

Newcastle City Council Preliminary Flood Risk Assessment

Final Report

August 2011



Report prepared by:

Bethany Shaw
Flood Risk Management Trainee
Technical Services

Checked by:

John Robinson
Principal Engineer
Technical Services

David Embleton
Head of Highway Networks and Traffic Management
Technical Services

Approved by:

Delegated Decision

Newcastle City Council

Civic Centre
Barras Bridge,
Newcastle upon Tyne,
NE99 1RD
0191 232 8520

Executive Summary

This report has been prepared by Newcastle City Council in order to fulfil the requirements of the Flood Risk Regulations (2009). Newcastle City Council has been identified as a Lead Local Flood Authority (LLFA) under the Regulations. The Preliminary Flood Risk Assessment (PFRA) is the first stage of a 5 year action plan, and comprises this report, along with the following spreadsheets.

The PFRA is intended to give a high level overview of flood risk from local flood sources, which include surface water, groundwater, ordinary watercourses and canals. The aim is to identify any areas at risk from flooding (Flood Risk Areas) within the Newcastle boundary.

The Environment Agency has nationally identified 'Indicative Flood Risk Areas' across England and Wales using thresholds set out by Defra. Newcastle does not exceed these thresholds, and so has not been identified as such an area.

The methodology for producing this PFRA is based on the Environment Agency's Final PFRA Guidance and Defra's Guidance on selecting Flood Risk Areas, both published in December 2010. As an LLFA, Newcastle City Council submitted the PFRA to the Environment Agency for review by 22nd June 2011. Approval of the PFRA will be finalised in August 2011 by NCC with the appropriate Delegated Decision. The Agency will then submit the PFRA to the European Commission in December 2011.

In order to establish a clear picture of flood risk in Newcastle, all available local flood risk information was collated and analysed. This included reviewing both historic flooding data and potential future flooding information. Most of the data was derived from Newcastle City Council's Strategic Flood Risk Assessments (SFRA's), Surface Water Management Plan (SWMP) and Envirocall records reporting flooding. In addition data was also sourced from external organisations such as the local water company (NWL) and the local fire service (TWFRS).

Based on the evidence, no past flood events were considered to have had 'significant harmful consequences'. Therefore the decision was made not to include any records of past flooding in Annex 1 of the Preliminary Assessment Spreadsheet. Despite this, it should be highlighted at this stage that some degree of flood risk from local sources does still exist across the City. As Newcastle is a dense and compact city, surface water in particular is a major source of localised flooding. Fluvial flooding from ordinary watercourses is rare.

As there is no Flood Risk Area within the Newcastle boundary, there is no requirement to create Flood Hazard Maps, Flood Risk Maps or a Flood Management Plan for the City. Instead, the next stage for Newcastle City Council will be to produce a 'Local Flood Risk Management Strategy' for the area. In order to achieve this, information from the PFRA (and other plans/strategies) highlighting localised flooding issues will be used to develop our approach to managing flood risk.

Table of Contents

Executive summary.....	ii
Table of Contents.....	1
List of Figures	3
List of Tables	3
Glossary.....	4
1. INTRODUCTION.....	5
1.1 Preliminary Flood Risk Assessment	5
1.2 Sources of flooding	6
1.2.1 Surface water.....	6
1.2.2 Groundwater	7
1.2.3 Ordinary watercourses.....	7
1.2.4 Sewer flooding	7
1.2.5 Interactions	7
1.3 Study area.....	8
1.4 Aims and Objectives	8
2. LLFA RESPONSIBILITIES.....	10
2.1 Introduction	10
2.2 Governance and Partnerships	10
2.2.1 Stakeholder Engagement	12
2.2.2 Public Engagement.....	12
2.3 Other Responsibilities	13
3. METHODOLOGY and DATA REVIEW	15
3.1 Introduction	15
3.2 Methodology.....	15
3.2.1 Assessing Historic Flood Risk.....	15
3.2.2 Assessing Future Flood Risk.....	16
3.2.3 Identifying Flood Risk Areas.....	17
3.3 Data Sources	18
3.3.1 Data Limitations	18
3.3.2 Data Sharing, Storage and Security	18
3.3.3 Quality Assurance.....	21
3.3.4 Data Licensing and Restrictions	22
4. HISTORIC FLOOD RISK.....	23
4.1 Overview of Historical Flooding in Newcastle.....	23
4.1.1 Surface Water Flooding	23
4.1.2 Groundwater Flooding	23
4.1.3 Sewer Flooding.....	25
4.1.4 Canal and Ordinary Watercourse Flooding.....	25
4.1.5 Interaction with Main Rivers and the Sea	25
4.2 Analysis of Historic Flooding in Newcastle.....	25

4.3 Significant Consequences of Historic Flooding.....	26
5. FUTURE FLOOD RISK	28
5.1 Introduction	28
5.2 Overview of Future Flood Risk.....	28
5.2.1 Surface Water Flooding	28
5.2.2 Locally Agreed Surface Water Information	29
5.2.3 Groundwater Flooding	29
5.2.4 Sewer Flooding.....	32
5.2.5 Canal and Ordinary Watercourse Flooding.....	32
5.3 Potential Consequences of Future Flooding	34
5.4 Effects of Climate Change and Long Term Developments.....	38
5.4.1 The Evidence.....	38
5.4.2 Key Projections for Northumbria River Basin District.....	38
5.4.3 Implications for Flood Risk.....	39
5.4.4 Adapting to Change	39
5.4.5 Long term developments	39
6. FLOOD RISK AREAS	41
6.1 Introduction	41
6.2 Review of Indicative Flood Risk Areas.....	44
7. NEXT STEPS.....	46
7.1 Introduction	46
7.2 Local Flood Risk Management Strategy	46
7.3 Flood Incident Investigations and Register	47
8. References.....	49
9. Annexes	50

List of Figures

Figure 1-1. Flooding from local sources (taken from PFRA Final Guidance).	6
Figure 1-2. Newcastle City council's administrative boundary.	9
Figure 2-1. Newcastle City Council's Flood Risk Management structure.	11
Figure 4-1. Map of historical flood event locations and sources.	24
Figure 4-2. Breakdown of historic flood incidents by source.	26
Figure 5-1. Flood Map for Surface Water.	30
Figure 5-2. Areas Susceptible to Groundwater flooding.	31
Figure 5-3. Flood Map illustrating Flood Zones 2 and 3.	33
Figure 5-4. Areas above future flood risk.	35
Figure 5-5. Number of people at risk from future flooding.	36
Figure 5-6. Number of critical services at risk from future flooding.	37
Figure 6-1. Indicative Flood Risk Areas for England.	42
Figure 6-2. Clusters of places above the flood risk thresholds.	43

List of Tables

Table 1-1. Obligations under the Flood Risk Regulations 2009.	5
Table 2-1. Description of other LLFA responsibilities and enactment dates.	13
Table 3-1. Criteria for defining a 'significant' flood event.	16
Table 3-2. Key Flood Risk Indicators.	16
Table 3-3. PFRA information and datasets.	16
Table 3-4. Quality Assurance system used in the PFRA.	21
Table 3-5. Data restrictions and licensing details.	22
Table 4-1. Consequences of historical flood incidents, categorised by source.	27
Table 5-1. Properties at risk from surface water flooding.	28
Table 5-2. Number of properties in Flood Zones 2 and 3.	32
Table 5-3. Flood risk thresholds for future flooding consequences.	34
Table 6-1. Flood Risk Area data gathered by the EA.	41
Table 6-2. Indicative Flood Risk Area Review.	44
Table 7-1. Flooding Incident Register format.	47

Glossary

Abbreviation	Definition
ASiSWF	Areas Susceptible to Surface Water Flooding
BAP	Biodiversity Action Plan
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Food and Rural Affairs
DRN	Detailed River Network
EA	Environment Agency
EC	European Commission
FMfSW	Flood Map for Surface Water
FWMA	Flood and Water Management Act 2010
FRA	Flood Risk Areas
GHG	Green House Gas
LLFA	Lead Local Flood Authority
SLA	Service Level Agreement
MoU	Memorandum of Understanding
NCC	Newcastle City Council
NRD	National Receptor Database
NWL	Northumbrian Water Limited
PFRA	Preliminary Flood Risk Assessment
SFRA	Strategic Flood Risk Assessment
SSSI	Site of Specific Scientific Interest
SWMP	Surface Water Management Plan
TWFRS	Tyne and Wear Fire and Rescue Service
WAG	Welsh Assembly Government

1. INTRODUCTION

1.1 Preliminary Flood Risk Assessment

This document reports the findings of research carried out by Newcastle City Council in order to prepare the PFRA for the Newcastle area.

The PFRA report stems from two new major pieces of legislation regarding flooding issues: The Flood Risk Regulations (which came into power on the 10th December 2009) and the Flood and Water Management Act (which gained assent on the 8th April 2010).

As a result of these legislations, all Unitary Authorities and County Councils have been designated as Lead Local Flood Authorities (LLFAs). LLFAs now have certain duties and responsibilities to fulfil, which will be outlined further in Section 2.

The Flood Risk Regulations transpose the European Floods Directive into domestic law in England and Wales. The intention of the Directive is to reduce the probability and consequences of flooding by establishing a common framework for understanding and managing flood risk across Europe. The Regulations also impose duties on the Environment Agency and LLFA's.

