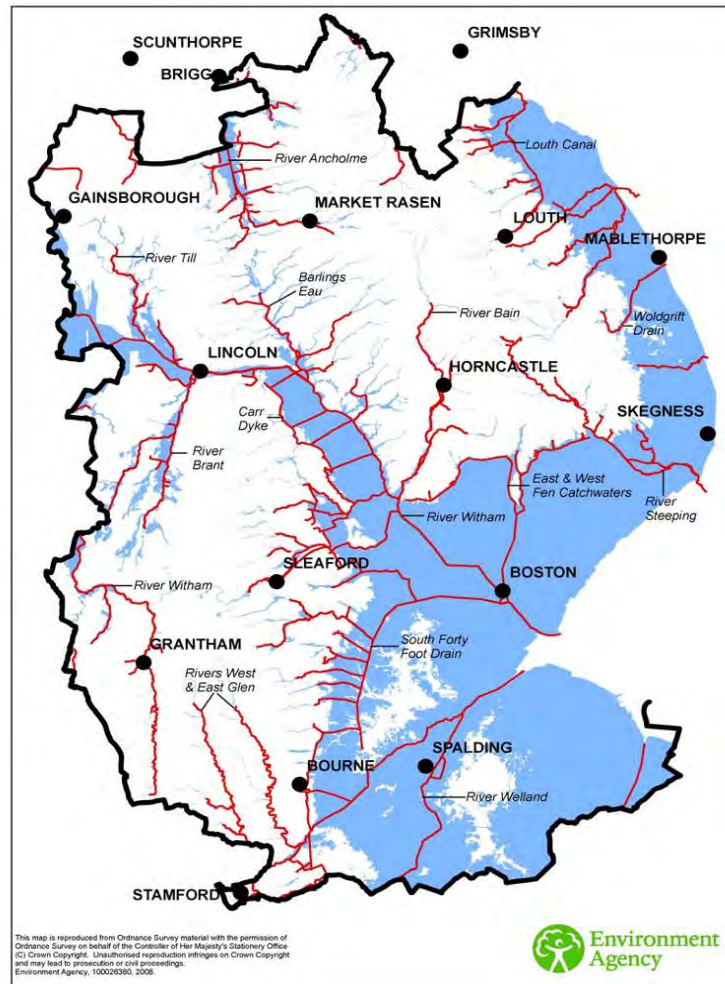


Figure 4 - Extreme flood risk outline from sea, tidal and river sources (Flood Zone 3)

This PAR covers local flood risk sources i.e. from ordinary watercourses, surface water, groundwater, canals and small impoundment reservoirs and from sewerage systems when caused by rainwater; and interactions with flooding from Main River, and the sea.

Due to the topography of Lincolnshire from the rolling hills and steep valleys of the Lincolnshire Wolds to the low lying coastal fringes and fenland areas around the Wash; many communities are at potential risk of flooding from heavy rainfall and surface water. For example, significant historic flooding has occurred in Lincoln, Louth, Horncastle, Grantham and Sleaford.

Groundwater flooding also affects communities in Lincolnshire. Parts of Sleaford and Bourne, and the surrounding areas are susceptible to flood risk due to high groundwater levels in the underlying aquifer. Also parts of the Lincolnshire Wolds are susceptible to groundwater flooding when water levels are high in the Chalk aquifer. The villages along the spring line to the east of the Wolds are also likely to be at risk of this type of flooding.

Flood risks from the Fosdyke Canal, Horncastle Canal, Louth Canal and Grantham Canal are also a concern to local communities and have been considered as part of this PFRA.

A number of small impoundment reservoirs exist across the county and flood risk from this source has been considered as part of the overall “high level” risk assessment.

2 Lead Local Flood Authority responsibilities

Defra Guidance requirements:

- *Governance and partnership arrangements, possible diagram to illustrate; and*
- *Communication with partners and the public.*

2.1 Flood and Water Management Act 2010

As Lead Local Flood Authority (LLFA), Lincolnshire County Council has a number of responsibilities under the requirements of the Flood and Water Management Act 2010 of which undertaking the PFRA is one. Other requirements are:

- **Leadership and co-ordination of flood risk management in Lincolnshire:** this includes developing and supporting partnership arrangements as appropriate;
- **Local Strategy for Flood Risk Management:** LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments. This PFRA will assist the development of the Lincolnshire Local Flood Risk Management Strategy;
- **Asset Register:** Duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records;
- **Designation powers:** The LLFA, district councils and the EA have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management;
- **SuDS Approving Body:** Under the Flood & Water Management Act 2010 the LLFA will become the SuDS Approving Body (SAB) for any new drainage system involving more than one property. Although this has not yet been enacted, it is expected to come into force during 2012. At this point the LLFA will be responsible for approving, adopting and maintaining new drainage systems provided they are constructed in accordance with national standards;
- **Investigating flood incidents:** LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have flood risk management functions and what they have done or intend to do

with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out; and

- **Works powers:** When this section of the Act is enacted, LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area.

2.2 PFRA project governance and partnership arrangements

The formal project was set up to undertake the PFRA and to deliver the PAR. It was managed in accordance with the requirements of the LLFA and based on good project management principles and structures, appropriate, proportionate and fit for purpose for this project. Wherever appropriate, a consistent approach was taken with that adopted for the Lincolnshire Multi Agency Flood Emergency Plan (MAFP) which is an emergency planning document.

Project governance, decision making and resource support was provided by a project team, with members drawn from organisations within the Lincolnshire Flood Risk and Drainage Management Framework.

Members of the project team (including a Lincolnshire County Council Executive Member) each had specific project roles and responsibilities in support of the project, in addition to a collective responsibility to deliver the project objectives to time, cost and quality. A project plan and a risks and issues log were developed and maintained.

A partnership framework, comprising strategy, operational and delivery groups, has been established across Lincolnshire to provide co-ordinated management and delivery of flood risk and drainage functions of all relevant organisations. These groups are shown in Figure 5 below:

Lincolnshire Flood Risk & Drainage Management Framework

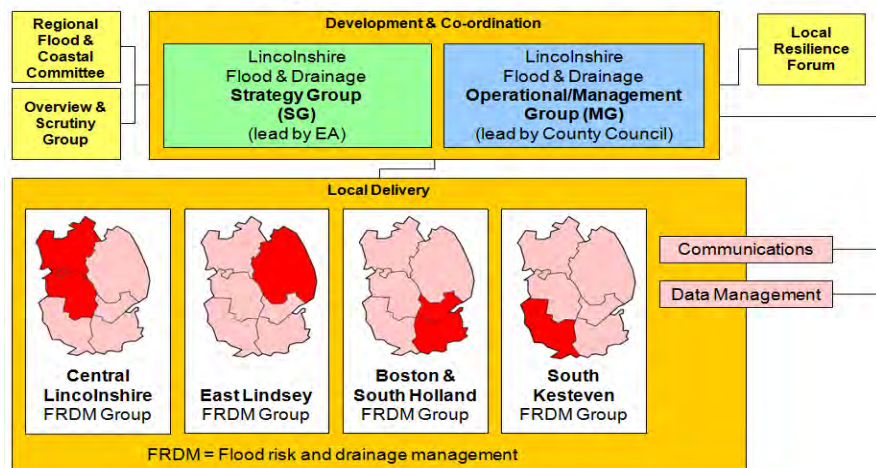


Figure 5 – Lincolnshire partnership framework groups

Partner organisations involved are shown in Table 3 below:

The Environment Agency	North East Lindsey IDB
Lincolnshire County Council	Lindsey Marsh DB
West Lindsey District Council	Witham First District IDB
East Lindsey District Council	Upper Witham IDB
City of Lincoln Council	Witham Third IDB
North Kesteven District Council	Witham Fourth District IDB
South Kesteven District Council	Black Sluice IDB
Boston Borough Council	Welland and Deepings IDB
South Holland District Council	South Holland IDB
ADA (Lincolnshire Branch)	North Level IDB
Gainsborough IDB	King's Lynn IDB
Newark Area IDB	Anglian Water
Ancholme IDB	Severn Trent Water

Table 3 - Partner organisations involved in the Lincolnshire Partnership Framework

The **Strategy Group** ensures integration of the strategic direction of the Environment Agency's flood and coastal risk management overview role with that of the new leadership role of the lead local flood authority. It also acts as a key point of contact with the Lincolnshire Resilience Forum. It is chaired by the Environment Agency and meets every six months, or more often as required.

The **Operations Group** delivers the responsibilities of the Lead Local Flood Authority. It meets every two months and is chaired by Lincolnshire County

Council with support from the Environment Agency, District Councils, Anglian Water and Internal Drainage Boards through the Lincolnshire branch of the Association of Drainage Authorities. Its role is to co-ordinate key countywide functions, empowering the Local Flood Risk and Drainage Management Groups to deliver flood risk management and drainage solutions at the local level.

The **Local Flood Risk and Drainage Management Groups** build on pre-existing local drainage groups. Their function is to provide flood risk management and drainage solutions developed by the consensus of partner organisations and tailored to meet local circumstances. They are the delivery arm of the Lincolnshire Flood Risk and Drainage Management Framework. They are based on Local Development Framework boundaries and meet as often as required to conduct the business needed.

Terms of Reference for each of the partnership groups are provided in **Appendix A**.

2.3 Communication with partners and the public

Communication with partners was carried out as an integral part of the framework group meetings and routine business activity. This enabled the joint consideration of the PFRA as it was developed and the collective “sign up” to the PAR by the partnership framework as a whole.

Regular PFRA progress updates were provided to all six groups at the appropriate level of detail and comments and feedback received. In particular, the Local Flood Risk and Drainage Management Groups played a key role in identifying and sharing relevant data and information. They also assisted with identifying and agreeing candidate flood risk areas based on historic flooding records, and then subsequently considered these in respect of potential future flooding using the Environment Agency’s surface water flood maps and the Defra thresholds for national significance. Overall, three specific PFRA workshops were held with each FR&DM Group to help achieve the PFRA objectives. The strategy group and the operational group provided advice and guidance along with communication links to senior managers in all partner organisations.

Key synergies and links were drawn with other relevant projects and initiatives (some F&WM Act related), ongoing within the partnership such as the development of the MAFP and the consideration of Data Management, and establishing the LLFA asset register and record.

Communication with the public and elected members has been principally through parish councils and established county and district/borough corporate

communication routes; aided greatly by the Lincolnshire County Council – Environment, Flood Risk and Drainage Member portfolio holder being a key member of the PFRA project team.

As part of collecting information relating to historic flooding, reported incidents were captured and parish councils were written to (including a pro-forma for completion), asking for any information they held on areas flooded and impacts on their community that may assist the development of the PFRA. This prompted a good response overall and information gained has been assessed. It will be considered further as part of the development of the Lincolnshire Local Flood Risk Management Strategy. The pro-forma sent to all parish councils is shown in **Appendix B**.

3 Methodology and data review

Defra Guidance requirements:

- *Describe what information was gathered from within the LLFA, from the Environment Agency, from authorities listed in regulation 36(3), from other partners, and information which is available to the public;*
- *Describe the availability and limitations of the information gathered i.e. was the data readily available? Are records missing? Were there any issues with gathering data from others?*
- *Describe the systems used to share and store information now and in the future; and*
- *Describe quality assurance, security, data licensing and restrictions.*

3.1 Methodology of approach and information gathered

It is clearly recognised that there are key links and synergies between the work required for the PFRA and that needed to produce the LLFA Local Flood Risk Management Strategy. Much of the data and information collected for the PFRA is beneficial for early development of the Local Strategy. In order to avoid confusion of need and terminology in respect of both the PFRA and the Local Strategy, the following logical approach was adopted:

1. Potential Local Flood Risk Areas (LFRAs) exist and impact communities across the county of Lincolnshire;
2. Some LFRAs have experienced flooding in the past and may continue to do so in the future (Historic LFRAs);
3. Some LFRAs have not yet experienced flooding but using latest national scale science and information available from the Environment Agency's mathematical modelling and mapping outputs, they may do so in the future (Future LFRAs); *NOTE: care must be taken not to assume the national scale maps are also appropriate for use at a local property scale.*
4. Considering all the historic and future flood risk areas across the county, flooding of some of these areas may be deemed to cause "Significant harmful consequences". For the purposes of the PFRA these have been considered in consultation with the Lincolnshire Partnership Framework groups and take an initial account of currently available community flood risk indicators relating to impacts on human health, economic activity and the environment;

5. Where this is the case, some LFRAs suffering from significant harmful consequences may reach Defra's national flood risk area indicator thresholds (e.g. Human Health - 30,000 people, 150 critical services etc. for England) and be deemed to be nationally significant local flood risk areas and hence be formally submitted to the Environment Agency in the PFRA Preliminary Assessment Report (PAR), as required by the Flood Regulations 2009 and the European Flood Directive;
6. LFRAs with the potential for significant harmful consequences but not reaching Defra's national flood risk area indicator thresholds, may in some cases, be considered to be "County significant" having regard to county level significance thresholds. Due to the current lack of appropriate local level flood risk evidence, whilst initial consideration has been given to potential threshold options, they have yet to be determined and will be considered further as part of the Local Flood Risk Management Strategy; and
7. In addition, other flood risk problem areas identified will be captured in the developing Local Flood Risk Management Strategy, recognised as either existing or potential future flood risk areas and considered in the light of available resources, competing priorities and community/property level action etc.

The outline logical approach as shown in Figure 6 below was established and used to consider identified historic, and potential future local flood risk areas, in the light of Defra's thresholds for national level significant harmful consequences and for determining how these thresholds influence the understanding and consideration of what might be deemed county level significant harmful consequences.