The main requirements are to prepare:

- Preliminary Flood Risk Assessments
- Flood Hazard and Flood Risk Maps
- Flood Risk Management Plans

The timescales for the above are presented here in Table 1.

Table 1-1. Obligations under the Flood Risk Regulations 2009.

TASK	DESCRIPTION	DEADLINE
PFRA	Determine local flood risk from surface water, groundwater, ordinary watercourses and canals.	22nd June 2011
Identify Flood Risk Areas	Based on the PFRA and national criteria, identify areas of significant flood risk.	22nd June 2011
Prepare Flood Hazard Maps and Flood Risk Maps	To identify the level of hazard and risk within each identified Flood Risk Area.	22nd June 2013

The PFRA covers the first two tasks in Table 1. The outcome of the PFRA will determine if latter two tasks are required.

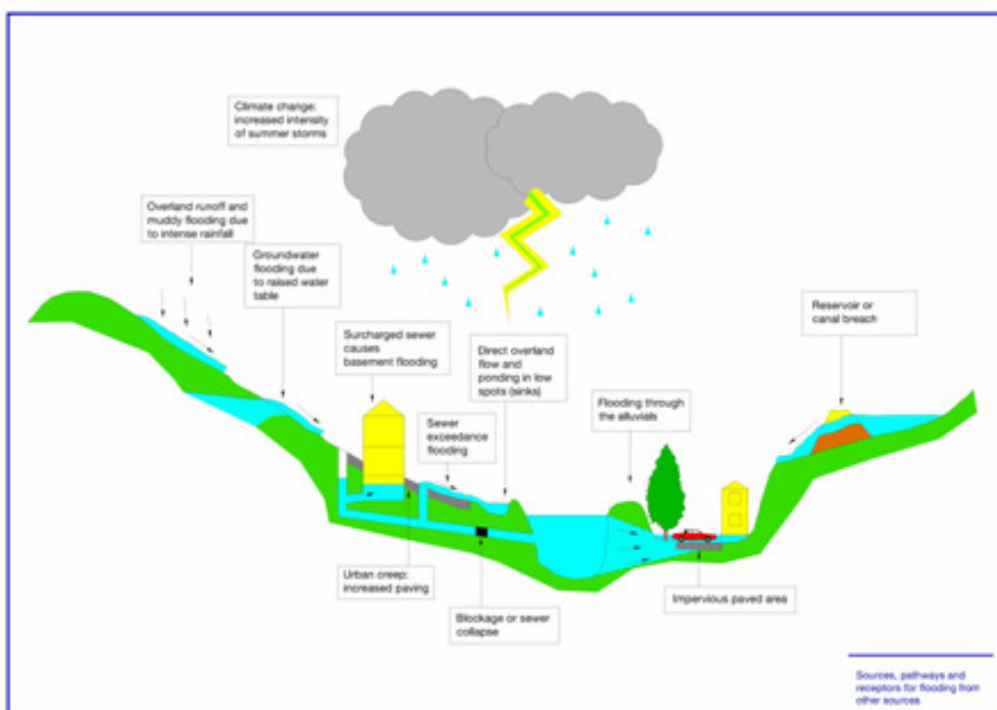
The criteria for producing the PFRA state both past and possible future flooding from local sources must be considered. Any potential harmful consequences for human health, economic activity and the environment must also be taken into account. The PFRA will form the basis for the Local Flood Risk Management Strategy.

1.2 Sources of flooding

As set out in the Flood Risk Regulations, the Environment Agency is responsible for flooding from the sea, main rivers and reservoirs. Therefore these sources do not need to be considered for the PFRA.

Only the local sources of flooding which are the responsibility of the LLFA must be considered when producing the PFRA. These include surface water, groundwater, ordinary watercourses and canals. In addition, any sources of flooding that interact with the above should also be considered. This includes the sources under the Environment Agency's jurisdiction. Figure 1-1 below shows potential sources of flooding to take into account. A brief description of each is then given.

Figure 1-1. Flooding from local sources (taken from PFRA Final Guidance).



1.2.1 Surface water

Surface water is generated by intense or prolonged rainfall. Surface water flooding may occur when heavy rainfall exceeds the capacity of local drainage networks and

water flows across the ground. The water follows natural depressions, and creates flow paths along roads in the City, before ponding in low areas.

1.2.2 Groundwater

Groundwater can reach the surface through springs, or a rising water table. This generally occurs after long periods of high rainfall which recharges the aquifer. The groundwater is most likely to emerge in low-lying areas, such as the base of a hill where the water table intersects the land. Groundwater flooding is not a major problem in Newcastle.

1.2.3 Ordinary watercourses

The two largest rivers in Newcastle (the Tyne and the Ouseburn) are both classed as main rivers, and are therefore the responsibility of the Environment Agency. There are a number of small streams which are classed as ordinary watercourses, but fluvial flooding in Newcastle is relatively rare. Flooding from watercourses occurs when the channel capacity is exceeded during periods of high flow. Catchment characteristics such as drainage density, relief, rainfall, infiltration and runoff rates, as well as channel characteristics such as steepness, roughness and area, determine flow magnitude. Natural obstructions such as fallen branches, as well as obstructions caused by illegal fly tipping reduce channel capacity and may contribute to flooding.

There are no canal systems in Newcastle.

1.2.4 Sewer flooding

Surface water drainage networks and foul sewers are found right across the City. Some surface water pipes discharge into ordinary and main watercourses, whilst the foul or combined sewers discharge to the local treatment works.

The main network of trunk sewers are combined sewers, as it is only recently (1960s onwards) that a separate system of sewers has developed. Typically, foul systems comprise a network of drainage sewers, sometimes with linked areas of separate and combined drainage, all discharging to sewage treatment works. Combined Sewer Overflows (CSOs) provide an overflow release from the drainage system into local watercourses or surface water systems during times of high flows. Surface water systems will generally collect surface water drainage separately from the foul sewerage and discharge directly into watercourse.

A major cause of sewer flooding is often due to large rainfall events causing sewers to surcharge, leading to external and highway flooding, and sometimes internal sewer flooding to properties.

1.2.5 Interactions

Flooding is often the result of water originating from more than one source, or water building up because another source (such as a river, or the sea) has prevented it from discharging normally.

An example of this in Newcastle is during times of high flow in the Ouseburn, water in the channel can prevent surface water pipes discharging, causing them to back up.

1.3 Study area

The study area for the PFRA is defined by Newcastle City Council's administrative boundary. This is shown in Figure 1-2 overleaf, along with the ward boundaries. There are four neighbouring authorities to Newcastle City Council (NCC); Gateshead, North Tyneside, South Tyneside, and Northumberland. All of the above are also LLFAs. Some of the watercourses in Newcastle originate in Northumberland, while some cross the border with North Tyneside. The River Tyne separates Newcastle from Gateshead and South Tyneside.

1.4 Aims and Objectives

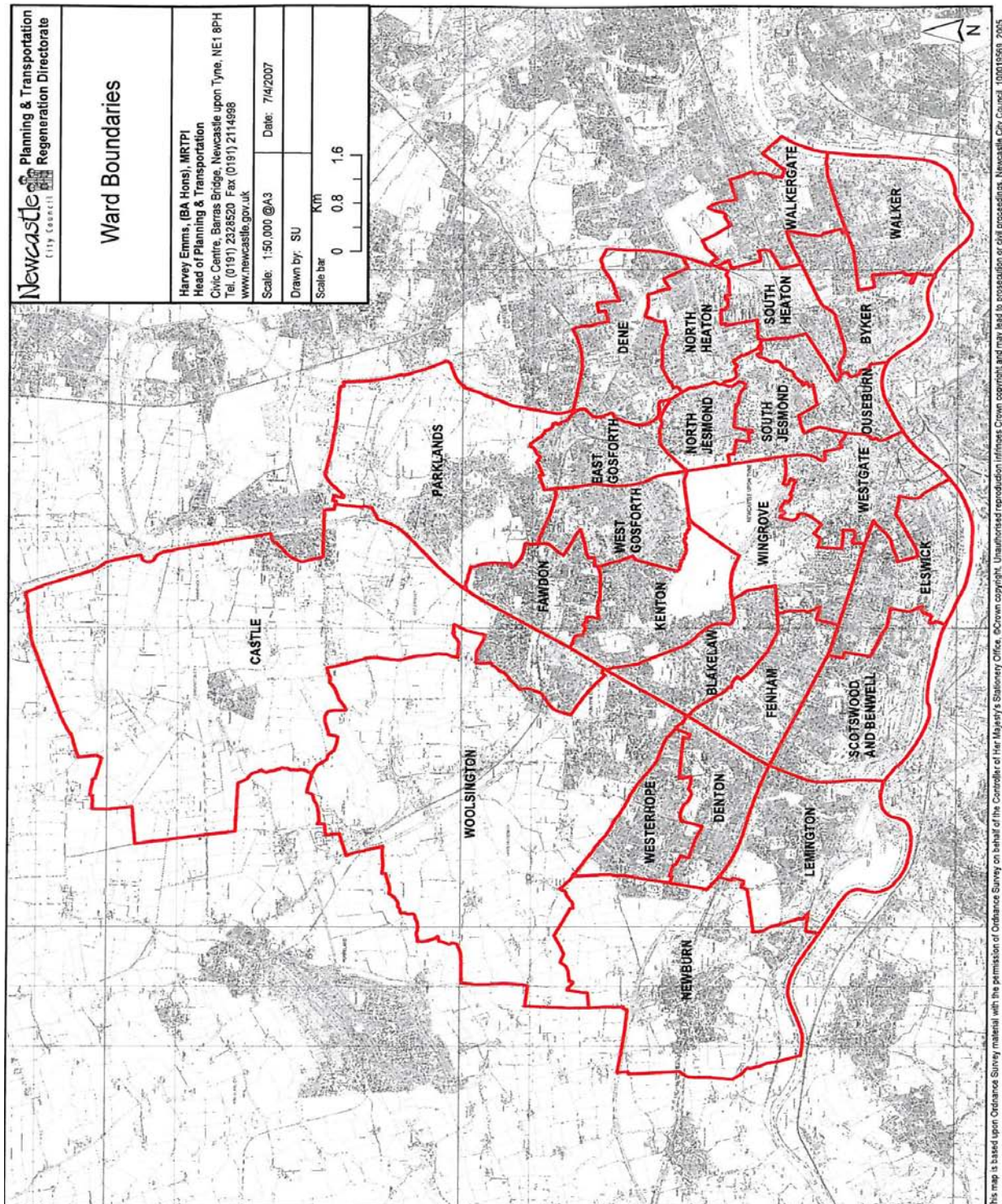
The PFRA is designed to be a national high level screening exercise in order to identify areas where the risk of flooding is significant. These areas will then subsequently be analysed further to assess the level of hazard and risk through maps and management plans.

The aim of the PFRA is to review historical and potential future flood risk and determine Flood Risk Areas.

The primary objectives are:

- Identify partner organisations involved in flood risk assessment and summarise stakeholder engagement.
- Describe partnership and collaboration for ongoing collection, assessment and storage of flood risk data and information.
- Summarise data sharing and storing systems used, quality assurance, security and licensing arrangements.
- Describe the methodology used for the PFRA with respect to data sources, availability and review procedures.
- Assess historic flood events within the study area from local sources of flooding and the consequences of these events.
- Establish an evidence base of historic flood risk information, which will be built upon in the future and used to support and inform the preparation of Newcastle City Council's Local Flood Risk Strategy.
- Assess the potential harmful consequences of future flood events within the study area.
- Review the provisional national assessment of Indicative Flood Risk Areas provided by the Environment Agency and provide explanation and justification for any amendments required to the Flood Risk Areas.

Figure 1-2. Newcastle City Council's administrative boundary.



2. LLFA RESPONSIBILITIES

2.1 Introduction

As previously mentioned there are several new duties and responsibilities for Lead Local Flood Authorities to carry out, the PFRA is just one. This section will outline the other necessary tasks for Newcastle City Council.

2.2 Governance and Partnerships

As an LLFA, Newcastle City Council is responsible for leading local flood risk management within the administrative boundary. Sir Michael Pitt's Review recommended that the LLFA should bring together all relevant bodies to help manage local flood risk. This recommendation has been enacted (FWMA 2010) and it is a requirement for the flood risk management authorities to co-operate with each other in order to fulfil their duties. The act also gives LLFAs the power to request information regarding flooding issues and flood risk management from others. The flood risk management authorities relevant to Newcastle have been identified as:

- Neighbouring councils
- Highways authorities
- Water company
- Environment Agency

Initiating, managing and maintaining partnerships are key steps to providing a co-ordinated approach to flood risk management across Newcastle. Ideally the collaborative working relationships will be formalised to ensure that communication, co-operation, and data exchange between parties is clearly defined. This may be done through Service Level Agreements (SLA) or Memorandums of Understanding (MoU). Stakeholders are then made fully aware of the expectations of themselves and of others.

As part of an ongoing process to meet the requirements set out by the FWMA, partnerships with the following organisations will be formally established:

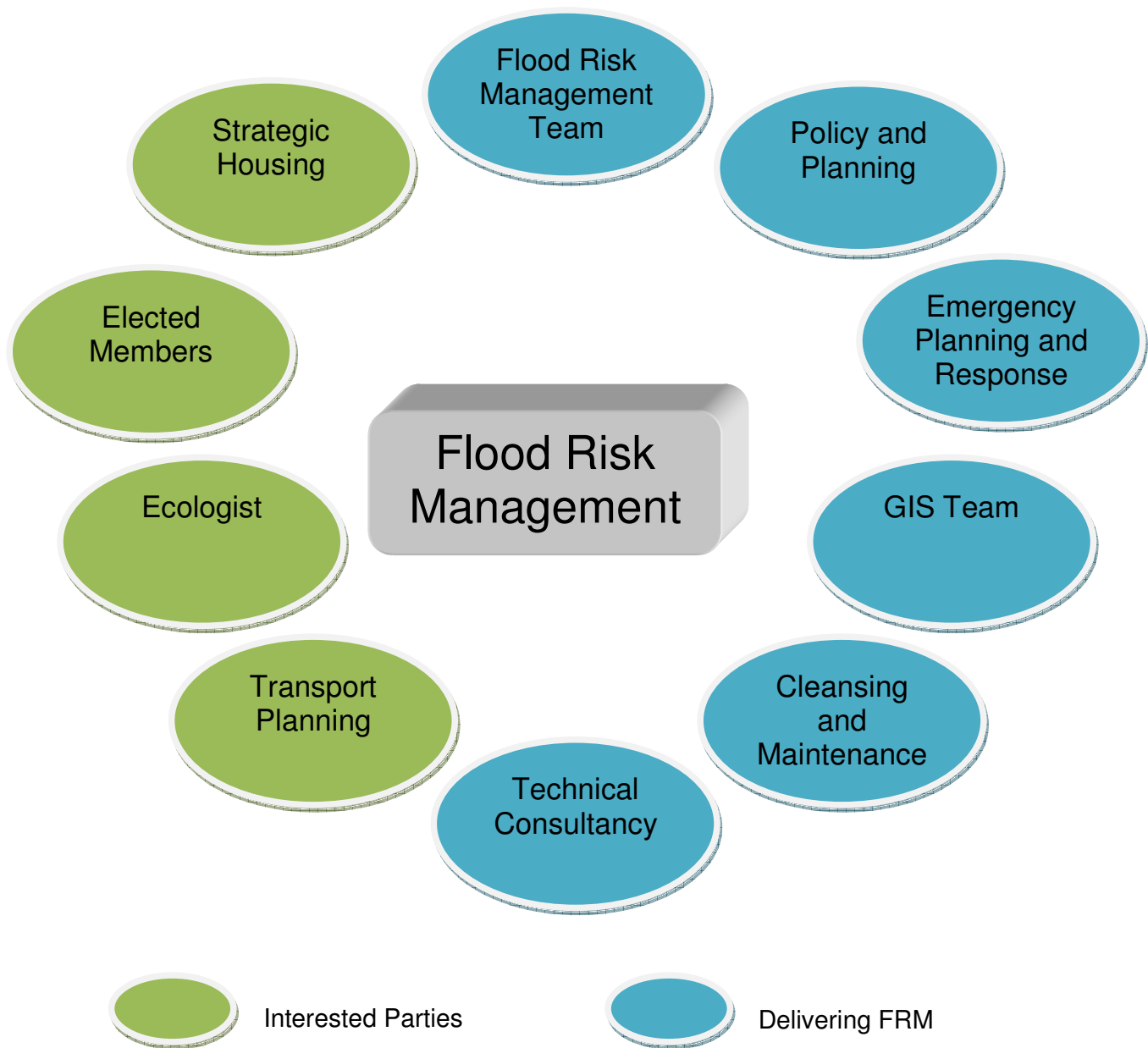
- Environment Agency
- Northumbrian Water Limited (NWL)
- Highways Agency and A-One
- Northumberland County Council
- North Tyneside Council
- Gateshead Council
- South Tyneside Council

Other interested parties may include:

- Tyne and Wear Fire and Rescue Service
- Northumberland Wildlife Trust
- Nexus (Metro)
- Network Rail
- Bus operators

A diagram seen below in Figure 2-1 indicates the internal departments within NCC that are directly responsible for, or have an interest in flood risk management.

Figure 2-1. Newcastle City Council's Flood Risk Management structure.



2.2.1 Stakeholder Engagement

Engaging stakeholders is beneficial for flood risk management as it means additional knowledge, skills and resources are available.

As part of the PFRA, Newcastle City Council has sought to engage stakeholders representing the following organisations, as well as various directorates and departments within the Council:

- Environment Agency
- Northumbrian Water Limited (NWL)
- Tyne and Wear Fire and Rescue Service
- Highways Agency
- NCC Spatial Planning and Policy
- NCC Emergency Planning and Response
- NCC Technical Consultancy

Newcastle and Gateshead Councils are jointly producing a Surface Water Management Plan, which is now in the final stages. During this process a 'Newcastle Gateshead SWMP Engagement Plan' was created and can be accessed here: <http://www.gateshead.gov.uk/DocumentLibrary/Building/PlanningPolicy/Evidence/SurfaceWaterManagementPlan-EngagementPlan-February2011.pdf>

Consultation so far has focused on key partners (Environment Agency and NWL) with draft reports sent out for comments from the wider stakeholders such as key landowners, developers and other local authorities. In addition an event was also held to gain further comments.