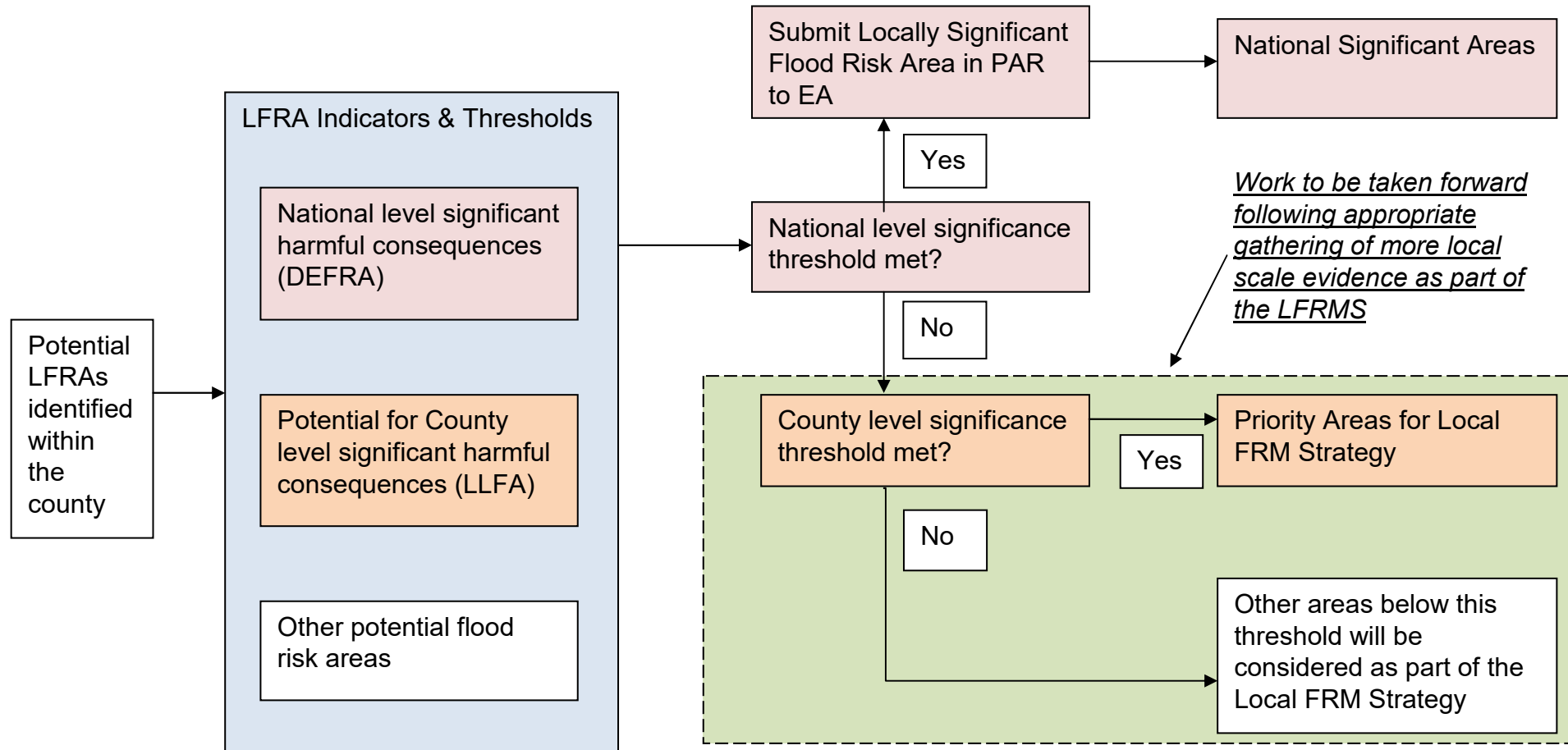


Figure 6 – Outline logical approach used for consideration of Local Flood Risk Areas in developing the PFRA and LFRMS

A strong partnership approach was adopted throughout the development of the PFRA and the following methodology was used:

- Detailed project initiation document (PID) developed and agreed;
- Identified initial existing documented information on relevant historic flooding (e.g. CFMPs, SFRAs, District historic flooding information etc);
- Obtained an initial overview of county wide historic flooding problem areas and recorded on large scale maps;
- History of parish flooding template was sent to all parish councils for completion (See **Appendix B**);
- Developed a data capture template to collect summary information and metadata from the partners. (See **Appendix C**);
- Held four Local Flood Risk and Drainage Management Group partnership data collection workshops (first round) to specifically:
 - collect and collate surface water flood risk data held within each partner organisation;
 - jointly identify any additional data and maps that may exist;
 - receive completed data capture templates with respect to all data on surface water flooding areas, held within partner organisations;
 - partners to “tell and show” all relevant data and information held using expert GIS knowledge, systems and equipment to view shape files, maps and other data formats etc; and
 - agree initial Candidate Flood Risk Areas (CFRAs) based on historic events.
- Collated data and information from partners in various formats and to various levels of detail to be later agreed as “Local Flood Risk Information”;
- Produced a list of initial CFRAs based on historic flooding records, and maps showing their location across the county;
- Developed a flood risk area vulnerability indicators template (See **Appendix D**);
- Obtained indicator data for each of the initial CFRAs and considered the impacts of flooding;

- Reviewed the Environment Agency's two national datasets showing surface water flooding:

Areas Susceptible to Surface Water Flooding (AStSWF); and
Flood Map for Surface Water (FMfSW).

The AStSWF dataset contains one rainfall event, with three susceptibility bandings: less, intermediate and more. The FMfSW contains two rainfall events, divided into two depth bandings: 1 in 200 rainfall shallow and 1 in 200 rainfall deep, as well as 1 in 30 rainfall shallow and 1 in 30 rainfall deep.

- Following detailed discussion with the FR&DMGs and each dataset being compared and contrasted with local knowledge and experience of local flooded areas during past events; the project group decided to use the FMfSW 1 in 200 rainfall deep maps as a reference point for potential future flooding at this stage. This dataset appeared to compare more favourably with local knowledge and experience and was felt to possibly better reflect potential future surface water problem areas for the "benchmark" 1 in 200 chance rainfall and 1 in 100 chance flood event in any year. (*Note: the difference between a 1 in 200 chance rainfall and a 1 in 100 chance flood event in any year is due to the receiving catchment topography, geology, vegetation and land use etc. reducing the volume of rainwater running off the land surface.*)
- Using the FMfSW 1 in 200 rainfall deep maps as a reference point and collected indicator data; a prototype composite GIS data layered flood risk area was produced as a pilot;
- Also using the same FMfSW, spreadsheets were produced showing the following data for all parishes and wards across Lincolnshire:
 - number of residential properties in each parish;
 - number of residential properties shown to be at risk in each parish according to the Environment Agency's maps (i.e. AStSWF Map, FMfSW – shallow and deep), and the properties flooded falling outside of the flooded areas shown on the maps;
 - percentage of residential properties in each parish shown to be at flood risk; and
 - number and percentage of critical assets in each parish shown to be at future flood risk.
- Held a further four Local Flood Risk and Drainage Management Group partnership flood risk area workshops (second round), to review the initial historic CFRAs in the light of the county wide parish spreadsheet information

and the GIS data pilot; and to identify any initial potential future flood risk areas based on the Environment Agency's mapping products and other relevant data and information;

- Compared these initial potential Lincolnshire historic and future FRAs with the Defra thresholds for significance, having regard to the following “sieving process”:
 - Provide a list of all parishes within the county showing property counts and assets (from historic records and future flood modelling), and the proportion of these within the parish shown as being impacted on by a) AStSWF Map, b) FMfSW – shallow and c) FMFSW – deep;
 - Highlight all parishes where a historic flooding return has been received;
 - Categorise all parishes where the proportion impacted upon (including historic and future flooded property numbers) for each of a), b) and c) is greater than 20%, 10% and 5%;
 - Then; for all parishes below each of these thresholds, include those parishes with greater than 20, 10 and 5 properties, (including historic and future flooded property numbers) impacted upon; (consideration of the results at this stage was given to the county norm for property figures and parish proportion percentage);
 - Then, for all parishes below these thresholds, categorise those with 1 or more CI&ES assets impacted upon;
 - Parishes caught by the sieving process were then considered in terms of seven different options mixing various flooded property numbers and parish proportion percentage impact thresholds, the total number of LFRAs, their location, any impacts due to property clustering and other sensitivity factors.
- An initial list of potential county level significant indicative local flood risk areas was produced as “work in progress” for further consideration by the project team;
- Held the third round of workshops with each of the FR&DM Groups to review the “work in progress” lists and test them against the observed experience, local knowledge and professional opinion of the group members. The potential level of significance of flooding in each of the FRAs was also considered having regard to the local flood risk information currently available, and further evidence was needed in the due consideration of significance;
- To assist this consideration of county significance, a further seven options of differing property numbers in parishes and wards shown on the Environment

Agency's Flood Map for Surface Water as being at risk of flooding were produced as "work in progress" for consideration by the project team and these options are listed and discussed further in Section 4 of this report;

- In addition, a 0.5 Km square grid map of the county was produced showing grid squares reflecting the different property numbers identified and considered as part of the seven options above;
- Indicative maps showing initial areas across the county where potential flood risk from local sources requires further investigation as part of the local strategy, were produced and these are contained within Section 7 of this report;
- Community vulnerability indicators were produced to assist further consideration and risk assessment as required in the future; and
- Using all the information gained throughout this process, the project team concluded that no new FRAs with national level significant harmful consequences could be identified in Lincolnshire.

3.2 Data availability and limitations

Historical data and information was available from records made following the summer 2007 flooding event, but there was very little information regarding previous flooding events prior to this date.

Summary data capture templates were completed by partner organisations, and actual data e.g. maps, spreadsheets and tables etc. were shared at the data capture workshop, and collated and stored by LCC on the corporate geographical information system (GIS). A common suite of relevant data and information files was established and this was subsequently agreed to form "Locally Agreed Surface Water Information" as described later in Section 5.2 of this report.

As advised by the Environment Agency (Lincoln), the receptor data used throughout the PFRA was obtained from the Lincolnshire Research Observatory team (LCC), principally collated from all Local Resilience Forum (LRF) partners following the flooding in summer 2007, and used primarily for county emergency planning purposes. This information is managed and updated by the County Council Emergency Planning Unit on behalf of the LRF. It was agreed with the Environment Agency (Lincoln) that for the purposes of the PFRA, the National Receptor Database (NRD) should not be used, as this LRF local information provided a more accurate list of certain receptor data, such as critical infrastructure and vulnerable communities, e.g. care homes, etc. Differences between the two datasets are being

considered by the Environment Agency as part of the ongoing review and improvement of the NRD.

Of primary concern is the current lack of appropriate local scale data and information (i.e. the evidence base), to be able to clearly establish future flood risks to communities from local sources, and determine indicative county level significant harmful consequences. An increased level of scientific evidence, knowledge and understanding is required to help guide key decisions on local significance thresholds involving human health, economic activity and environment vulnerability indicators. Whilst the Environment Agency's national scale flood mapping outputs can be used as a guide, this current science is not appropriate for determining and assessing local flood risk areas.

The receptor data used is currently principally parish based and it is recognised that in some instances some communities impacted upon by local flooding may spread across or comprise areas of more than one parish. Also, due to the constraints of current data sets, initial consideration of flood risk to local communities has been carried out using parish and ward unit areas. It is acknowledged that in many cases only some of the properties within parish and ward boundaries may be affected by future flood risk and therefore "clusters" of properties within and across parish and ward boundaries need to be considered further as part of the Local Flood Risk Management Strategy.

Little data and information currently exists on the potential flooding of Lincolnshire's transport network and this is an area where further evidence gathering is required to inform the consideration of significance thresholds.

Lastly, local data and information relating to flood risk from the interaction of different local flooding sources is limited and this is further explained in Section 5 of this report.

The outstanding issues and data/evidence gaps etc. mentioned above will be further considered and progressed as part of the development of the Local Flood Risk Management Strategy.

3.3 Storage systems, information sharing and quality assurance

Currently partners store data and information in various formats, to varying degrees of detail and to various quality standards. For the purposes of this project, where data was deemed to be fit for purpose by the partner organisation supplying it, the project team considered that it was of sufficient quality for use in this preliminary assessment. All electronic data provided is stored and shared on CDs. The Lincolnshire Research Observatory team (LCC), have accepted and stored the

PFRA data collected and where possible has produced GIS data layers to allow overlay maps to be produced.

There were no issues identified that prevented partners from openly sharing the relevant data and information held within their respective organisations in a spirit of openness, trust and partnership.

3.4 Future developments

Recognising the need to improve systems and processes within the partnership framework for data sharing and management as a whole, the LLFA has commenced a data management project, involving the Lincolnshire Research Observatory, and running in parallel with the PFRA. This data management project will take account of quality assurance, security, data licensing and restrictions etc. on behalf of the partnership framework. As previously mentioned, and as part of the Local Flood Risk Management Strategy, an improved evidence base of flood probability, hazard, risks and consequences (including modelling and mapping where necessary), is required prior to being able to reasonably establish significant harmful consequences, county level significance thresholds and associated county indicative local flood risk areas.

3.5 Relevant information held by partner organisations

Relevant information held by the partner organisations comprises the “Locally Agreed Surface Water Information” as described in Section 5 of this report.

3.6 Relevant information available to the public.

No direct access to the PFRA information by the public is to be readily available until the PAR has been through LCC scrutiny and executive approvals and all wider communications have been carried out via the partnership framework.

3.7 Scrutiny and review procedures adopted

Regular PFRA progress updates have been provided to the partnership framework groups throughout the project and comments and suggestions received.

A Joint Scrutiny Committee report was produced in early November 2010 providing an overview of the PFRA work needed and the timescales for completion. It went before the committee for information and agreement to review the Final Draft PAR

prior to it being submitted to the Lincolnshire County Council Executive meeting in June 2011. (See **Appendix E**)

4 Past flood risk

Defra Guidance Requirements:

- *This section summarises relevant information on past floods with significant harmful consequences (if possible/desired, summarises relevant information on all past floods);*
- *Statement of what are considered 'significant harmful consequences' and why;*
- *Summary table and description, outlining when floods have occurred and their consequences ;*
- *Summary map of past floods (or separate maps by source if there is lots of information) which should include information about the extent and conveyance route of past floods where available; and*
- *Reference to the detailed records of past floods with significant harmful consequences in the spreadsheet (Annex 1).*

4.1 When floods have occurred and their consequences

Information was obtained from all the locally agreed surface water information shown in 3.2 above. Serious fluvial and surface water flooding has occurred across Lincolnshire over the last century with notable local surface water and groundwater flooding events shown in Table 4 and Table 5 below:

Date	Area Affected	Consequences
February 1977	Sleaford	200 properties affected (surface water)
September 1991	Lincoln	120 properties affected (surface water)
July 1993	Lincoln	90 properties affected (surface water)
Dec 2000 to January 2001	Binbrook, Louth and Burwell	3 properties flooded (prolonged groundwater flooding)
July 2002	Waddington Lowfields	175 properties affected (surface water)
June/July 2007	Numerous across the county	Approx 2,000 reported properties/roads flooded

Table 4 – Serious flood events in Lincolnshire

A summary of property numbers flooded in June/July 2007 (taken from local authority records), is shown in Table 5 below:

Local authority area	Approx number of properties flooded
Central Lincolnshire FR&DMG	
West Lindsey District	626
North Kesteven District	67
Lincoln City	300
East Lindsey FR&DMG	
East Lindsey District	703
South Kesteven FR&DMG	
South Kesteven District	96
Boston & South Holland FR&DMG	
Boston Borough	106
South Holland District	59
Total	Approx 2,000

Table 5 - Summary of property numbers flooded in June/July 2007

Property numbers in Table 5 above are taken from records of flooded areas across Lincolnshire and their impacts etc. held by district/borough councils. Actual information on the flooding hazard (i.e. depth, velocity, speed of inundation) is limited however; where information is available these records generally provide:

- Data source;
- Property address;
- Flooding type;
- Potential cause of flooding;
- Consequences (i.e. domestic/commercial/agricultural);
- Number of addresses affected;
- Operatives comments;
- Whether associated with SUDs;
- Emergency mitigation measures taken;
- Asset owner;
- Contact in an emergency;
- Date issue resolved;
- Previous cause, contacts and history;
- Current status of resolving issue (i.e. Red/Green/Amber);
- Action required by; and
- Year of flooding.

4.2 What are significant harmful consequences and how have county level significance thresholds been considered

Table 6 below lists factors influencing the consideration of significant harmful consequences and initial county level significance thresholds and include:

- Expert knowledge, experience and clear evidence of historic flooding and the consequences on communities affected;
- Degree of currently available evidence and sound science available for the consideration of future flood risk at a local scale;
- Current flooding issues with key communities and progress with actions and activities following the Summer 2007 flooding;
- Neighbouring LLFAs consideration of various factors and thresholds in determining what they believe to be significant harmful consequences;
- Flooding hazard in terms of depth;
- Impacts using county average figures and specific parish/community impacts in terms of numbers of properties, population, critical assets etc. affected and the % proportion of the overall parish/community;
- Clustering and concentration of properties at potential risk;
- Impacts on economic and environmental factors and assets including main transport routes;
- The need to work with a manageable number of significant flood risk areas in the local strategy;
- Iterative process by starting with known flooding scenarios/events and consequences and then building on this and other information and science available to consider future flooding scenarios;
- Need to consider a spread of options involving historically flooded property numbers plus future predicted flooded property numbers on a spectrum of significance;
- Recognising that this is a starting point for the preliminary assessment and will be revisited as necessary;
- Establish something that is simple, easily understood and can be communicated clearly; and
- Recognising the need and/or ability to undertake further investigation/feasibility/work may well rely on locally available funding.