2.2.2 Public Engagement

Members of the public may also have valuable information to contribute to the PFRA and to local flood risk management more generally across Newcastle. Public engagement helps to build trust, facilitate access to additional local knowledge, and increases the chances of stakeholder acceptance of options and decisions proposed in future flood risk management plans.

Newcastle City Council intends to engage with the public during the next stage, when the Local Flood Risk Management Strategy is being created. The Council will follow the guidelines outlined in the Environment Agency's 'Building Trust with Communities' document. This publication outlines how to communicate risk to the general public, including the causes, likelihood and consequences of a flood. Public engagement is also addressed by the Newcastle Gateshead SWMP Engagement Plan.

2.3 Other Responsibilities

Aside from producing the PFRA and facilitating partnerships, there are a number of other duties that LLFAs must perform under the FWMA and the Regulations, in order to take the lead on local flood risk management. These are listed and briefly described in Table 2-1 below.

Table 2-1. Description of other LLFA responsibilities and enactment dates.

DUTY	DESCRIPTION	COMMENCEMENT
Investigating Flood Incidents	LLFAs have a duty to investigate and record significant flood events within their area. In the event of a flood, NCC must identify which risk management authorities have relevant functions and how they plan to respond. The responding risk management authority must publish the results of its investigation and notify any other relevant organisations.	April 2011
Asset Register	LLFAs have the task of maintaining a register of structures or features which are considered to have an effect on flood risk. This database must include details on ownership, current condition and maintenance. The register must be available for inspection.	April 2011
SuDS Approving Body (SAB)	LLFAs have been identified as the SAB for any new drainage system. They must approve proposed drainage systems in new developments and re-developments, subject to exemptions and thresholds. Approval must	Expected April 2012

	be given before the developer can start construction. The SAB is then responsible for adopting and maintaining the SuDS, provided more than one property is served. Highways authorities will be responsible for maintaining SuDS in public roads, according to National Standards.	
Local Strategy for Flood Risk Management	NCC is required to develop, maintain, apply and monitor a Local Strategy for Flood Risk Management in its area. The local strategy will have distinct objectives to manage local flood risks important to local communities.	October 2010
Works Powers	LLFAs have the powers to undertake works to manage flood risk from surface runoff, groundwater, and on ordinary watercourses in-line with the local strategy.	Implementation is planned to follow the national strategy coming into force later in the year.
Designation Powers	NCC has the power to designate structures and features that affect flooding or coastal erosion in order to ensure assets that are relied on for flood management are maintained. This will overcome the risk of a structure being damaged or removed which is relied on for flood management. The owner must seek consent from NCC to alter, remove, or replace it.	Implementation is planned to follow the national strategy coming into force later in the year.

3. METHODOLOGY and DATA REVIEW

3.1 Introduction

The PFRA process is a tool for identifying areas of significant flood risk, which will subsequently require further investigation and management. In order to do this it is necessary to determine the probability and consequences of both historic and future flooding. Therefore, the PFRA requires:

- The collection of historic flooding data
- The collation of information regarding potential flood events in the future
- Forming the Preliminary Assessment Report with the above information
- Identifying Flood Risk Areas

Final Guidance issued by the Environment Agency in December 2010 forms the basis for performing the assessment. It states the data used should be readily available or derivable, and should be sufficient for high-level screening. Following this advice, the following methodology has been employed.

3.2 Methodology

As per the requirements, information was gathered on past and future floods from a range of available or readily derivable sources. Data collection already carried out for the production of the SFRAs Level 1 and 2, and the Draft Newcastle Gateshead SWMP was of great use. The scale of information obtained varied from local or location specific, to national datasets provided by the Environment Agency.

3.2.1 Assessing Historic Flood Risk

Data and information was gathered from the stakeholders identified earlier in 2.2.1. Sources included internal departments within Newcastle City Council, and external organisations such as the Environment Agency, the local water company and the Fire and Rescue service. Due to the range of data sources, the information received came in slightly different formats, although largely the data was contained in a spreadsheet format. A database was set up, into which all the historical flooding data was entered. This created a standardised format for all the information to be analysed and compared.

The historic flooding information gathered provides details of major past flood events and associated consequences. The recorded impacts of past flooding were mainly limited to descriptions of damage to residential and business properties. Very little information on environmental and cultural consequences exists.

A threshold was set by Defra in order to distinguish between 'significant' and 'non-significant' flood events. This significance criteria was used by Defra to define 'Flood Risk Areas' nationally. This is shown below in Table 3-1, and will be used to define significant and non-significant historic (and future) flood events.

Table 3-1. Criteria for defining a 'significant' flood event.

IMPACT	DESCRIPTION	THRESHOLD
Human Health	Number of people affected by flooding (based on residential properties).	200
	Number of critical services affected (schools, hospitals, nursing homes, police/fire/ambulance stations).	1
Economic Activity	Number of non-residential properties affected e.g. businesses in shops and offices.	20

Where there was no information about the consequences of a past flood, the flood was considered to have had no significant harmful consequences. Therefore such an event was not recorded in the Preliminary Assessment Report spreadsheet.

Each historical flood was plotted using GIS software in order to visually display the data. This was done to provide a summary of all the information readily available on past floods, and allow the spatial distribution of historic flooding to be seen. This will be a useful reference for producing the Local Strategy.

3.2.2 Assessing Future Flood Risk

Future flood risk is defined as any flood that may potentially occur in the future. Locations with no past history of flooding may still be at risk, and these must be accounted for by considering where flooding may occur in the future.

Data and information for potential flooding has been sourced predominantly from the Environment Agency's national surface water maps, as well as local surface water modelling commissioned as part of the SFRAs and SWMP.

The following factors were considered when assessing future flood risk across the Newcastle study area:

- Topography
- Location of ordinary watercourses
- Location of flood plains
- Location of populated areas
- Characteristics of watercourses
- Location of flood defences
- Concentrations of business
- Impact of climate change

3.2.3 Identifying Flood Risk Areas

Using the information on historic and future flood risk, LLFAs must identify any significant flood risk in their area, and therefore any Flood Risk Areas. In order to do this, flood risk indicators were used to determine the impacts of flooding on human health, economic activity, cultural heritage and the environment. These indicators are summarised in Table 3-2.

Table 3-2. Key Flood Risk Indicators.

IMPACTS OF FLOODING ON:	FLOOD RISK INDICATORS
Human Health	Number of residential properties. Critical services (hospitals, schools, nursing homes, Police/fire/ambulance services).
Economic Activity	Number of non-residential properties. Length of road or rail. Area of agricultural land.
Cultural Heritage	Cultural heritage sites (World Heritage Sites, listed buildings).
Environment	Designated sites (SSSIs, BAP habitat etc).

The indicators in Table 3-2 were created by Defra and the Environment Agency to identify areas nationally where flood risk and potential consequences exceed certain thresholds. These thresholds are:

- 200 people, or
- 20 businesses, or
- 1 critical service at risk (taken from Table 3-1).

Areas identified using this methodology and exceeding 30,000 people at risk have been classed as 'Indicative Flood Risk Areas'. For further details of how these areas were calculated refer to 'Defra's Guidance for selecting and reviewing Flood Risk Areas for local sources of flooding' (December 2010).

No Indicative Flood Risk Area was identified in or around Newcastle. As the Indicative Flood Risk Areas are based on national information, the PFRA process includes LLFAs carrying out a review using local information.

3.3 Data Sources

A key part of the PFRA process is the collation of available and readily derivable data and information on flooding, to provide an assessment of flood risk. Table 3-3 provides a list of relevant information and data sets, a brief description of each, and their source.

Table 3-3. PFRA information and datasets.

SOURCE	DATASET	DESCRIPTION
Environment Agency	Areas Susceptible to Surface Water Flooding	First generation national mapping, showing areas at risk from surface water flooding as less, intermediate, or more susceptible.
	Flood Map for Surface Water	Updated version of the above including 2 flooding scenarios (1 in 30 or 1 in 200 chance of occurring) and 2 modelled outcomes (depth greater than 0.1m or 0.3m).
	Flood Map (Rivers and the Sea)	Shows flooding from the sea and rivers with a catchment of more than 3km ² .
	Areas Susceptible to Groundwater Flooding	National mapping showing susceptibility to groundwater flooding.
	National Receptor Database	National dataset of social, economic, environmental, and cultural receptors such as residential properties, schools, hospitals, transport infrastructure and substations.
	Indicative Flood Risk Areas	Nationally identified flood risk areas based on the definition of 'significant' flood risk by Defra and WAG.
	Historic Flood Map	Shows flood extent from all sources of flooding.
	Catchment Flood Management Plan	Outlines all possible flooding sources in the

		area and ways to manage the risk.
Newcastle City Council	Historical flooding records – Envirocall	Includes flooding from surface water, ordinary watercourses and groundwater.
	SFRA Level 1	Contains information on historic flooding, including local sources of flooding from surface water, groundwater, and the drainage system. The Level 1 SFRA also carried out local surface water modelling.
	SFRA Level 2	Contains detailed flood risk information, however this is focused on the main rivers of the Tyne and the Ouseburn.
	Newcastle Gateshead SWMP	Detailed risk assessment of surface water flooding to key high risk areas through Newcastle. The SWMP also carried out further surface water modelling in these key areas.
	Anecdotal evidence	Local information from officers and the general public.
Northumbrian Water Limited	DG5 Register	Records of sewer flooding incidents in Newcastle per NWL drainage area. This information was supplied as part of the Newcastle SFRA.
	Sewer Flooding Locations	The location of sewer flooding locations within 100m square grids. This information was supplied as part of the Newcastle SFRA.