Table 6 - Factors influencing the consideration of significant harmful consequences and initial county level significance thresholds

Having regard to the above and using currently available, locally agreed information and community data (principally emergency planning related) held on the corporate GIS by the Lincolnshire Observatory (LCC); data spreadsheets were produced for all parishes within the county showing property counts and assets **based on historic flooding records** and the Environment Agency's surface water flood maps, and the number and proportion of these within the parish shown as being impacted on by a) AStSWF Map, b) FMfSW shallow and c) FMFSW deep.

As previously stated, following detailed observations of all three sets of maps and discussions with the FR&DM Groups, it was decided to use the FMfSW 1 in 200 rainfall deep, in all future consideration of local flood risk areas as this was considered by all to best reflect local knowledge and experience of the local topography and at risk areas.

The LFRA sieving process, as described in Section 3.1 of this report, was then carried out for seven options of significance thresholds (2 using the Environment Agency's FMfSW shallow and 5 using the Environment Agency's FMfSW deep).

For each of these options, the parish name was used to identify the potential LFRA and consideration was given to the total number of potential LFRAs, their location, any clustering and other non property number indicators; and then sensitivity checked against all the factors described in Table 6 above.

These options for significance thresholds assisted the current understanding of preliminary local flood risk to the county as a whole and this is described further in Section 7 of this report.

5 Future flood risk

Defra Guidance requirements:

- *This section summarises all relevant information on future floods;*
- *Summary table and description, outlining the relevant information on future floods and their consequences;*
- *Describe 'locally agreed surface water information' and state local drainage capacity;*
- *Summary map illustrating what constitutes 'locally agreed surface water information';*
- *Reference to the detailed records of future floods and their possible consequences in the spreadsheet (Annex 2);*
- *Climate change and long term developments; use the standard text provided in the text box (below);*
- *Summarise relevant local information (if any is available) concerning climate change impacts on local flood risk;*
- *List any new or proposed major developments which may increase local flood risk;*
- *The Environment Agency has commissioned work to consider the varying impacts of climate change on sources of local flood risk for each River Basin District across England and Wales. This work is due to complete March 2011, and may lead to us updating the standard text provided; and*
- *The standard text on long term developments may also need to be updated due to changes in the planning system.*

5.1 Description of future floods and their consequences

Principal flood risk sources in Lincolnshire are described in Section 1 of this report.

Local flooding is likely to be mainly from heavy rainfall causing surface water run-off, overflowing ordinary watercourses and sewers resulting in surface water flooding of domestic and/or commercial property, gardens, roads and agricultural land etc. In addition, more prolonged flooding may occur from increasing groundwater levels as aquifers fill and surcharge.

Whilst flooding from canals and reservoirs in Lincolnshire is a risk, following consideration by the FR&DM Groups, these sources are not considered to be significant in respect of the PFRA and are not considered further.

The consideration of future flooding in the PFRA has therefore focused on surface water and ground water sources using "locally agreed surface water information" (includes groundwater) as described below.

5.2 Locally agreed surface water information, local drainage capacity and interaction of flooding sources

Prior to the first round of data sharing partnership workshops an extensive literature search was carried out to obtain as much currently available information as possible on local sources of flood risk, and their impacts for both past and future flooding.

Summary data capture templates were completed by partner organisations describing the data held, in what form and to what degree of detail (See **Appendix C.**)

As the workshops focused on the individual Flood Risk and Drainage Management Groups (FR&DMG) set up under the partnership framework, this data and information was collated specifically for relevance to each Group. Electronic folders were produced and shared with partners as the PFRA process was carried out. Subject/topic area folders of data and information collected and shared with each FR&DMG are shown in Figures 7-10 below:



Figure 7

South Kesteven Flood Risk and Drainage Management Group (i.e. South Kesteven District)

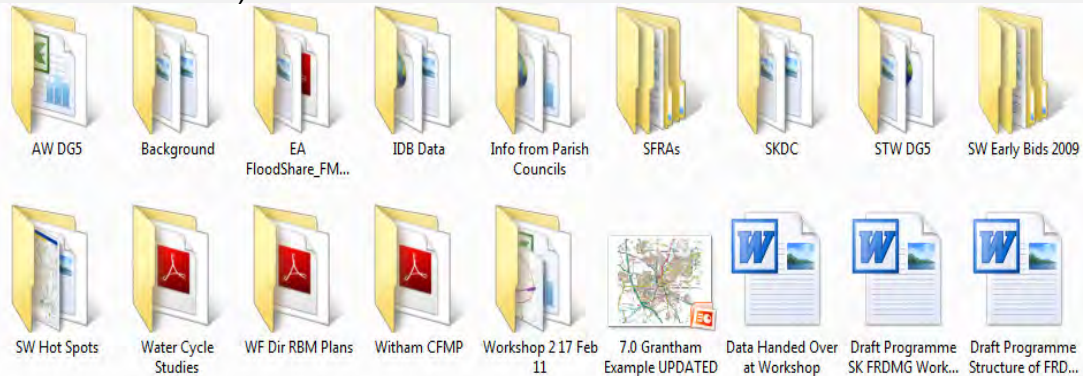


Figure 8

East Lindsey Flood Risk and Drainage Management Group (i.e. East Lindsey District)

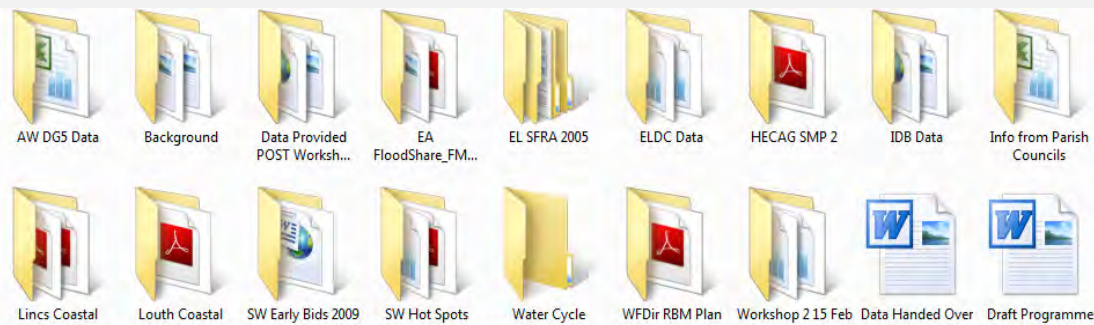


Figure 9

Boston and South Holland Flood Risk and Drainage Management Group (i.e. Boston Borough and South Holland District)

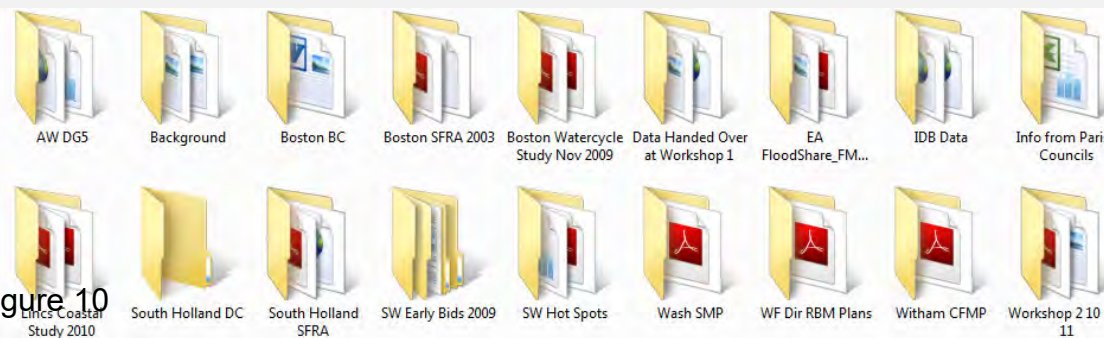


Figure 10

Figure 10

Data and information was provided in GIS shape file format, pdf, Word and Excel files and hard copy paper documents.

Actual data e.g. maps, spreadsheets and tables etc. were shared at the data capture workshop, collated and stored by LCC on the corporate GIS. A common suite of relevant data and information files was established and this was subsequently agreed to form "Locally Agreed Surface Water Information". This comprised the Environment Agency's surface water flood maps and other sources of relevant data as required in Para 3.5.1 of the Defra Guidance.

As can be seen from the above, data sources collated and shared included CFMPs, SMPs, EA's FloodShare, water company DG5 flooding records, LCC, district council and IDB records, plans, modelling maps and reports etc.

With regard to future groundwater flooding, the Environment Agency have launched national scale groundwater flood maps on a 1km grid showing high, medium and low risk. However, as advised by the local Environment Agency staff, these maps are not particularly appropriate for assessing risks at a county scale. The relevant map for Lincolnshire is provided in Section 7 of this report. Where necessary, further investigations into local flood risks from groundwater, will be carried out as part of the development of the Local Flood Risk Management Strategy.

One particular area where current data is limited is with regard to the interaction of flooding sources. Due to the low lying nature of land and buildings in parts of Lincolnshire, (e.g. river valley flood plains, coastal flood plains and fenland areas around the Wash), communities in these areas may be at risk of flooding from the interactions between fluvial, coastal, surface and groundwater sources. Typical examples where such interactions might have affected historic flooding or could affect future flooding are:

- Surface water outfalls to tidal waters where the discharge can become tide locked, causing water to back up in drainage systems;
- Locations where high water levels in main rivers during flood conditions can impede surface water drainage systems; and
- Systems where critical above ground storage capacity is lost due to high ground water levels.

These interactions may occur anywhere behind raised fluvial and coastal flood defences as shown on the river network map below and will be considered in greater detail and in the light of further data and information yet to be obtained, as part of the Lincolnshire Local Flood Risk Management Strategy.

Areas where there is potential for interaction with local sources of flooding are shown in blue on the Environment Agency's Flood Map below in Figure 11.

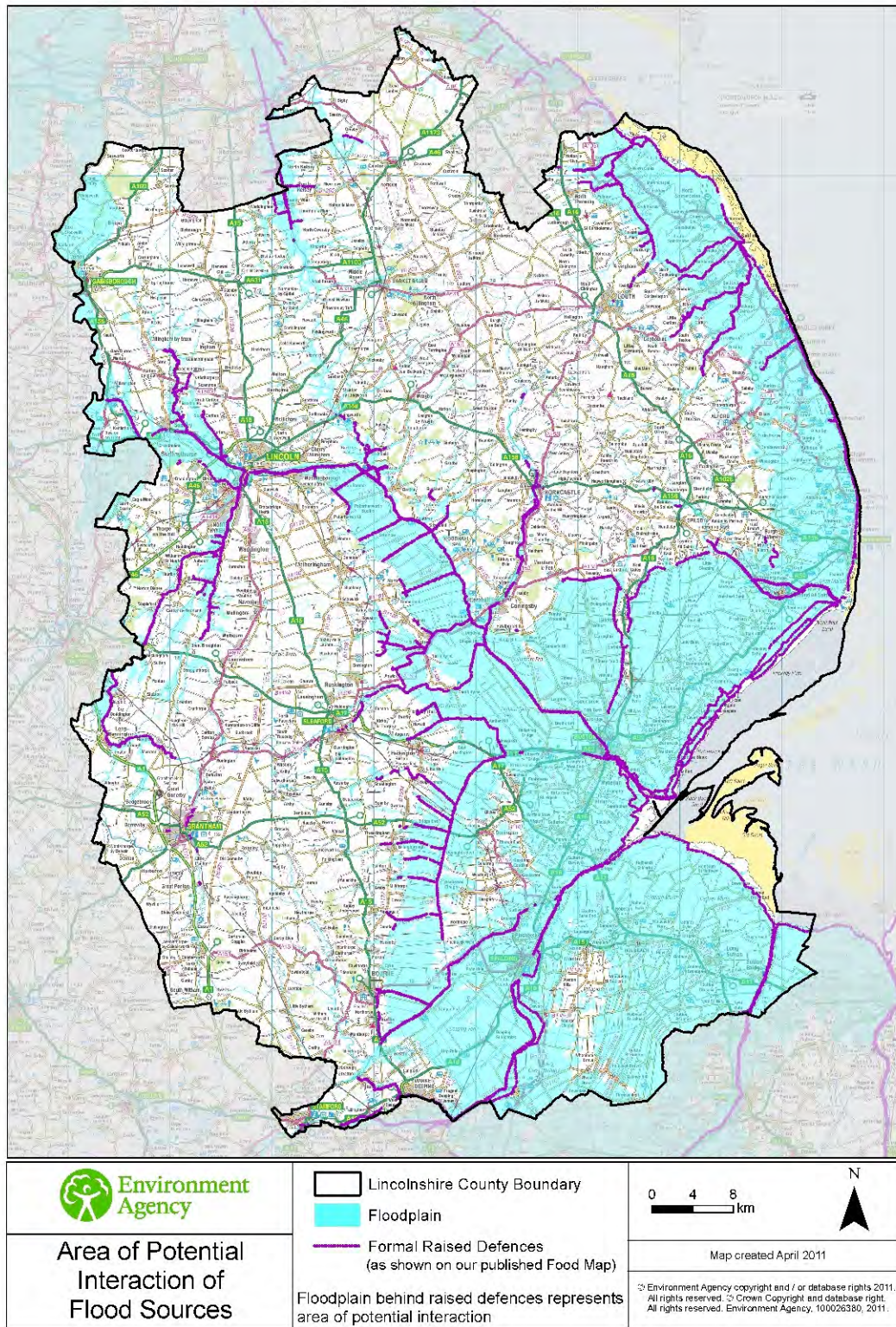


Figure 11 - Environment Agency Flood Map showing potential for interaction with local sources of flooding

5.3 Consideration of future floods with significant harmful consequences

Following the sieving process and further analysis as described previously in Section 3 and 4 of this report, and with particular reference to the national significance thresholds set by Defra, no national level significant Local Flood Risk Areas have been identified in Lincolnshire. All PFRA work carried out to date will contribute to the further consideration of significant harmful consequences, indicative county level significance thresholds and candidate county significant indicative local flood risk areas as part of the Local Flood Risk Management Strategy.

5.4 Climate change and long term developments

The Evidence

There is clear scientific evidence that global climate change is happening now. It cannot be ignored. Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation; however the broad trends are in line with projections from climate models.

Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s. We have enough confidence in large scale climate models to say that we must plan for change.

There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can't be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance or rarer) could increase locally by 40%.

Key Projections for Anglian River Basin District

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:

- Winter precipitation increases of around 14% (very likely to be between 3 and 31%)
- Precipitation on the wettest day in winter up by around 14% (very unlikely to be more than 29%)

- Relative sea level at Felixstowe very likely to be up between 10 and 41cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
- Peak river flows in a typical catchment likely to increase between 8 and 16%

Implications for Flood Risk

Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability. Wetter winters and more of this rain falling in wet spells may increase river flooding. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses. Even small rises in sea level could add to very high tides affecting places a long way inland. Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

Adapting to Change

Past emission means some climate change is inevitable. It is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

Although the broad climate change picture is clear, we have to make local decisions with uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.

Long Term Developments

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

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).

5.5 Climate change impacts on local flood risk

For the main rivers and coastline of Lincolnshire, the Environment Agency has carried out modelling to assess the increase in the flood risk from climate change for the year 2115. This information will be of use in producing the local flood risk management strategy, particularly for the areas of interaction the various sources flooding as shown in Figure 11.

5.6 New or proposed major developments likely to increase local flood risk

Following discussion with the FR&DM Groups and county, district and Environment Agency planners, it is considered that whilst some major developments are proposed within Lincolnshire; none of these are likely to significantly increase flood risk, if subjected to the storm parameters used by the Environment Agency in its modelling and mapping of surface water. All Lincolnshire planners and the FR&DM Groups will seek for developments to comply with the requirements of PPS25 and the associated Practice Guide to avoid increasing flood risk. In addition, the LLFA, as SUDs Approving Body, will also require the same outcome from new developments once these powers have been provided, probably during 2012.

The planning system in Lincolnshire will take account of the LLFA local flood risk management strategy. In addition, SFRA's will be reviewed as soon as practicably possible to reflect this and the increased focus on surface water flooding, locally agreed surface water information and improved modelling etc. contained within the preliminary findings in the PFRA.

6 Review of indicative National Flood Risk Areas

Defra Guidance requirements:

- Referring to 'locally agreed surface water information', review any indicative Flood Risk Areas provided by the Environment Agency; and
- If there are no relevant indicative Flood Risk Areas this section is not required.

6.1 Review of indicative Flood Risk Areas provided by the Environment Agency

Using the Defra indicators and threshold values reproduced below in Table 7, no indicative flood risk areas in Lincolnshire are shown on the Environment Agency's Indicative Flood Risk Areas map also shown in Figure 12 below.

Table 2. Indicators and threshold values to determine Flood Risk Areas

Area designation	Indicators	Threshold	Assessed Nationally or Locally
Human Health			
Indicative Flood Risk Areas	Number of people (based on number of residential properties x 2.34)	Set at 30,000 (England), 5,000 (Wales) within a cluster where risk is most concentrated.	Nationally
	Critical services (including schools, hospitals, nursing homes, power and water services)	"Nominal threshold" 150 (England) 25 (Wales) although number of people is the deciding threshold for indicative Flood Risk Areas.	Nationally
LLFA proposed new or expanded Flood Risk Areas	Number of people (based on number of residential properties x 2.34)	New Flood Risk Areas could be identified on the basis of being at equivalent risk to the indicative Flood Risk Areas. Annex A describes criteria which may be used to determine this.	Locally
	Critical services – (including schools, hospitals, nursing homes, power and water services)	Locally held information might provide a more accurate assessment of the number of people who depend on specific critical services. Although new Flood Risk Areas are unlikely to be identified on the basis of critical services alone, local information might suggest that a Flood Risk Areas might be expanded. Annex A provides more information on the assessment of critical services.	Locally
Economic activity			
Indicative Flood Risk Areas	Non-residential properties (including shops and businesses).	"Nominal threshold" of 3,000 (England) 500 (Wales) although number of people is the deciding threshold for indicative Flood Risk Areas.	Nationally
LLFA proposed new or expanded Flood Risk Areas	Non-residential properties (including shops and businesses).	Areas could be identified on the basis of being at equivalent risk to the indicative Flood Risk Areas. Generally business properties represent less than 2% of total properties in Flood Risk Areas so it is unlikely that additional non-residential properties alone will lead to new Flood Risk Areas.	Locally
	Agricultural land (e.g. area of land (hectares) based on agricultural grade)	Consequences of flooding to agricultural land from local flood risks are unlikely to identify new Flood Risk Areas but may contribute to Flood Risk Areas selected on other indicators. Annex B indicates factors to consider.	Locally

	Roads and rail (length in km)	Consequences from local sources of flood risk to roads and rail are unlikely to lead to new Flood Risk Areas being identified, but may contribute to Flood Risk Areas which are identified on the basis of other indicators. Annex B indicates factors to consider.	Locally
Environment			
LLFA Proposed new or expanded Flood Risk Areas.	Area of internationally or nationally designated site, (e.g. Special Areas of Conservation, Special Protection Areas; Ramsar sites or Sites of Special Scientific Interest	Consequences of flooding could be positive or negative; some habitats depend on seasonal flooding, although prolonged or unusually extensive flooding might damage habitats. Flooding by polluted/contaminated water might increase damage. Further information on factors to consider is set out in Annex C.	Locally
	Number of nationally / internationally important heritage features. - World heritage sites - Scheduled monuments (SMs) - Listed buildings - Registered parks and gardens	LLFAs should consider the potential consequences of flooding specific to each site. Further information on factors to consider is set out in Annex C.	Locally

Table 7 – Defra indicators and threshold values

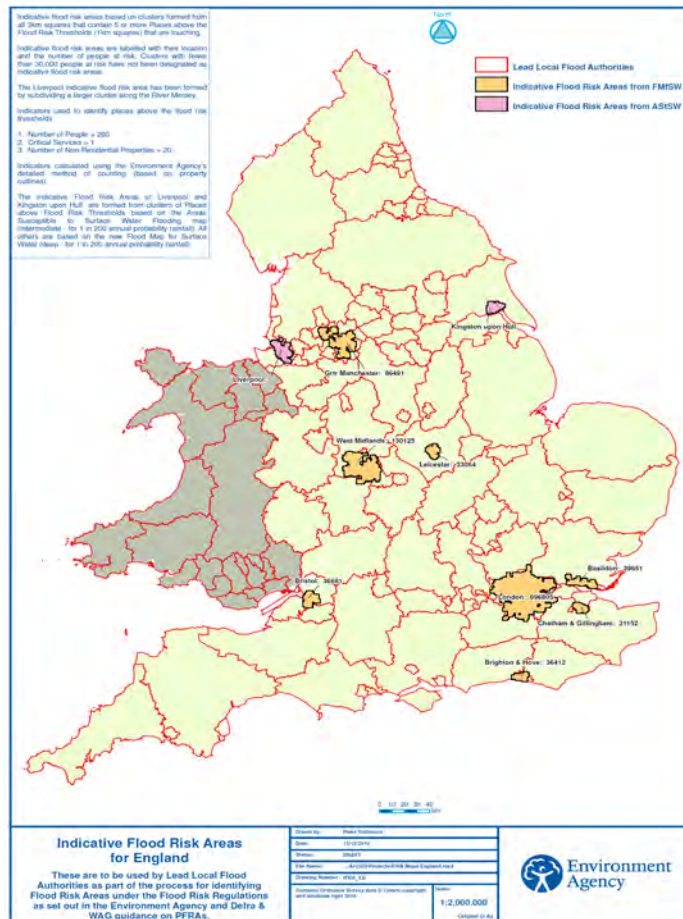


Figure 12– Indicative flood risk areas for England (based on administrative boundaries)

However, Defra indicated that some 1km grid squares of “places where flood risk is an issue” were identified wherever at least 200 people or 20 businesses or more than 1 critical service might be flooded to a depth of 0.3 metres by a rainfall event with a chance of 1 in 200 of occurring in any given year (equivalent to 'in the order of 1 in 100 chance of flooding). This assessment was based on the new Flood Map for Surface Water with blue shaded 1km squares as shown in Figure 13 below:

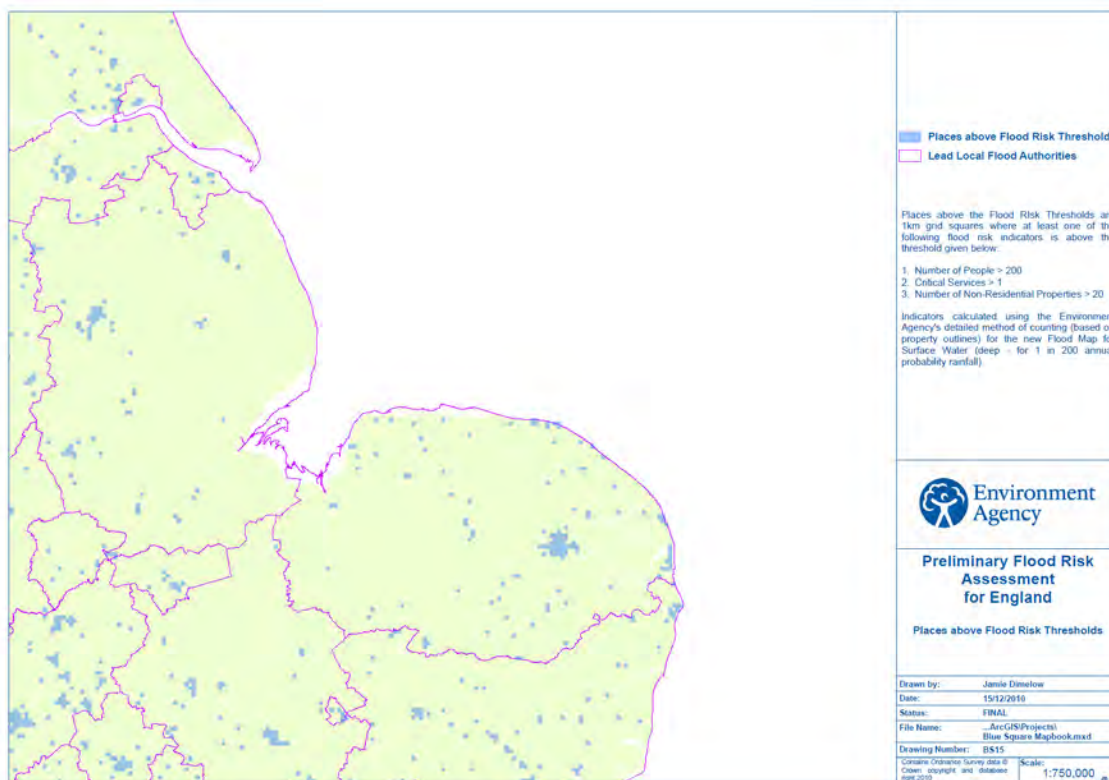


Figure 13 – Places in Lincolnshire above Environment Agency flood risk thresholds

Whilst some “places where flood risk is an issue” are shown in Lincolnshire on the Environment Agency’s thresholds map above, it is inappropriate to use this national scale mapping at a local scale. The current evidence base at a local level in Lincolnshire is insufficient to determine county significance and indicative local flood risk areas and this will be addressed as part of the Local Flood Risk Management Strategy.

7 Identification of Flood Risk

Defra Guidance requirements:

- *Describe amendments to indicative Flood Risk Areas due to geography, information about past flooding, or information about future flooding;*
- *Justify any new Flood Risk Areas using information about past flooding, or information about future flooding;*
- *Or state why no Flood Risk Areas have been identified;*
- *Refer to the detailed records of Flood Risk Area(s) in the spreadsheet (Annex 3); and*
- *If possible/desired, provide a map of Flood Risk Area(s).*

7.1 Amendments to indicative Flood Risk Areas

Having considered the Defra indicators and thresholds above and their impact on flood risk areas in Lincolnshire, the required national criteria to have a population at risk in a cluster of greater than 30,000 is not met, as is the case for all other national thresholds. Therefore no new flood risk areas with national level significant harmful consequences have been identified in Lincolnshire.

7.2 Current assessment and understanding of preliminary local flood risk to the county as a whole

Note: The PFRA does not identify and/or assess individual local flood risk areas within the county at this stage. This will be done as part of the LLFA Local Flood Risk Management Strategy (LFRMS).

To aid current understanding of preliminary local flood risk to the county as a whole, both parishes, and wards without parishes, have been considered separately to help take account of clustering of potential properties at future risk. Therefore parish and ward property numbers should be added together when considering any whole county figures.

Of particular interest and use as a benchmark in the consideration of initial county level significance thresholds and county significant indicative local flood risk areas, were the overall county averages of property numbers and percentages as shown in the Table 8 below. *(Note: historic flooded properties outside of the areas shown to be at risk on the Environment Agency's flood maps are not included in Table 8.)*

Whole County	All Property	All property in FMfSW Map (deep & shallow)		All property in FMFSW Map (deep)		All property in the AStSWF Map (int)	
		Property	%	Property	%	Property	%
Parishes	178,260	14,080	7.9	2,650	1.5	9,750	5.5
Wards	140,470	13,320	9.4	2,760	2.0	9,890	7.0

Table 8 – Whole county property, ward and parish percentage flooded figures

With regard to the early Candidate Flood Risk Areas already identified as communities (by the FR&DM Groups), as opposed to parishes; sensitivity checks were carried out on both the parish and the community approaches to address any compatibility issues.

Using local knowledge and experience of the FR&DM Groups and the project team, the “work in progress” potential county significant indicative flood risk area lists were revisited. A further seven options of potential thresholds of differing property numbers, in parishes and wards, and shown on the Environment Agency’s Flood Map for Surface Water as being at risk of flooding; were produced again as “work in progress” for consideration by the project team. These options are listed in Table 9 below:

Using historic flooded property records plus the Environment Agency’s Flood Map for Surface Water (deep) further options include:			
A)	>50 properties only -	117 people	= 38 LFRAs
B)	>40 :	- 94 :	= 54 :
C)	>30 :	- 70 :	= 79 :
D)	>20 :	- 47 :	= 98 :
E)	>20 properties <u>or</u> >1 critical infrastructure (CI) asset <u>or</u> >1 essential services (ES) asset <u>or</u> >1 conservation (Con) site, except for Anglian Water assets >2 and listed buildings >5		
F)	>20 properties <u>or</u> >1 CI <u>or</u> >1 ES <u>or</u> >1 Con		= 161 :
G)	>20 properties reviewed by FR&DM Groups		= 78 :
Tables relating to all options showing wards and parishes have been produced to aid further consideration as part of the LFRMS.			

Table 9 – Further options for consideration of significance thresholds and county significant indicative local flood risk areas

Again, a benchmark of the overall county averages of property numbers and percentages was considered. These figures include historic flooded properties outside of areas shown to be at risk by the Environment Agency's maps plus future properties shown to be at risk. See Table 10 below:

Whole County	All Property	All property in FMfSW Map (deep & shallow) + ALL Historic		All property in FMfSW Map (deep) + ALL Historic		All property in the AStSWF Map + ALL Historic(int)	
		Property	%	Property	%	Property	%
Parishes	178,260	16,671	9.1	4,681	2.6	12,341	6.7
Wards	140,470	13,790	9.8	3,230	2.3	10,360	7.4

Table 10 – Whole county property, ward and parish % flooded figures (Including all historic flooded properties)

From Table 9 above it can be seen that with reference to the Environment Agency's **FMfSW Map (deep) + ALL Historic** property flooding recorded, approximately 2.3% – 2.6% of the property in Lincolnshire is shown to have been either flooded in the past or may be at risk of surface water flooding in the future, from a mathematically modelled rainfall event with a 1 in 200 year chance of occurring in any year.