	Sewer Flooding Pipe References	NWL sewer pipe reference known to be at risk of flooding. This information was supplied as part of the Newcastle SFRA.
Tyne and Wear Fire and Rescue Service	Historical Flooding Records	Records of flooding events from the call out history records. Includes information on location, incident type and response given.

3.3.1 Data Limitations

All data collected during the PFRA process has been recorded in a data register. Most data received was of good quality and accuracy. Whilst the majority of the datasets could be mapped geographically using GIS, some could not. This reduced the quality of the mapping which visualises flood risk.

Historical flooding information was generally good quality; however the volume of incidents were low. The main source of historic flooding information and consequences was Newcastle City Council's Envirocall system. This allows members of the public to phone and report flooding and other incidents to the Council. Whilst still a useful data source, information such as the exact location, cause, and extent of flooding was often missing. This significantly reduced the amount of data that could be used and mapped. NCC is intending to address this issue in future with the flood investigation database that will be set up as part of the new duties. This will improve the quantity and quality of flooding information recorded.

Consequences of historical flood events were not provided from any other source.

As flood risk has only recently become a priority, reliable historical records only date back to 2000. A complete historical background to flooding issues in Newcastle is therefore un-obtainable. Recognising potential future flood risk will play an important part in building on the existing historical records, and extending the knowledge of flood risk in the city.

3.3.2 Data Sharing, Storage and Security

Data sharing protocols are being put in place with NWL, and a draft can be found in the Newcastle Gateshead SWMP Engagement Plan. Newcastle City Council's standard data sharing protocols were implemented for all other sources of information.

Once data is obtained it must be stored safely and securely, to ensure only those that need it have access. Paper copies of sensitive information are stored in locked filing systems, while digital copies are password protected.

3.3.3 Quality Assurance

Each dataset received was reviewed, and its quality and confidence were rated for use in the PFRA. A data quality score was given, which is a qualitative assessment based on the Data Quality System provided in the SWMP Technical Guidance document (March 2010). This quality assurance system is explained in Table 3-4.

The use of this system provides a basis for analysing and monitoring the quality of data that is being collected and used. It ensures uncertainties are recognised at an early stage. In addition, advice notes detailing known limitations issued by authorities supplying data were also taken into account when using the data.

Table 3-4. Quality Assurance system used in the PFRA.

DATA QUALITY SCORE	DESCRIPTION	EXPLANATION	EXAMPLE
1	Best available	No better available, not possible to improve in the near future.	High resolution LiDAR. River flow data. Rain gauge data.
2	Data with known deficiencies	Best replaced as soon as new data is available.	A sewer or river model that is a few years old.
3	Gross assumptions	Not invented but based on experience and judgement.	Location, extent and depth of surface water flooding.
4	Heroic assumptions	An educated guess.	Ground roughness for 2D models.

3.3.4 Data Licensing and Restrictions

A table summarising the restrictions on the use of the data obtained can be found in Table 3-5 below.

Table 3-5. Data restrictions and licensing details.

DATA OWNER	RESTRICTIONS ON DATA USE
Environment Agency	This data falls under the license agreement with Newcastle City Council and the Environment Agency. Much is unrestricted but the use of some data is restricted to NCC for the preparation of the PFRA.
NWL	This data falls under the draft Data Sharing Protocol between Newcastle City Council and Northumbrian Water. The use of all data provided is restricted to NCC for the preparation of the PFRA.
TWFRS	No data restrictions were identified by the Tyne and Wear Fire and Rescue Service during the collection of data.

4. HISTORIC FLOOD RISK

4.1 Overview of Historical Flooding in Newcastle

Flood records were collected from various data sources, and an electronic database of all historical flood incidents was produced. Where possible the database included location, source of flooding, any known impacts and the source of the information. In total only 29 records contained information on the source and location of flooding. These records highlighted 3 major flood events since records began in 2000:

- October 2000
- June 2005
- September 2008

Most major flooding events seem to have occurred more recently, this may be due to a higher level of reporting, or an increase in flood events, or a combination of the two. The major events resulted from a range of sources, including fluvial flows, blocked or damaged culverts, surface water, sewers, groundwater and interaction between drainage networks and rivers.

A summary map has been produced showing the 29 locations of historical flooding, colour coded by source. The EA historic flood zones have also been included. This can be found in Figure 4-1.

4.1.1 Surface Water Flooding

Surface water flooding occurs when heavy rainfall exceeds the capacity of local drainage networks, and water flows across the ground.

The main sources of information for surface water flooding were Newcastle City Council historical records, the Environment Agency and Tyne and Wear Fire and Rescue Service.

4.1.2 Groundwater Flooding

Groundwater flooding occurs when water rises up from an underlying aquifer, or when water flows from springs. This tends to occur after long periods of sustained rainfall, in low-lying areas where the water table is at shallow depth. Groundwater flooding is known to occur in areas underlain by major aquifers.

The risk of groundwater flooding in Newcastle was assessed during the SFRA Level 1 study, and was deemed to be low. Due to the history of coal mines in the North East, minewater must also be considered in Newcastle. Minework issues, springs, and potential mine water discharge points were identified in the Level 1 SFRA.



Flood Zone 2 = Fluvial/tidal event with a 0.1% chance of occurring in any one year.

Flood Zone 3 = Fluvial event with a 1% chance or tidal event with a 0.5% chance of occurring in any one year.

Figure 4-1
Historical Flood Event Locations and Sources

Key:
Historical Flood Events and Historical EA Flood Risk Zones

Historical Flooding Source

- Ordinary Watercourse
- Surface Water
- Sewer
- Minewater
- Groundwater
- Highway Drainage
- Interacting Sources

floodzone3

floodzone2



Newcastle City Council

Michael Murphy, Director of Technical Services

Design Services,
Environmental & Regeneration Directorate,
Newcastle City Council,
Club Centre, Barras Bridge, NE99 2BN
Tel: 0191 211 5950

michael.murphy@newcastle.gov.uk
www.newcastle.gov.uk

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michael.murphy@newcastle.gov.uk

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4.1.3 Sewer Flooding

Sewer flooding is often caused by sewer capacity exceedance, when excess surface water enters the drainage network. NWL supplied their DG5 Register during the production of the SFRAs, the latest being supplied in September 2010. The Register has been assessed to investigate the occurrence of sewer flooding incidents across Newcastle. A total of 54 properties are on the Register. However, the specific location of these properties is not available under the Data Sharing Protocol. Therefore these properties cannot be accurately mapped.

Once a property is identified on the water companies DG5 register, it typically means that they can put funding in place to take properties off the Register.

4.1.4 Canal and Ordinary Watercourse Flooding

There are no canal systems in Newcastle, and only 3 historical records described the source of flooding as ordinary watercourses. The majority of these flooding incidents were along the Devil's Burn, and were a result of incapacity issues.

4.1.5 Interaction with Main Rivers and the Sea

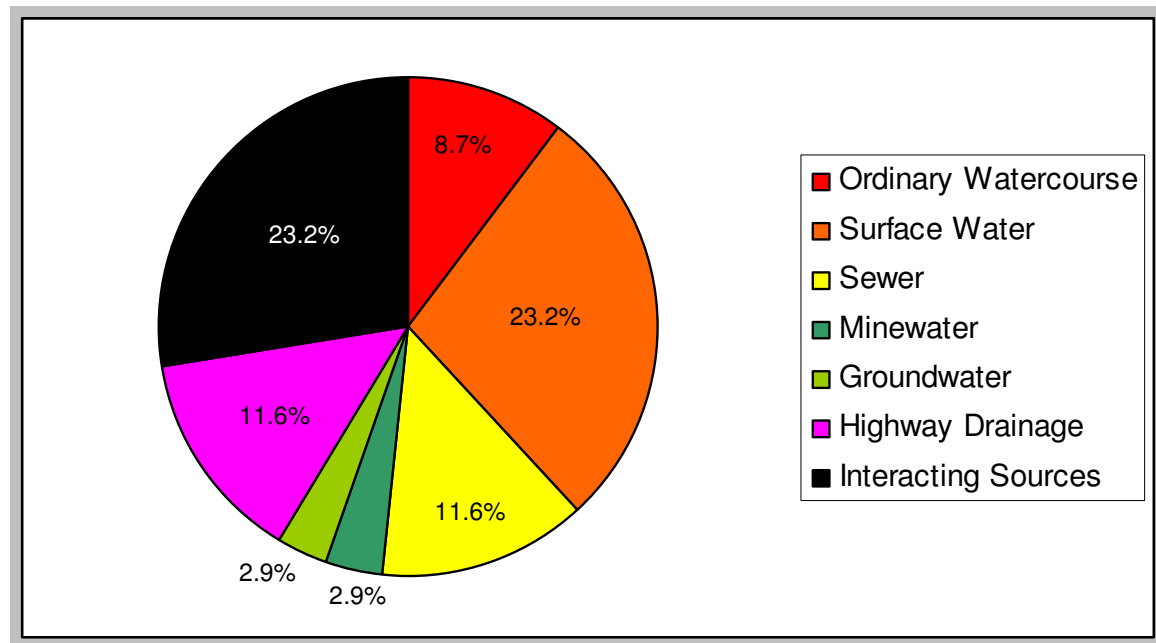
The historical records indicate 8 flooding events resulted from two or more sources interacting. All 8 incidents were associated with the sewer network. In some instances the sewer network interacts with the Ouseburn (main river) during high water levels, restricting out falls and causing water to back up. In other cases, surface water overloads the sewer network, and it cannot cope with the volume of water resulting in flooding.