7.3 Indicative maps showing areas across the county at potential risk of flooding from local sources

Indicative maps for each of the Flood Risk and Drainage Management Group areas show:

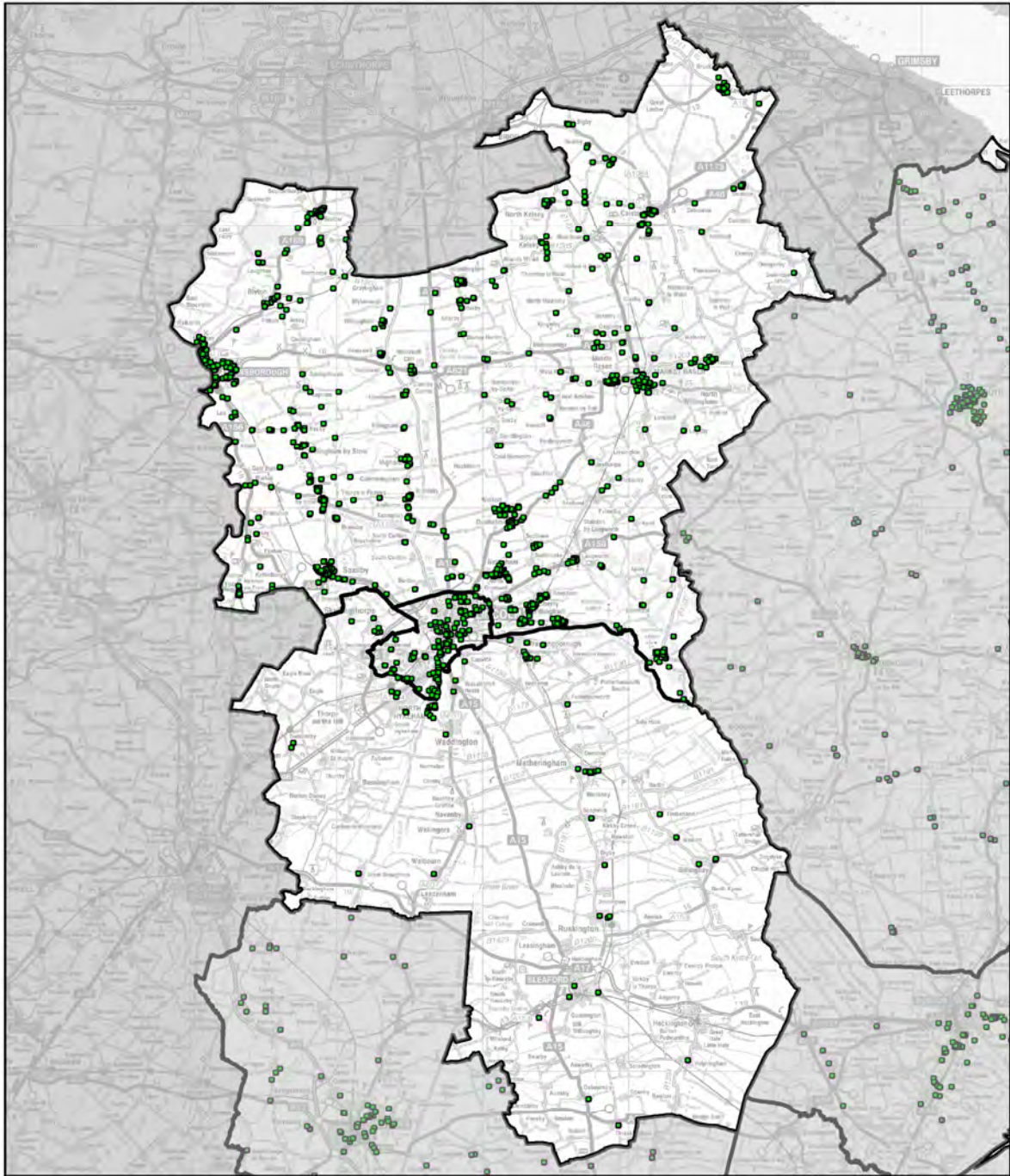
- Recorded historical local flooding;
- Extract from the Environment Agency Flood Map for Surface Water (deep);
- Initial areas where potential flood risk requires further investigation as part of the local strategy; and
- Areas susceptible to groundwater flooding.

The Environment Agency's Standard Notice in respect of the Flood Map for Surface Water is also provided.

Note: For clarity purposes it's better to view these maps electronically.

Central Lincolnshire FR&DMG – Recorded incidents of historical local flooding

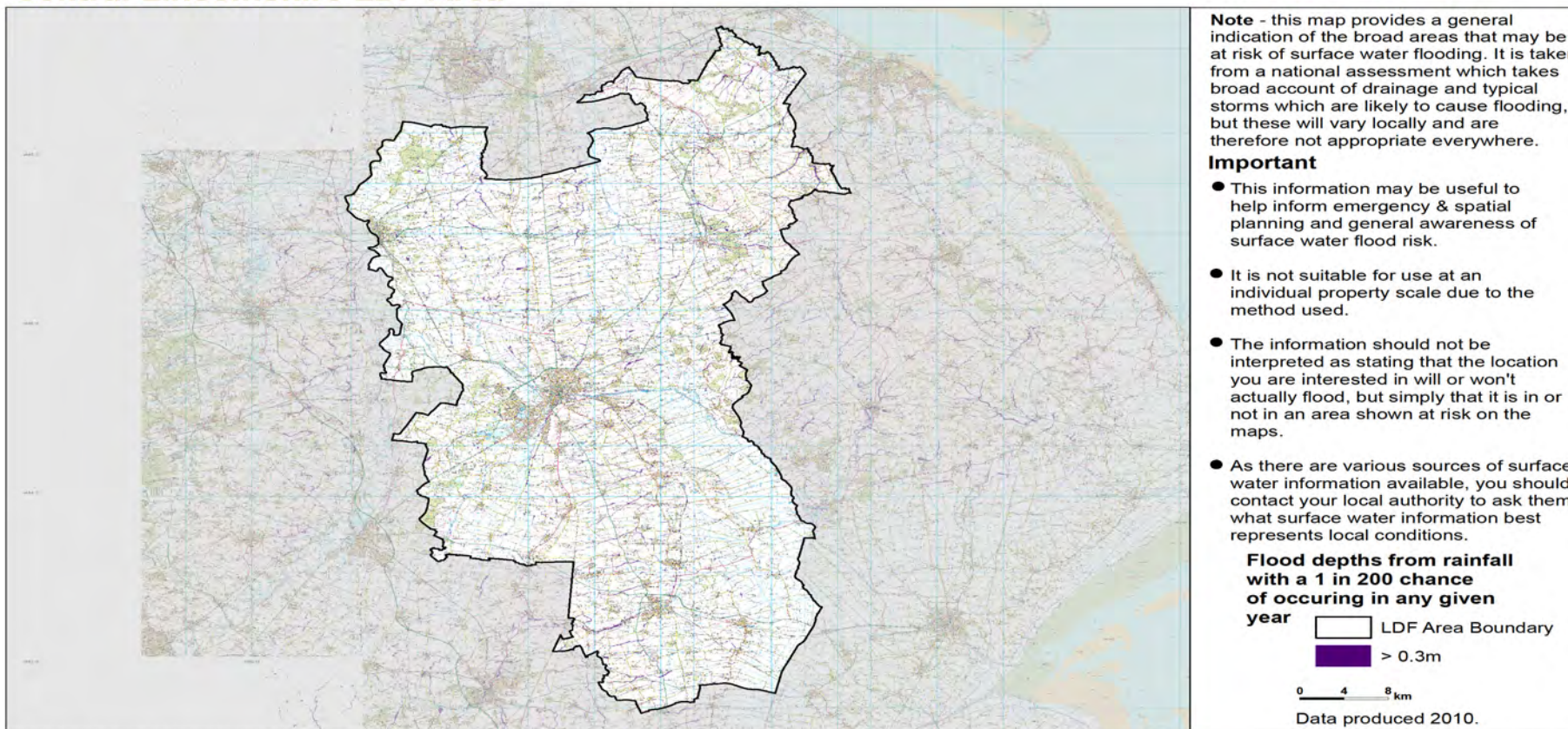
NOTE: MAP SHOULD BE VIEWED AT NO LARGER THAN 1:50,000 SCALE



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Legend – Recorded incidents of historical local flooding shown as 

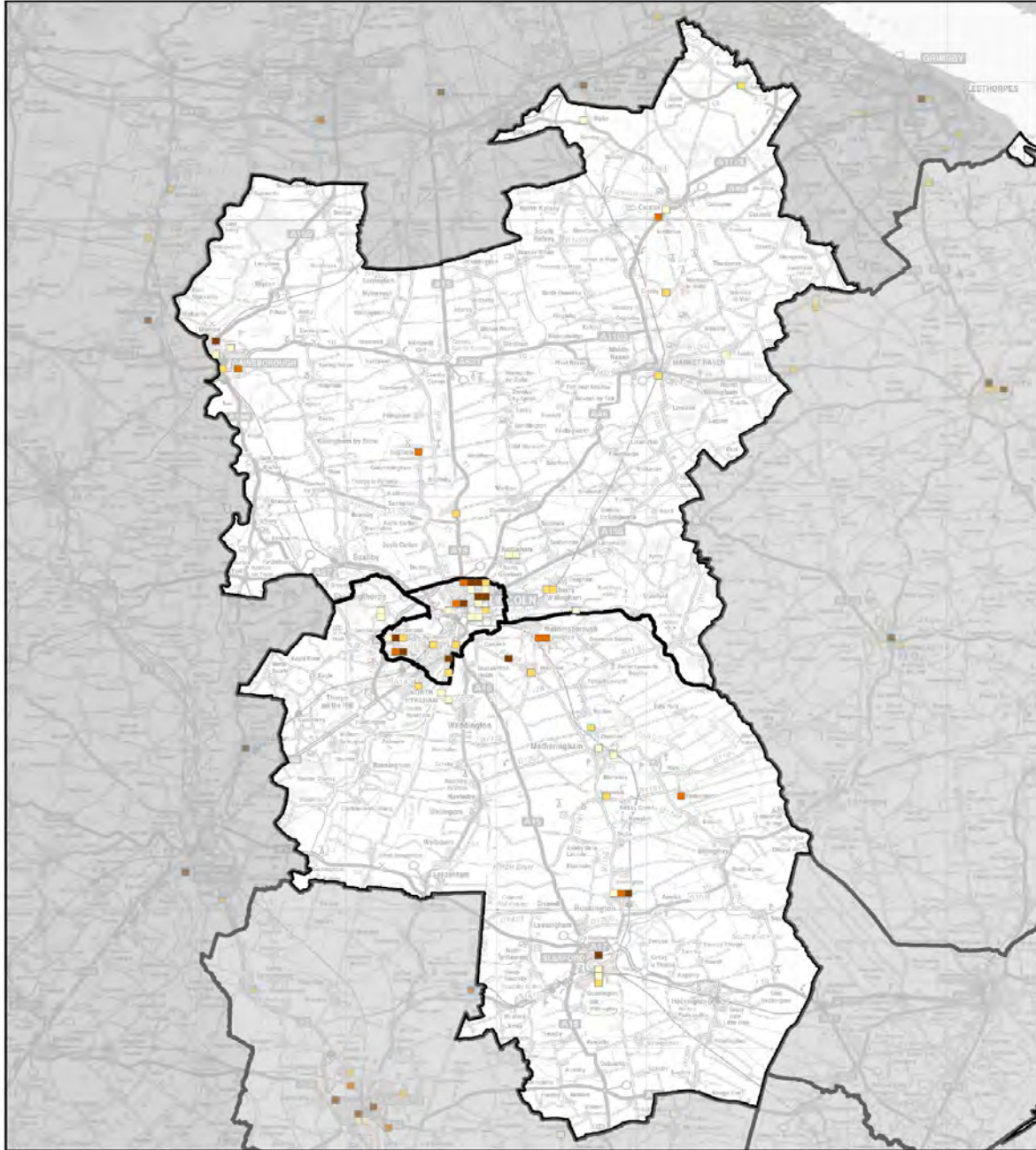
Flood Map for Surface Water Central Lincolnshire LDF Area



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Central Lincolnshire FR&DMG – Initial areas where potential flood risk requires further investigation as part of the local strategy

NOTE: MAP SHOULD BE VIEWED AT NO LARGER THAN 1:50,000 SCALE



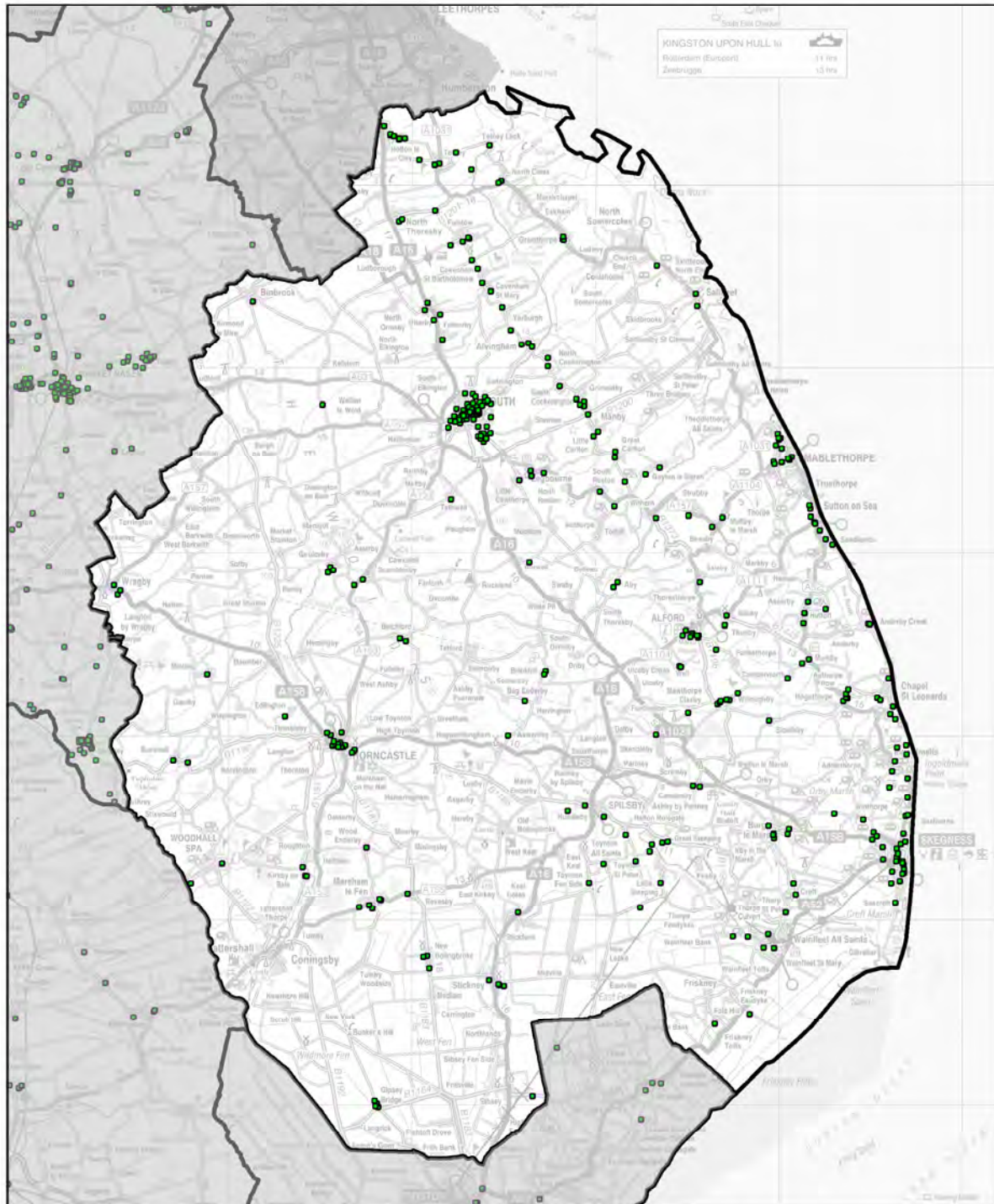
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Legend – Estimated number of properties within a 0.5 km sq at potential risk of local flooding




East Lindsey FR&DMG – Recorded incidents of historical local flooding

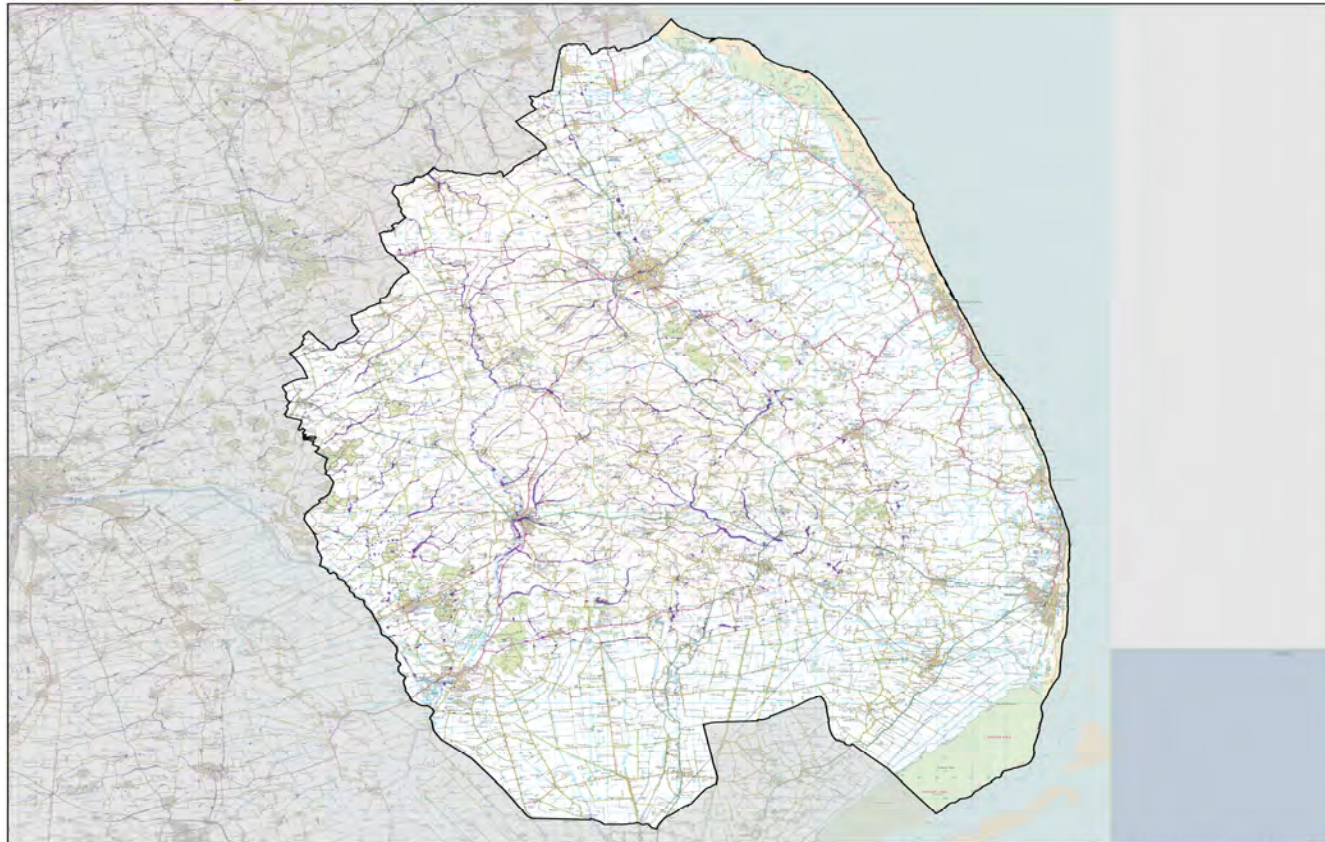
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Legend – Recorded incidents of historical local flooding shown as 

Flood Map for Surface Water East Lindsey LDF Area




Note - this map provides a general indication of the broad areas that may be at risk of surface water flooding. It is taken from a national assessment which takes broad account of drainage and typical storms which are likely to cause flooding, but these will vary locally and are therefore not appropriate everywhere.

Important

- This information may be useful to help inform emergency & spatial planning and general awareness of surface water flood risk.
- It is not suitable for use at an individual property scale due to the method used.
- The information should not be interpreted as stating that the location you are interested in will or won't actually flood, but simply that it is in or not in an area shown at risk on the maps.
- As there are various sources of surface water information available, you should contact your local authority to ask them what surface water information best represents local conditions.

Flood depths from rainfall with a 1 in 200 chance of occurring in any given year

 > 0.3m

 LDF Area Boundary

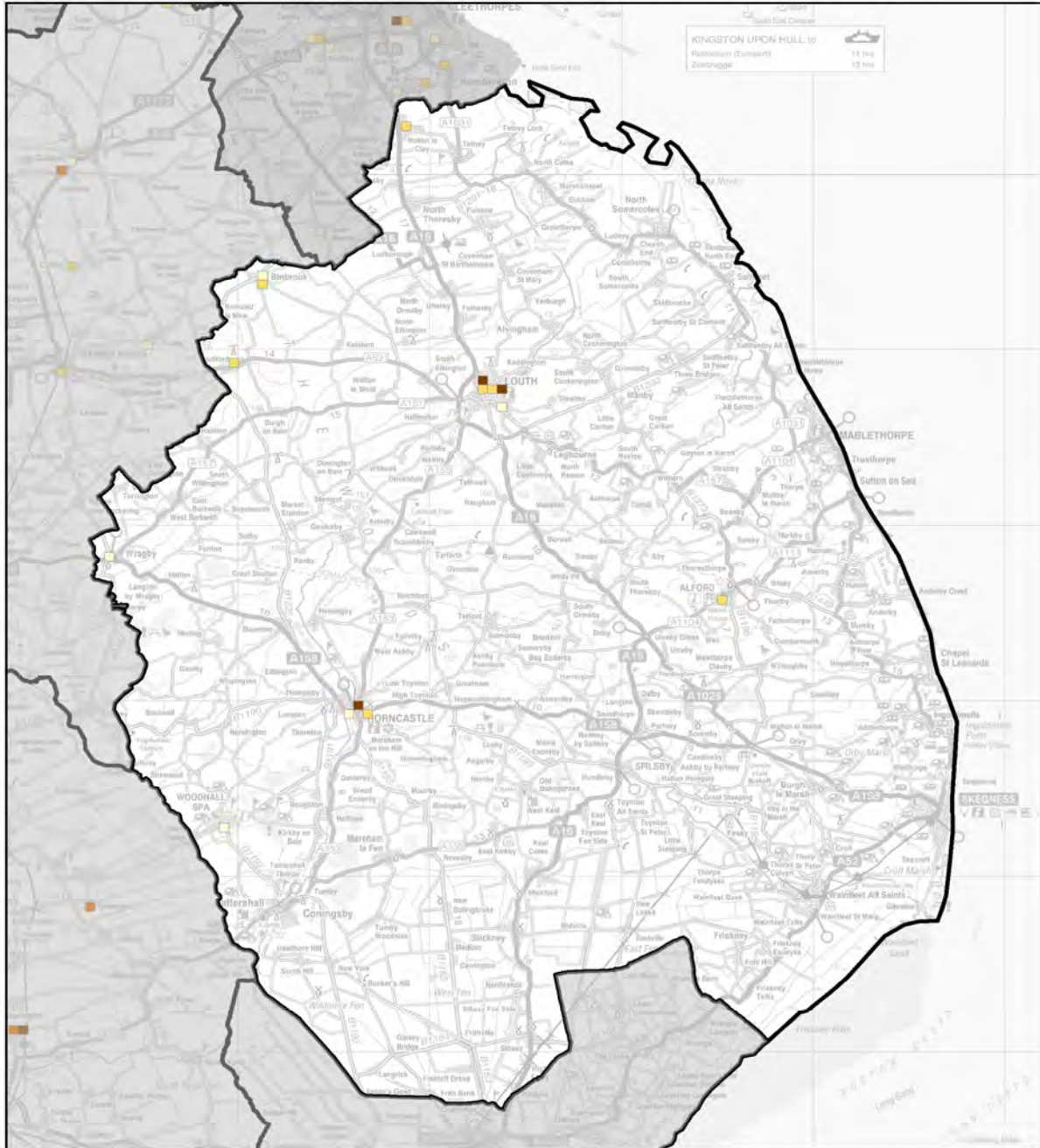
0 4 8 km

Data produced 2010.

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East Lindsey FR&DMG – Initial areas where potential flood risk requires further investigation as part of the local strategy

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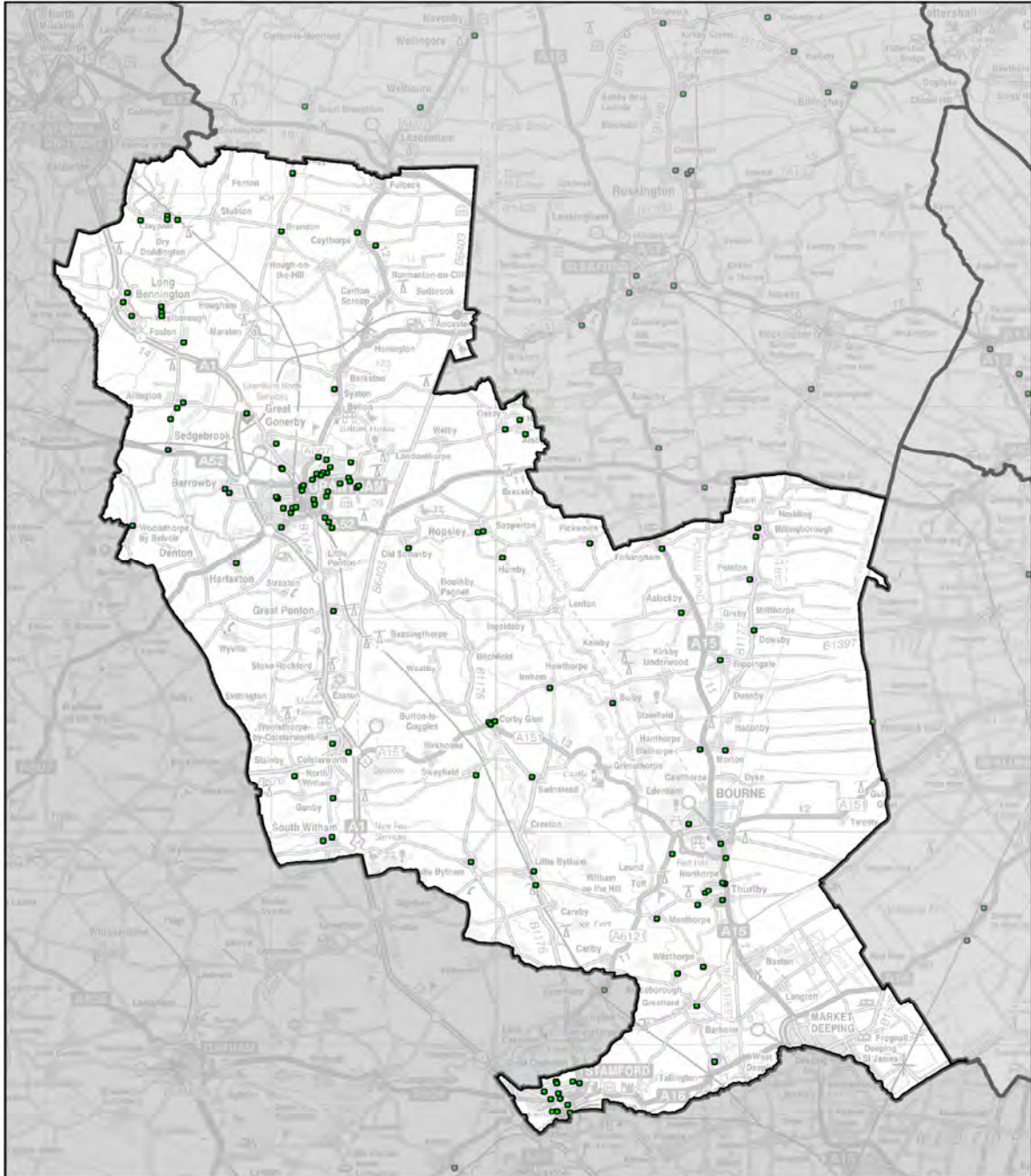
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Legend – Estimated number of properties within a 0.5 km sq at potential risk of local flooding




South Kesteven FR&DMG – Recorded incidents of historical local flooding

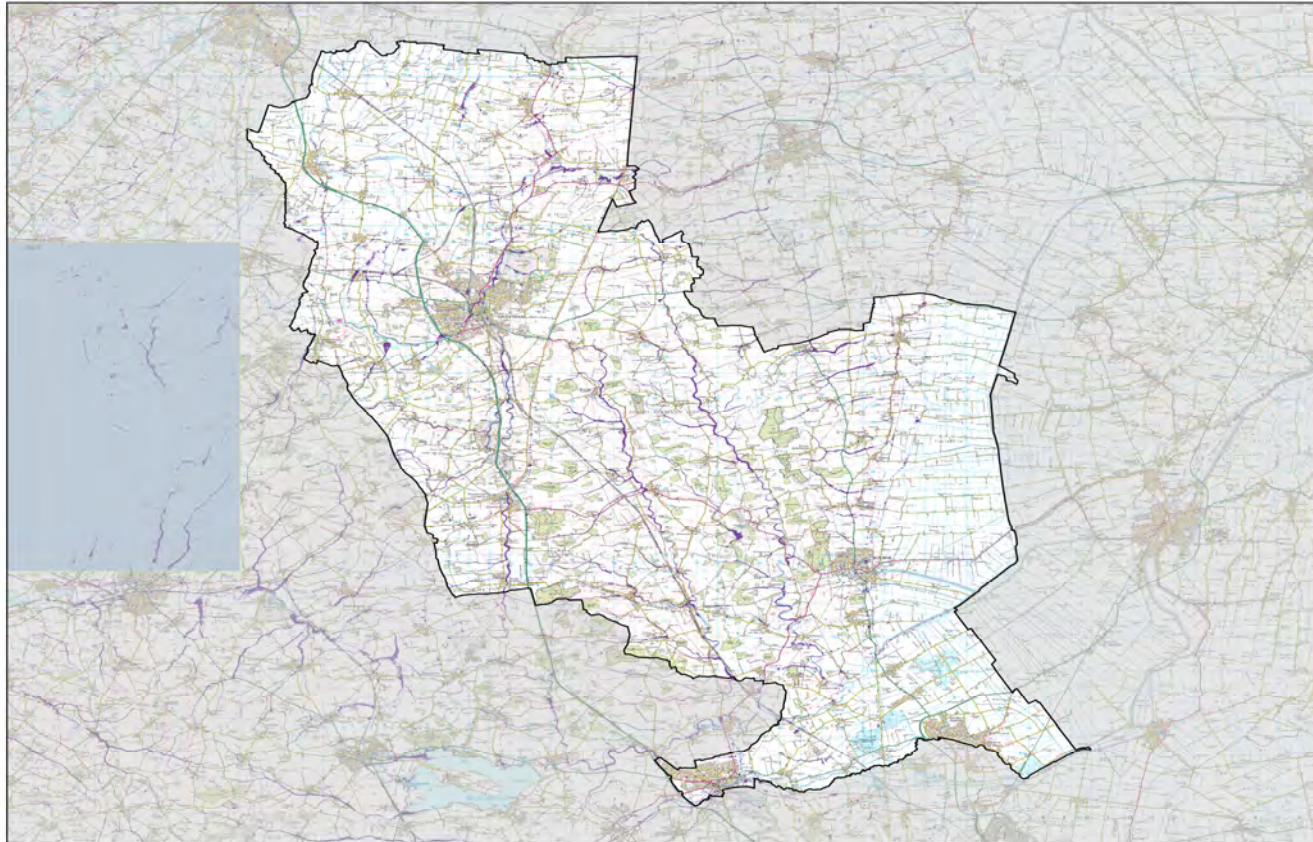
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Legend – Recorded incidents of historical local flooding shown as 

Flood Map for Surface Water South Kesteven LDF Area




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Important

- This information may be useful to help inform emergency & spatial planning and general awareness of surface water flood risk.
- It is not suitable for use at an individual property scale due to the method used.
- The information should not be interpreted as stating that the location you are interested in will or won't actually flood, but simply that it is in or not in an area shown at risk on the maps.
- As there are various sources of surface water information available, you should contact your local authority to ask them what surface water information best represents local conditions.