4.2 Analysis of Historic Flooding in Newcastle

Figure 4-2 illustrates the percentage of historical flood incidents attributed to each source of flooding.

Surface water and interacting sources each account for 23.2% of historical flood events. Sewer and highway drainage follow, being responsible for 11.6% each. Ordinary watercourses are 8.7%, while groundwater and minewater are both 2.9% each.

Figure 4-2. Breakdown of historic flood incidents by source.



4.3 Significant Consequences of Historic Flooding

The historical flooding records provided some information on the consequences of an event, however this was generally limited to any properties (residential and non-residential) or major infrastructure affected. This information has again been categorised according to source of flooding, and is presented below in Table 4-1. The number of people affected was calculated by multiplying the number of residential properties by 2.34 (as per EA Guidance), and rounding to the nearest whole number.

Table 4-1. Consequences of historical flood incidents, categorised by source.

SOURCE	INCIDENTS	TOTAL PROPERTIES	RESIDENTIAL PROPERTIES	PEOPLE	NON-RESIDENTIAL PROPERTIES	CRITICAL SERVICES
Ordinary Watercourse	3	4	4	9	0	0
Surface Water	8	8	3	7	5	0
Sewer	4	2	2	3	0	0
Mine Water	1	1	0	0	1	0
Groundwater	1	3	3	7	0	0
Highways Drain	4	0	0	0	0	0
Multiple	8	6	6	14	0	0
Total	29	24	18	40	6	0

As can be seen from Table 4-1, no historical flooding events have met the criteria set out in Table 3-1 for having 'significant consequences'. This means no single event affected 200 people, or 1 critical service or 20 non-residential properties. Therefore, whilst there have been historical flood events in Newcastle, none are considered to have had significant harmful consequences based on the information that was available.

As a result, none will be recorded in Annex 1 of the Preliminary Assessment Spreadsheet.

5. FUTURE FLOOD RISK

5.1 Introduction

If a location does not have a recorded history of past floods, it does not mean that there is no risk of flooding. To ensure flood risk is assessed objectively this PFRA has also considered where flooding might occur in the future. The assessment of future flood risk is primarily based on modelled information.

5.2 Overview of Future Flood Risk

5.2.1 Surface Water Flooding

The Environment Agency has produced a national assessment of surface water flood risk in the form of two national mapping datasets. The first generation national mapping, Areas

Susceptible to Surface Water Flooding (ASStSWF), was released in 2008. The ASStSWF map shows areas where surface water would be expected to flow or pond using three susceptibility bandings for a rainfall event with a 1 in 200 chance of occurring. It was produced using a simplified method, which excluded the underground sewerage, drainage systems, smaller over ground drainage systems and buildings.

The Environment Agency updated their national methodology in 2010 and released their second generation national mapping, Flood Map for Surface Water (FMfSW). The revised model included a number of improvements to the ASStSWF model including two flood events (1 in 30 and 1 in 200 annual chance), the influence of buildings and the influence of the sewer system. The FMfSW also displayed its outputs using two depth bandings (greater than 0.1m and greater than 0.3m).

Using the Environment Agency's national dataset FMfSW, the number of properties at risk of surface water flooding in Newcastle has been estimated. This is shown below in Table 5-1.

Table 5-1. Properties at risk from future surface water flooding.

NATIONAL DATASET	BANDING	TOTAL PROPERTIES	RESIDENTIAL PROPERTIES	NON – RESIDENTIAL PROPERTIES
Flood Map for Surface Water (1 in 200 year)	➤ 0.1m deep	5092	4901	191
	➤ 0.3m deep	1146	1115	31

The SFRAs carried out by NCC included local surface water modelling across the city. This modelling was based on the Environment Agency's first generation national mapping, with local rainfall characteristics, topography and buildings being added to create a more realistic local model.

Additional surface water modelling was undertaken during the Newcastle Gateshead SWMP, focusing on specific development sites. A strategic level risk assessment has recently been commissioned.

5.2.2 Locally Agreed Surface Water Information

The Environment Agency guidance recommends that as an LLFA, Newcastle City Council should: review, discuss, agree and record, with the Environment Agency, Water Companies and other interested parties, the surface water flood data which best represents the local conditions. This will then be known as locally agreed surface water information. Whilst this is not a requirement under the Regulations, it informs the PFRA process and has a key role in identifying Flood Risk Areas.

As already outlined, there are four sources of surface water information for Newcastle; two national Environment Agency maps and two local maps produced by NCC during the preparation of the SFRAs and joint SWMP with Gateshead.

It is considered that the FMfSW dataset should be the 'locally agreed surface water information' for Newcastle, as it provides an overview of the future flood risk from surface water. It has also been produced using the latest methodology developed by the Environment Agency and the best available information. The FMfSW will also be used in the strategic phase of the SWMP.

The FMfSW is shown in Figure 5-1, as the locally agreed surface water information, highlighting areas at risk of surface water flooding in the future.

5.2.3 Groundwater Flooding

The Environment Agency's national dataset, Areas Susceptible to Groundwater Flooding

(AStGWF) has been used to form the basis of the assessment of future flood risk from groundwater. The map has been derived using the top two susceptibility bands of the British

Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map and therefore covers consolidated aquifers and superficial deposits. It does not take account of the chance of flooding from groundwater rebound. It shows the proportion of each 1km grid square where groundwater might emerge. This dataset is illustrated in Figure 5-2.

Figure 5-1
Locally agreed surface water
information - Flood Map for
Surface Water

Key:

FMSW

-  > 0.3m (Deep)
-  > 0.1m (Shallow)



Newcastle
City Council

Michael Murphy, Director of Technical Services

Design Services,

Environmental & Regeneration Directorate,

Newcastle City Council,

Club Centre, Barras Bridge, NE99 2BN

Tel: 0191 211 5950

michael.murphy@newcastle.gov.uk

www.newcastle.gov.uk

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 Design Services, Environmental & Regeneration Directorate
 michael.murphy@newcastle.gov.uk

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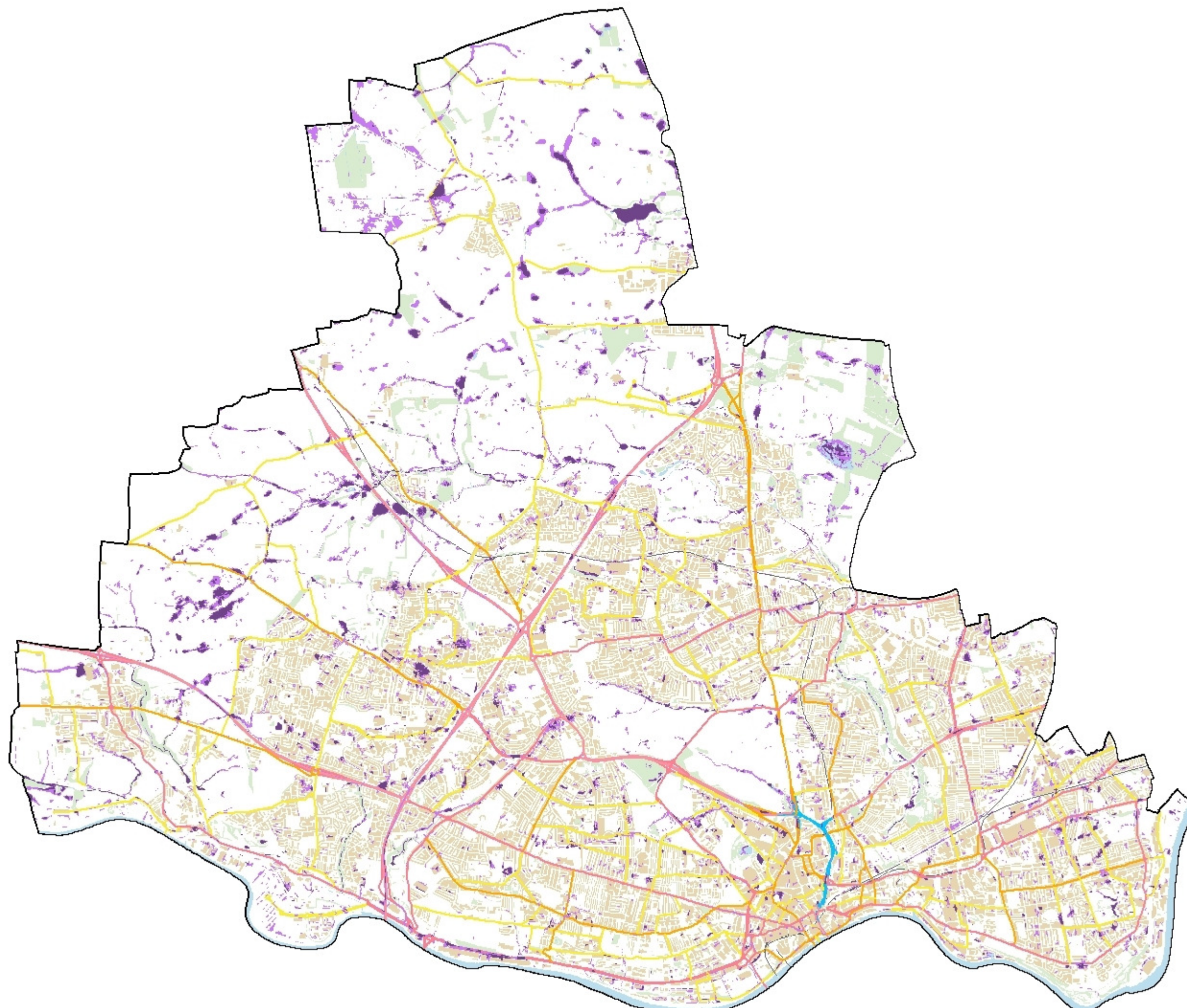
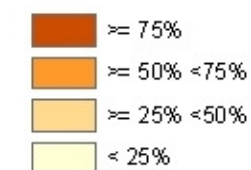