Flood depths from rainfall with a 1 in 200 chance of occurring in any given year

-  > 0.3m
-  LDF Area Boundary

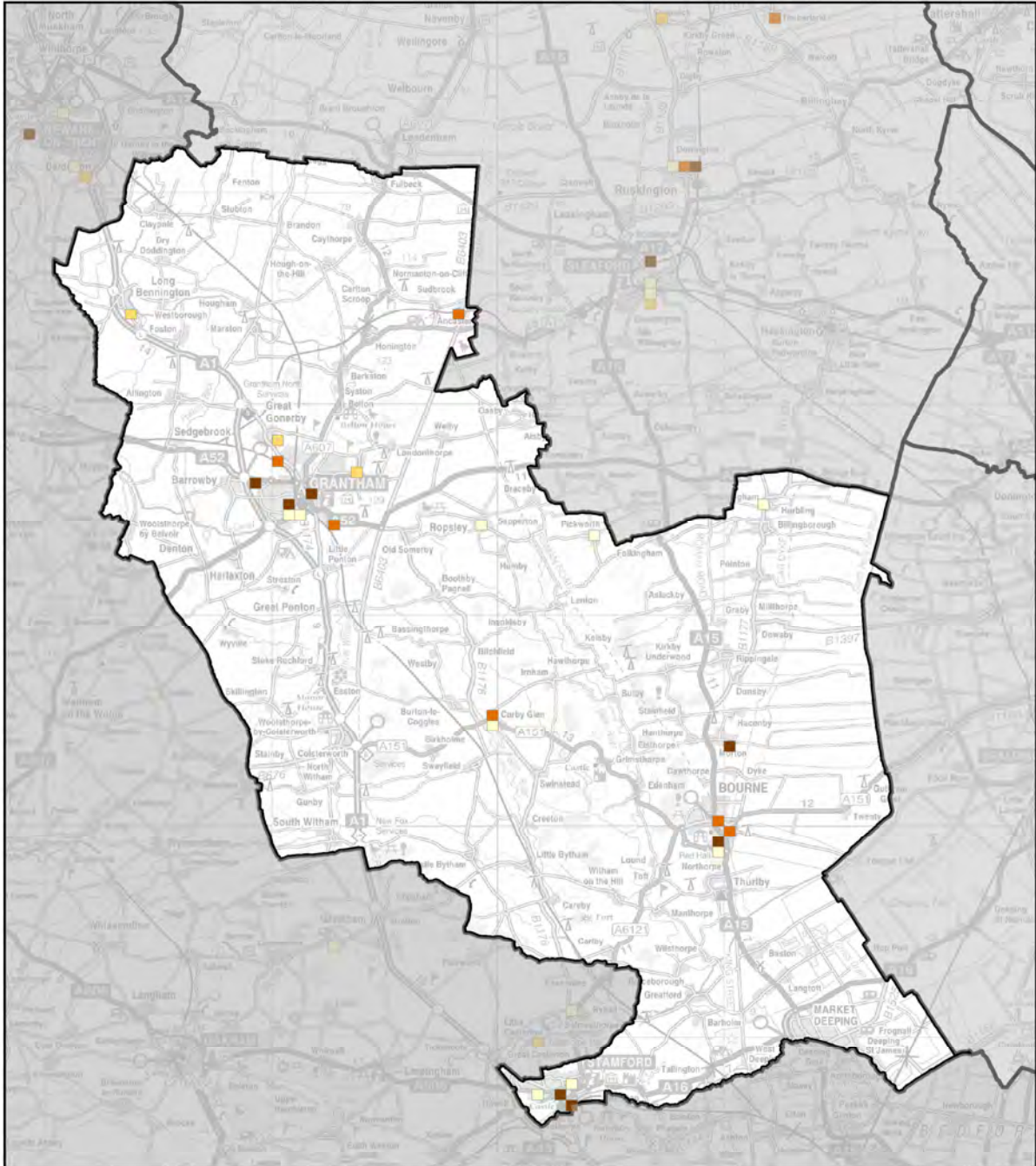
0 4 8 km

Data produced 2010.

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South Kesteven FR&DMG – Initial areas where potential flood risk requires further investigation as part of the local strategy

NOTE: MAP SHOULD BE VIEWED AT NO LARGER THAN 1:50,000 SCALE



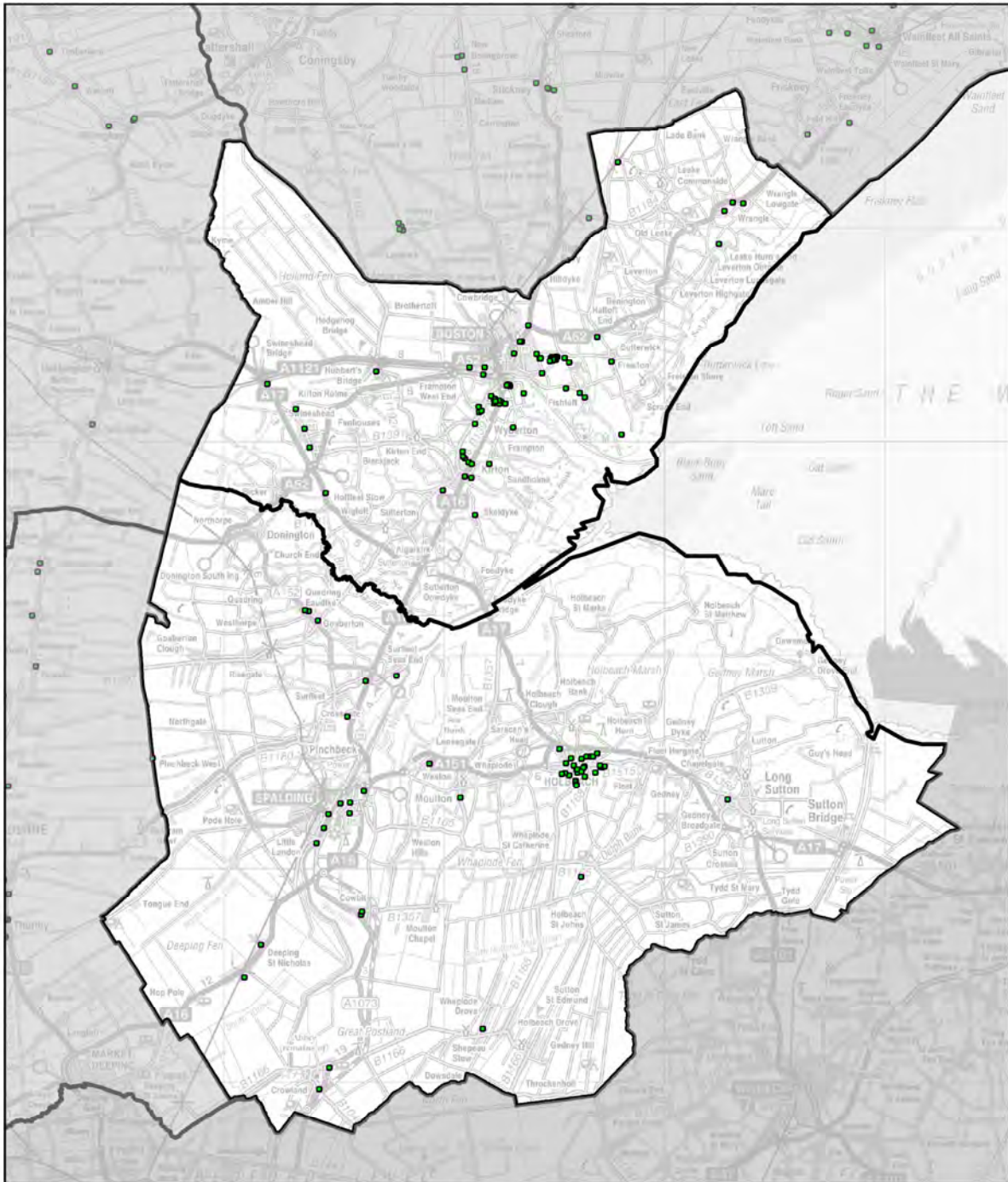
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Legend – Estimated number of properties within a 0.5 km sq at potential risk of local flooding




Boston and South Holland FR&DMG – Recorded incidents of historical local flooding

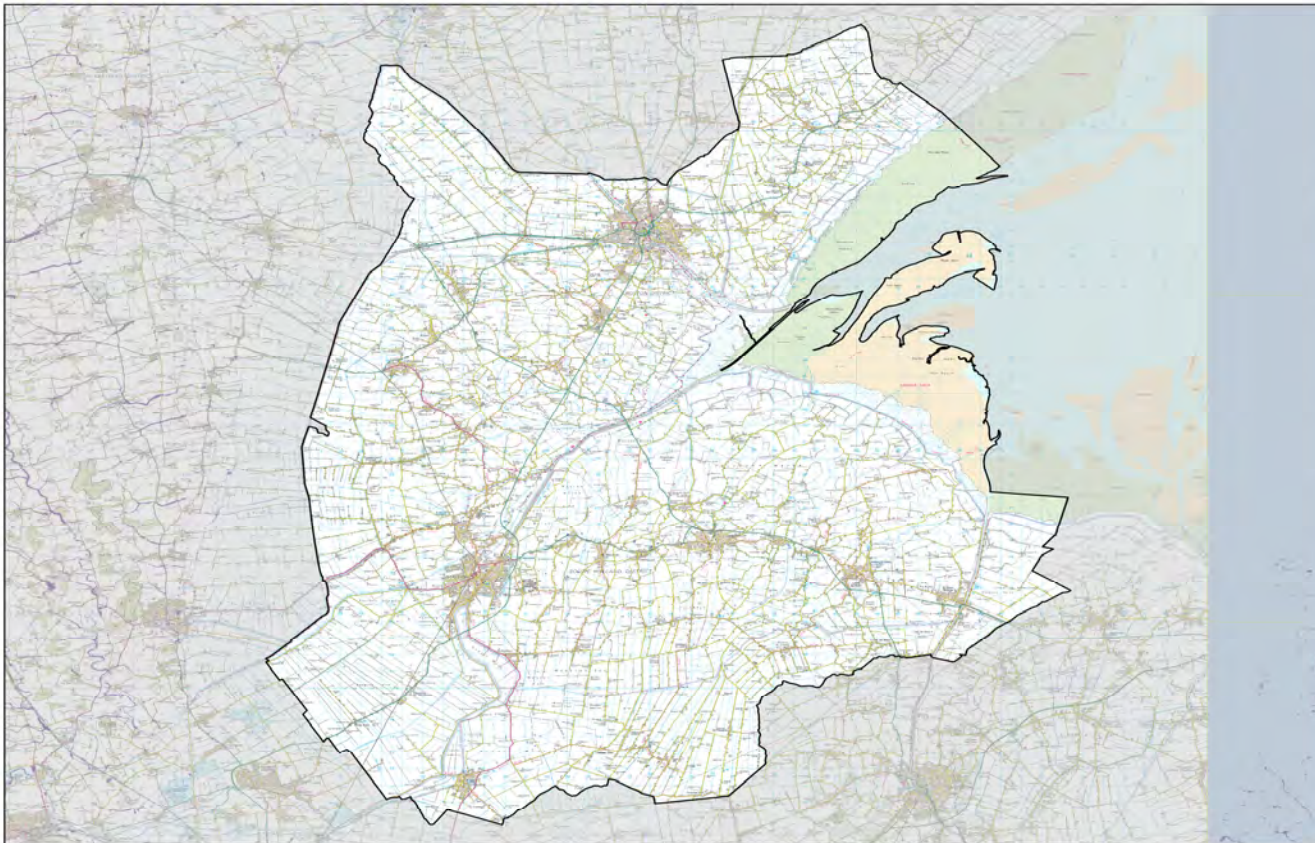
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Legend – Recorded incidents of historical local flooding shown as 

Flood Map for Surface Water Boston and South Holland LDF Area





Note - this map provides a general indication of the broad areas that may be at risk of surface water flooding. It is taken from a national assessment which takes broad account of drainage and typical storms which are likely to cause flooding, but these will vary locally and are therefore not appropriate everywhere.

Important

- This information may be useful to help inform emergency & spatial planning and general awareness of surface water flood risk.
- It is not suitable for use at an individual property scale due to the method used.
- The information should not be interpreted as stating that the location you are interested in will or won't actually flood, but simply that it is in or not in an area shown at risk on the maps.
- As there are various sources of surface water information available, you should contact your local authority to ask them what surface water information best represents local conditions.

Flood depths from rainfall with a 1 in 200 chance of occurring in any given year

-  > 0.3m
-  LDF Area Boundary

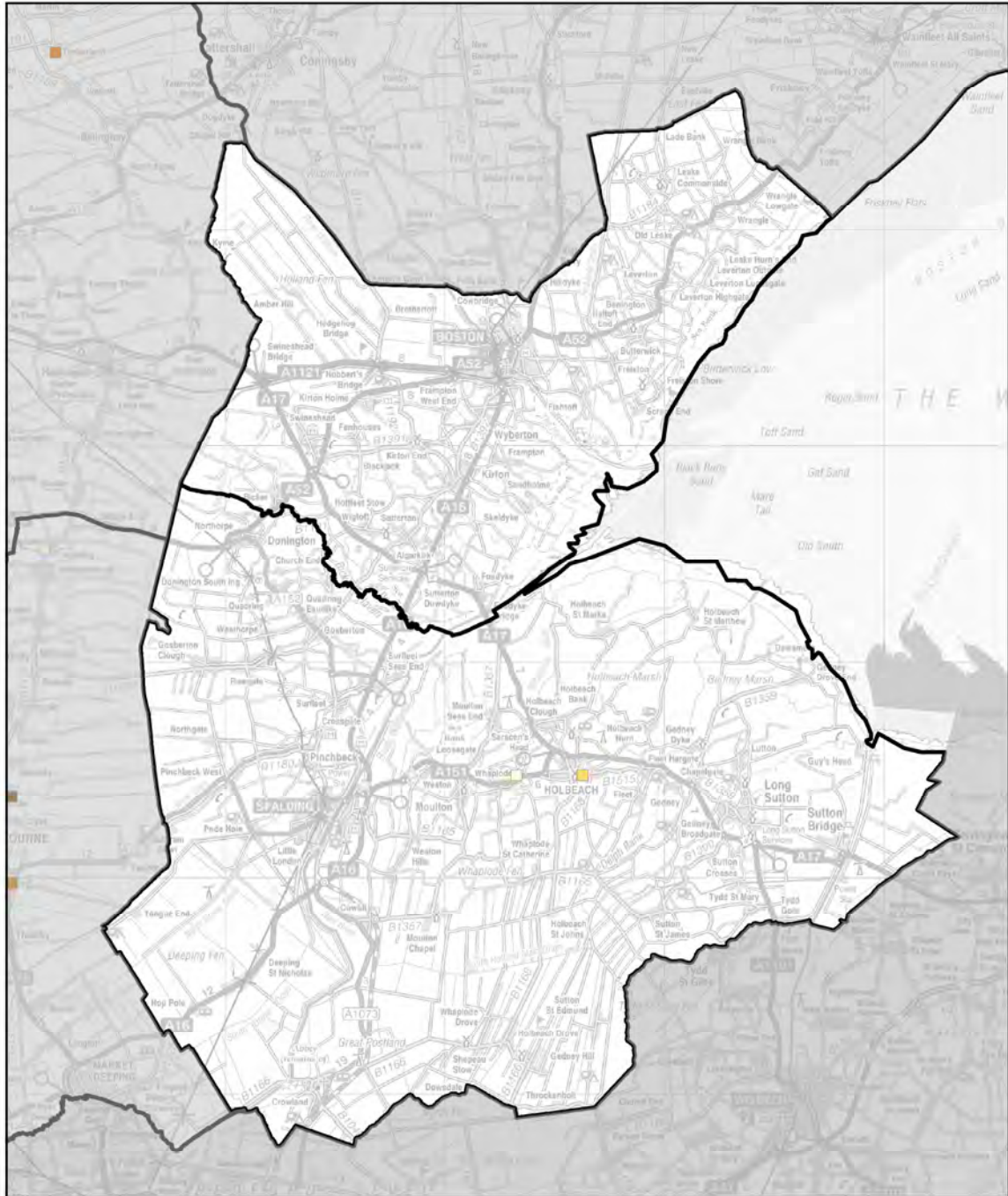
0 4 8 km

Data produced 2010.

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Boston and South Holland FR&DMG – Initial areas where potential flood risk requires further investigation as part of the local strategy

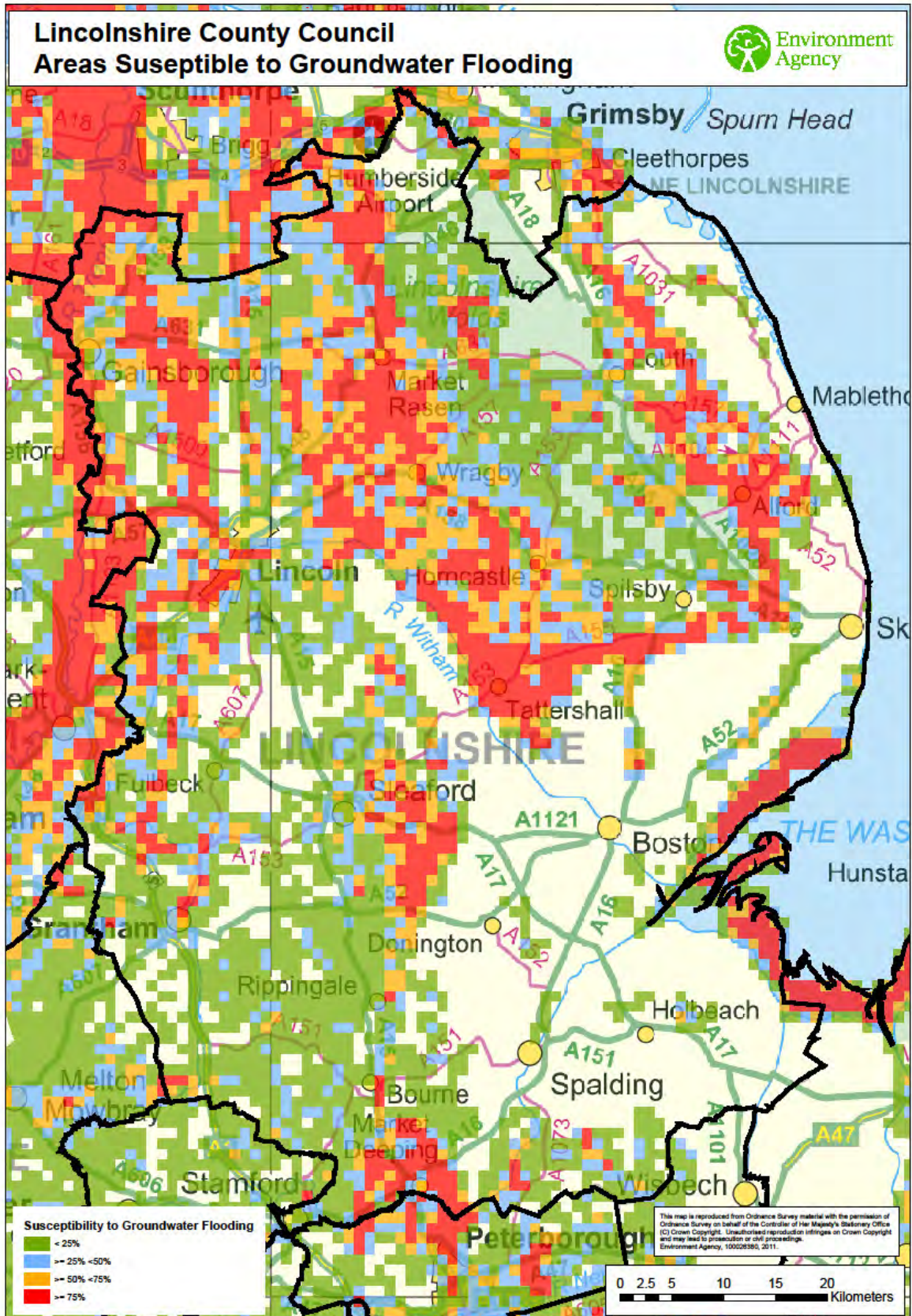
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Legend – Estimated number of properties within a 0.5 km sq at potential risk of local flooding





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8 Next steps

Defra Guidance requirements:

- *Describe arrangements and proposals for partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information. This will help in future assessments and reviews and during the mapping and planning stages.*
- *For each new flood with significant consequences that occurs, provision should be made to record:*

Flood location

Flood type

Date of commencement of each flood

Duration of flood

Estimated adverse consequences on the population, economic damage, cultural heritage and environment.

8.1 Proposed measures to support the PFRA in 6 years time

The Lincolnshire PFRA is a “living document” and will be kept under review by the LLFA during future years. The Regulations require the first review to be completed before 22nd June 2017 and then at intervals at no more than 6 years. A number of particular measures to help support the “living document” and its reviews are mentioned below:

- The Lincolnshire Flood Risk and Drainage Management Framework partnership will continue to build closer cooperation and collective responsibility and accountability for local flood risk management and guide the individual actions of the partners;
- The LLFA Data Management Project will provide pragmatic and effective solutions to data collection, collation, sharing and storing etc. amongst the partnership. Composite GIS data layering and links to customer relations management and asset management processes will be developed;
- During the first review period, the Local Flood Risk Management Strategy will be developed and improved science, data and other evidence gathered and management decisions taken will undoubtedly influence and assist the PFRA; and
- Under the Flood & Water Management Act 2010, the LLFA has a duty to investigate flooding incidents with significant consequences, and as part

of this process, local flood risk, hazard and consequence data and information will be gathered relating to pre, during and post flood events. Again, all new evidence gathered will be carefully considered and where appropriate used to update the PFRA.

8.2 Development of the Local Flood Risk Management Strategy (LFRMS)

The PFRA undertakes a countywide preliminary assessment of flood risk to the county as a whole, specifically to identify any LFRAs that meet the national level significance thresholds provided by Defra. The PFRA does not identify and/or assess individual local flood risk areas within the county at this stage. This will be done as part of the Local Flood Risk Management Strategy over the next few years and will be guided by the Flood Risk and Drainage Management Framework partnership. A number of key areas identified throughout the PFRA work that the Local Flood Risk Management Strategy will focus on include:

- The Local Government Group Preliminary Framework “living document” will be referred to and used to guide the development of the Local Flood Risk Management Strategy;
- Having established options for determining potential county significance, thresholds and flood risk areas, this work will be further developed;
- Further evidence of flood probability, hazard and consequence and hence overall flood risk from local sources is needed, and work will be put in hand through the Flood Risk and Drainage Management Framework partnership and lead by the LLFA;
- In particular, more information and knowledge is required on community vulnerability including various residential, business/commercial, service and industrial property types and numbers; the location and dependence on different types of critical infrastructure and essential services (e.g. electricity, gas, sewerage and water installations, police and fire and rescue stations, hospitals and care homes etc.) and their location in respect of community focus and activity;
- Increased confidence is needed in terms of scientific evidence to establish future depth, velocity and speed of inundation of local sources of flooding in local community locations;
- The county transport network will be further considered to establish flood risk vulnerable locations and routes and the subsequent impact on network users and dependencies;

- The need for future Surface Water management Plans (SWMPs) and other local studies will be assessed;
- Closer links will be drawn between plans and strategies to ensure joined up planning, delivery and emergency response between the partners across the county;
- Work carried out in respect of the PFRA and the Local Flood Risk Management Strategy will benefit the LLFA and partners in establishing the effective role of the SUDs Approval Body (SAB); and
- SFRA within the county will be reviewed in the light of new data and information gathered as part of the PFRA and Local Flood Risk Management Strategy process, to ensure emerging Local Development Frameworks (LDFs), land use policies and new developments adequately take account of flood risk from all sources.

9 Key references

Preliminary Flood Risk Assessments - Living draft guidance and appendices for Lead Local Flood Authorities – May 2010 – Environment Agency)

Preliminary Flood Risk Assessments - Final guidance for Lead Local Flood Authorities – 7/12/2010 – Environment Agency)

<http://publications.environment-agency.gov.uk/pdf/GEHO1210BTGH-e-e.pdf>

Preliminary Flood Risk Assessments – Annexes to the final guidance for Lead Local Flood Authorities – 02/03/2011 – Environment Agency)

<http://publications.environment-agency.gov.uk/pdf/GEHO1210BTHF-e-e.pdf>

Selecting and reviewing Flood Risk Areas for local sources of flooding – Guidance to Lead Local Flood Authorities – December 2010 – Defra and Welsh Assembly Government

<http://archive.defra.gov.uk/environment/flooding/documents/interim2/flood-risk-method.pdf>

Preliminary Framework to assist the development of the Local Strategy for Flood Risk Management “A Living Document” – February 2011 – Local Government Group

Draft Lincolnshire Multi-Agency Flood Plan

The Flood Risk Regulations 2009

<http://www.legislation.gov.uk/ukxi/2009/3042/contents/made>

10 Glossary

Act	A Bill approved by both the House of Commons and the House of Lords and formally agreed to by the reigning monarch (known as Royal Assent)
Assets	Structures, or a system of structures used to manage flood risk.
Candidate county significant indicative local flood risk areas	Initial areas where significant harmful consequences occur to a community and the resulting impact of the flood on the number of “clustered” properties/residents in the ward/parish is deemed to reach a certain threshold, whereby the incident can reasonably be considered to be of county significance. <i>(NOTE: county indicative flood risk areas will be considered further as part of the Local Flood Risk Management Strategy.)</i>
Candidate Flood Risk Areas	Initial potential flood risk areas identified by Flood Risk and Drainage Management Groups (using historic flooding information only), to assist the early thought process of what may or may not be considered a county significant indicative flood risk area.
Catchments	An area that serves a river with rainwater. Every part of land where the rainfall drains to a single watercourse is in the same catchment.
Cultural heritage	Buildings, structures and landscape features that have an historic value. These are also known as heritage assets.
Defences	A structure that is used to reduce the probability of floodwater or coastal erosion affecting a particular area (for example a raised embankment or sea wall)

Flood	The temporary covering by water of land not normally covered with water
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and Welsh Assembly Government.
Groundwater	Water which is below the surface of the ground and in direct contact with the ground or subsoil.
Indicative Flood Risk Areas	Areas determined by the Environment Agency as indicatively having a significant flood risk, based on guidance published by Defra and Welsh Assembly Government and the use of certain national datasets. These indicative areas are intended to provide a starting point for the determination of Flood Risk Areas by LLFAs.
Initial county level significance thresholds	Initial levels of impact of local flooding to human health, local economy and the environment, at which significant harmful consequences occur, that can reasonably be considered to be of county significance. <i>(NOTE: county thresholds will be considered further as part of the Local Flood Risk Management Strategy.)</i>
Local flood risk	Flood risk from sources other than main rivers, the sea and reservoirs, principally meaning surface runoff, groundwater and ordinary watercourses.
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
National Receptor Dataset	A collection of risk receptors produced by the Environment Agency.
Ordinary watercourses	All watercourses that are not designated Main River, and which are the responsibility of Local

	Authorities or, where they exist, IDBs.
Pathway	The connection between a particular source and a receptor that may be harmed.
Preliminary assessment report	A high level summary of significant flood risk, based on available and readily derivable information, describing both the probability and harmful consequences of past and future flooding.
Preliminary assessment spreadsheet	Reporting spreadsheet which LLFAs need to complete. The spreadsheet will form the basis of the Environment Agency's reporting to the European Commission.
Receptor	Something that may be harmed by flooding.
Regulations	The Flood Risk Regulations 2009
Resilience	The ability of the community, services, area or infrastructure to withstand the consequences of an incident.
Risk	Measures the significance of a potential event in terms of likelihood and impact.
Risk assessment	A structured and auditable process of identifying potentially significant events, assessing their likelihood and impacts, and then combining these to provide an overall assessment of risk, as a basis for further decisions and action.
River basin district	There are 11 river basin districts in England and Wales, each comprising a number of contiguous river basins or catchments. The Environment Agency is responsible for collating LLFA reports at a river basin district level.
Significant harmful consequences	Where flooding occurs to people, residential and commercial property, and key critical infrastructure and essential services property to a depth of 0.3m and above. Frequency of

	<i>flooding (NOTE: speed of inundation, velocity and other hazard factors and associated impacts including indirect impacts on communities of flooding to critical infrastructure and essential services will be considered further as part of the Local Flood Risk Management Strategy.)</i>
Strategic Flood Risk Assessment	Spatial planning documents prepared by local planning authorities under PPS25 in England.
Source	The origin of a hazard (e.g. heavy rainfall, strong winds, surge etc).
Surface runoff	Rainwater (including snow and other precipitation) which is on the surface of the ground (whether or not it is moving), and has not entered a watercourse, drainage system or public sewer.

11 Abbreviations

AStSWF	Areas Susceptible to Surface Water Flooding
CI	Critical Infrastructure
CILFRA	Candidate Indicative Local Flood Risk Area
CFMP	Catchment Flood Management Plan
CFRA	Candidate Flood Risk Area
CON	Conservation Asset
Defra	Department for Environment, Flood and Rural Affairs
ES	Essential Service
F&WM Act	Flood & Water Management Act 2010
FmSW	Flood Map for Surface Water
FR&DMG	Flood Risk & Drainage Management Group
GIS	Geographical Information System
IDB	Internal Drainage Board
LCC	Lincolnshire County Council
LDF	Local Development Framework
LFRMS	Local Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
LRF	Local Resilience Forum
MAFP	Multi-Agency Flood Response Plan
NRD	National Receptor Database
PAR	Preliminary Assessment Report
PFRA	Preliminary Flood Risk Assessment
PID	Project Initiation Document
PPS25	Planning Policy Statement 25
SAB	Sustainable Urban Drainage Approving Body
SFRA	Strategic Flood Risk Assessment
SWMP	Surface Water management Plan

Annexes

Annex 1 - Records of past floods and their significant consequences (preliminary assessment report spreadsheet)

Annex 2 - Records of future floods and their consequences (preliminary assessment report spreadsheet)

Annex 3 - Records of Flood Risk Areas and their rationale (preliminary assessment report spreadsheet)



Annex 1_2&3
Spreadsheet Vers 1.C

Annex 4 - Review checklist



PFRA Review
Spreadsheet 11_05_:

Appendices

- A Terms of Reference of Lincolnshire Flood Risk and Drainage Management Framework
- B Parish flood history pro-forma sent to Parish Councils
- C Data capture template used by partners to collect summary flood risk information and metadata
- D Local flood risk area vulnerability indicators template
- E Joint scrutiny and approval arrangements