Figure 5-2
Areas Susceptible to
Groundwater Flooding

Key:

Areas Susceptible to
Groundwater Flooding



Newcastle
City Council

Michael Murphy, Director of Technical Services

Design Services,
Environmental & Regeneration Directorate

Newcastle City Council,
Club Centre, Barras Bridge, NE99 2BN

Tele: 0191 211 5950

michael.murphy@newcastle.gov.uk

www.newcastle.gov.uk

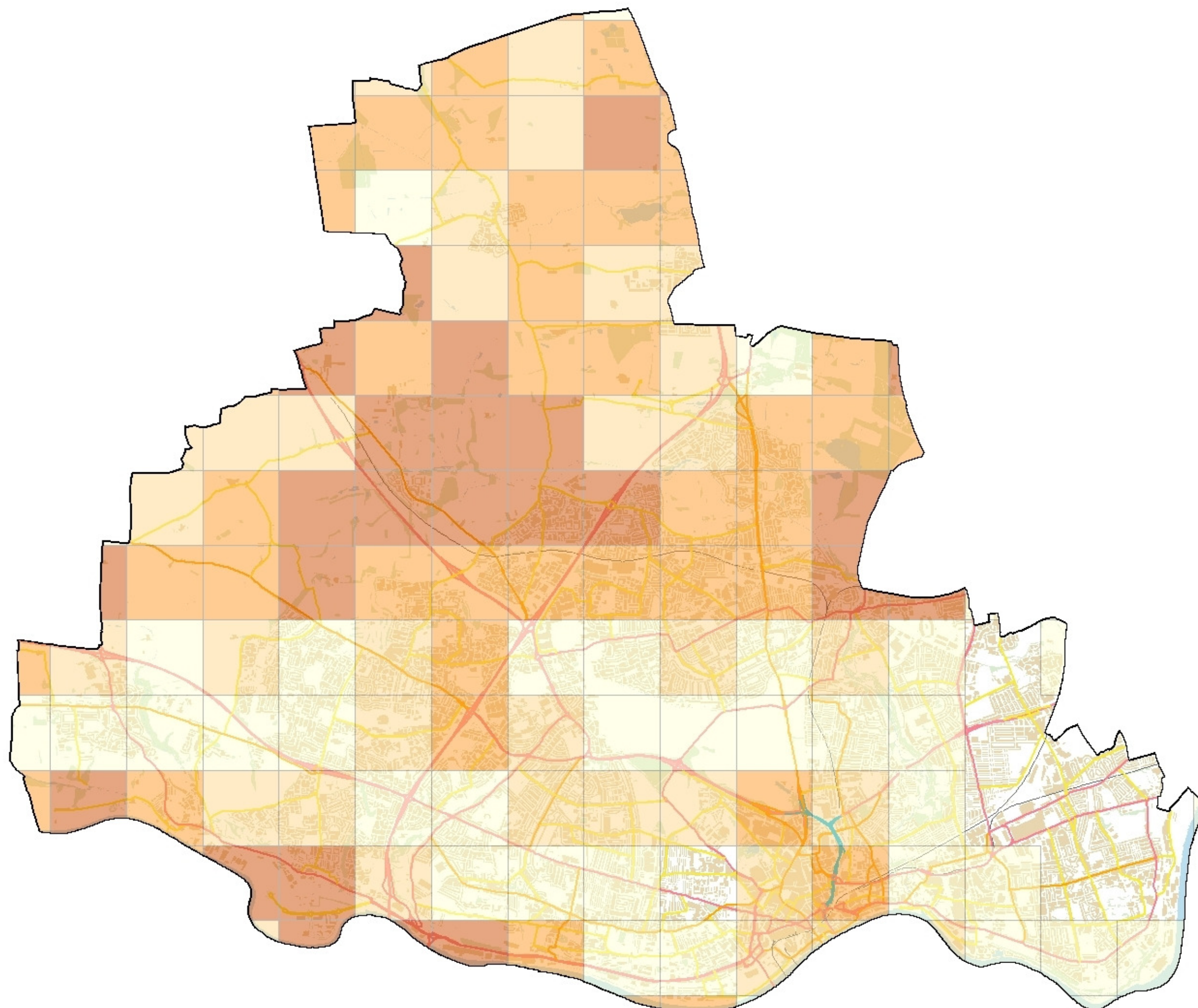
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5.2.4 Sewer Flooding

No local or national information on future flood risk from sewers has been made available for this PFRA. The Newcastle Gateshead SWMP may carry out detailed sewer modelling during the detailed risk assessment phase of the plan; however this is likely to be focused on specific locations.

5.2.5 Canal and Ordinary Watercourse Flooding

There are no canal systems in Newcastle. The Environment Agency's fluvial Flood Map and Detailed River Network (DRN) datasets, along with the Level 1 SFRA, have been used to assess the risk of flooding from ordinary watercourses. There are 30 ordinary watercourses within the Newcastle boundary. These include:

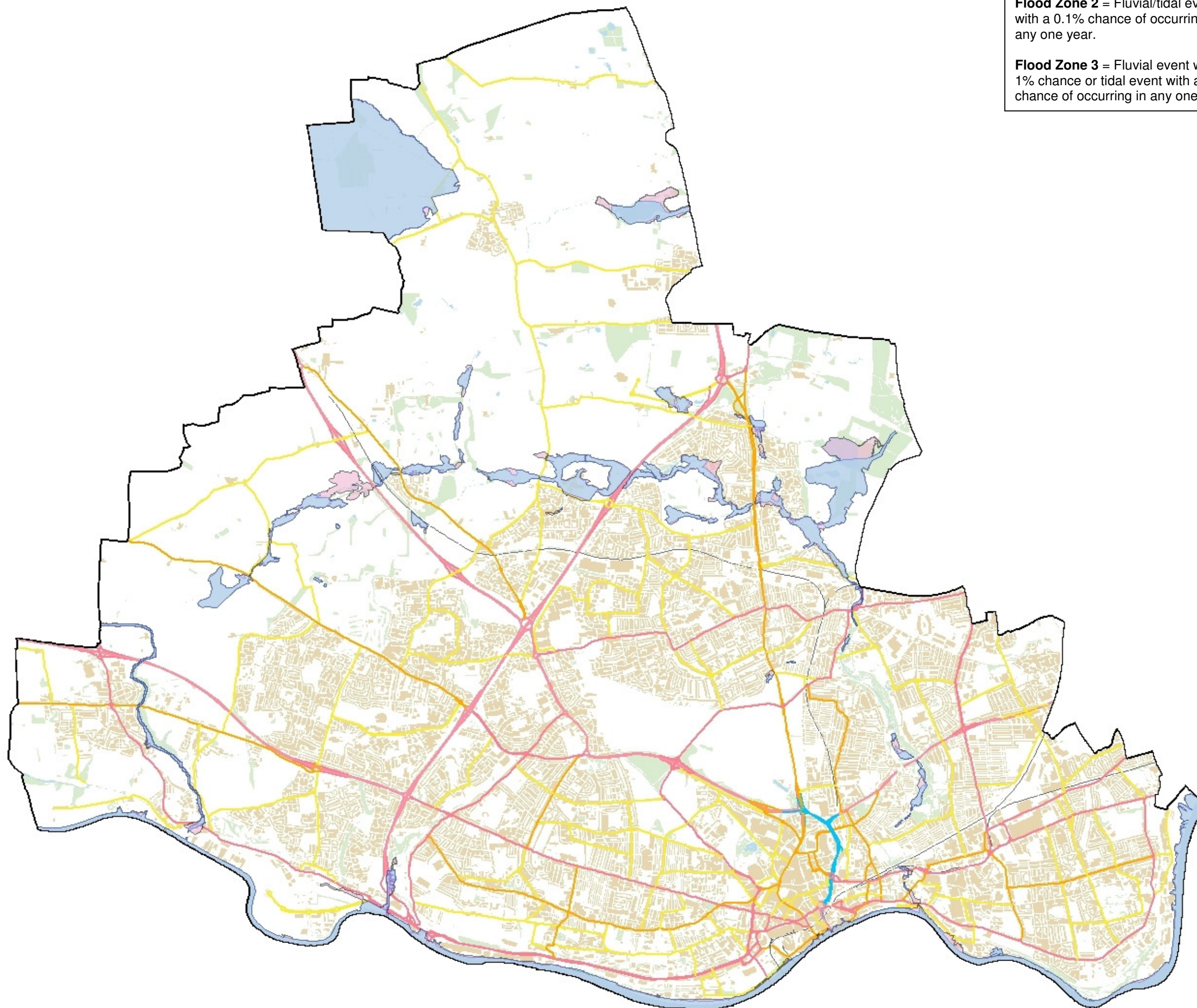
- Dewley Burn
- New Burn
- Reigh Burn

The flood zones are based primarily on early strategic flood zone modelling carried out by the Environment Agency. Whilst the Environment Agency Flood Map may not provide the best representation of future risk along these ordinary watercourses, the locally agreed surface water information (FMfSW) could be used to illustrate flow patterns not identified in the Flood Map.

The Flood Map dataset is illustrated in Figure 5-3. The number of properties within Flood Zones 2 and 3 have been calculated, the results of which can be found in Table 5-2.

Table 5-2. Number of properties found in Flood Zones 2 and 3.

FLOOD ZONE	TOTAL PROPERTIES	RESIDENTIAL PROPERTIES	NON-RESIDENTIAL PROPERTIES
2	523	423	100
3	313	229	84



Flood Zone 2 = Fluvial/tidal event with a 0.1% chance of occurring in any one year.

Flood Zone 3 = Fluvial event with a 1% chance or tidal event with a 0.5% chance of occurring in any one year.

Figure 5-3
Flood Map – illustrating
Flood Zones 2 and 3

Key:

Historic Flood Zones

- Flood Zone 3
- Flood Zone 2



Newcastle
City Council

Michael Murphy, Director of Technical Services

Design Services,
Environmental & Regeneration Directorate,
Newcastle City Council,
City Centre, Barras 6 ridge, NE99 2BN
Tel: 0191 211 5950

michael.murphy@newcastle.gov.uk
www.newcastle.gov.uk

Scale 1: 50,000



Notes: Produced by RF
Design Services, Environmental & Regeneration Directorate
michael.murphy@newcastle.gov.uk

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5.3 Potential Consequences of Future Flooding

The Environment Agency has used the FMfSW (1 in 200 year rainfall) and the NRD to estimate the potential consequences of future flooding on a national scale. The assessment was based on 1km national grid squares and a set of flood risk thresholds. The criteria used can be found below in Table 5-3.

Table 5-3. Flood risk thresholds used to identify future consequences of flooding.

'SIGNIFICANT HARMFUL CONSEQUENCES' DEFINED AS GREATER THAN:	DESCRIPTION
200 people, or	Flooded to a depth of 0.3m during a rainfall event with a 1 in 200 chance of occurring.
20 businesses, or	
1 critical service	

By counting the number of people, businesses and critical services at risk per 1km grid square, the Environment Agency has identified a number of areas across Newcastle which exceed the Defra and WAG significance criteria in Table 5-3. In total 29 grid squares exceeding the thresholds have been identified within, or intersecting, Newcastle's boundary. A visual representation of this data can be found in Figure 5-4.

The data has been broken down further to show the number of people at risk per 1km grid square (Figure 5-5). This will be useful when formulating the Local Strategy, as it highlights where the most help may be required in times of flooding. The grid squares containing the highest number of people at risk tend to be found in the city centre.

Figure 5-6 shows the number of critical services at risk per 1km grid square. Again, the distribution of critical services that may be affected will aid the Local Strategy, flood mitigation and flood response measures.

This dataset has been recorded in Annex 2 of the Preliminary Assessment Spreadsheet.

Figure 5-4
Areas above future flood risk thresholds

Key:

Significant Future Flood Risk

Areas Above Threshold



Newcastle
City Council

Michael Murphy, Director of Technical Services

Design Services,
Environmental & Regeneration Directorate,
Newcastle City Council,
City Centre, Barras Bridge, NE99 2BN
Tel: 0191 211 5950

michael.murphy@newcastle.gov.uk
www.newcastle.gov.uk

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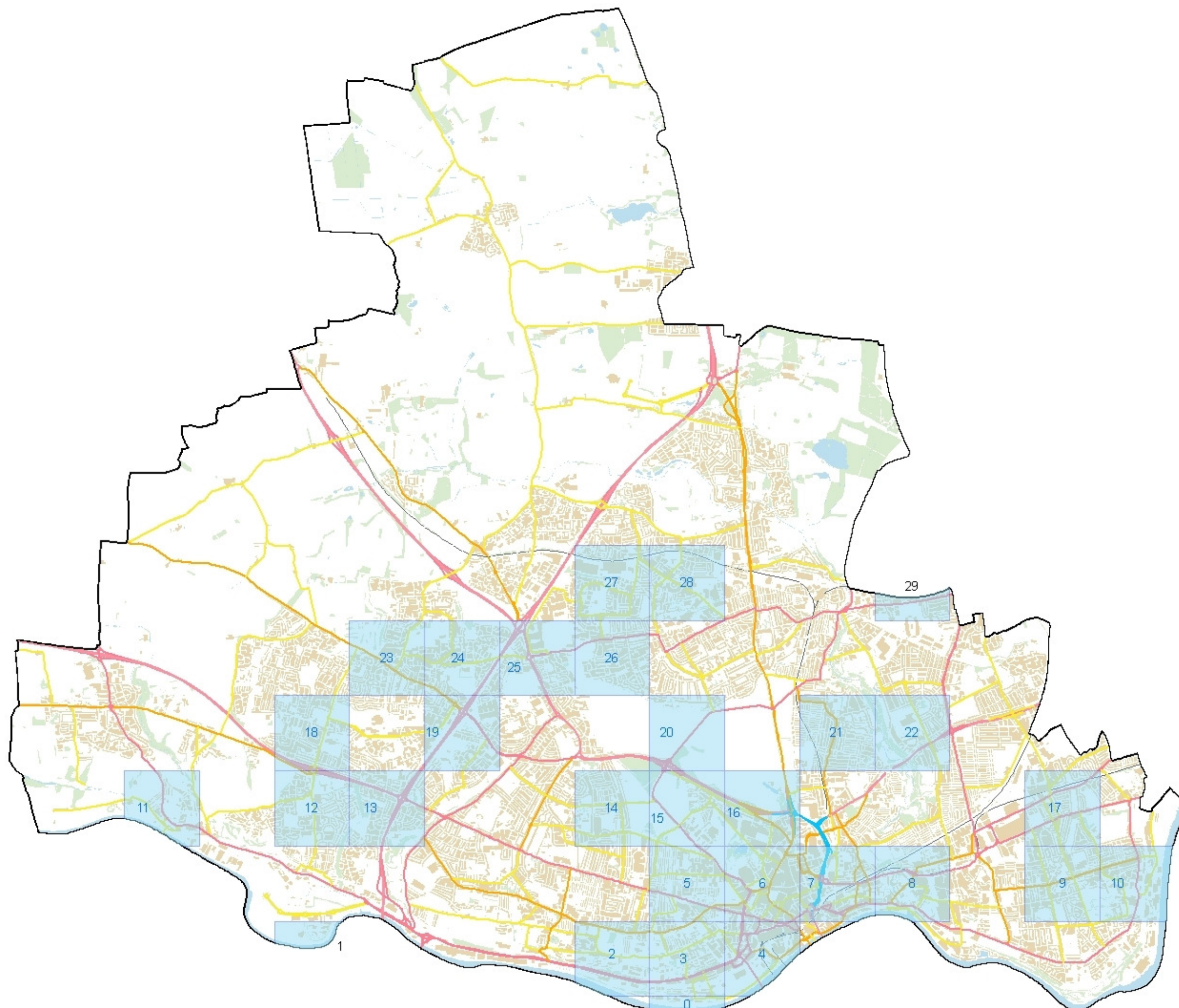


Figure 5-5
Number of people at risk per
1km² from future flooding

Key:

Future Flood Risk
 Above People Threshold
 (Data supplied by EA)

Number of People

0 - 199
 200 - 1065



Newcastle
 City Council

Michael Murphy, Director of Technical Services
 Design Services,
 Environmental & Regeneration Directorate,
 Newcastle City Council,
 Civic Centre, Barras Bridge, NE99 2BN
 Tel: 0191 211 5950

michael.murphy@newcastle.gov.uk
 www.newcastle.gov.uk

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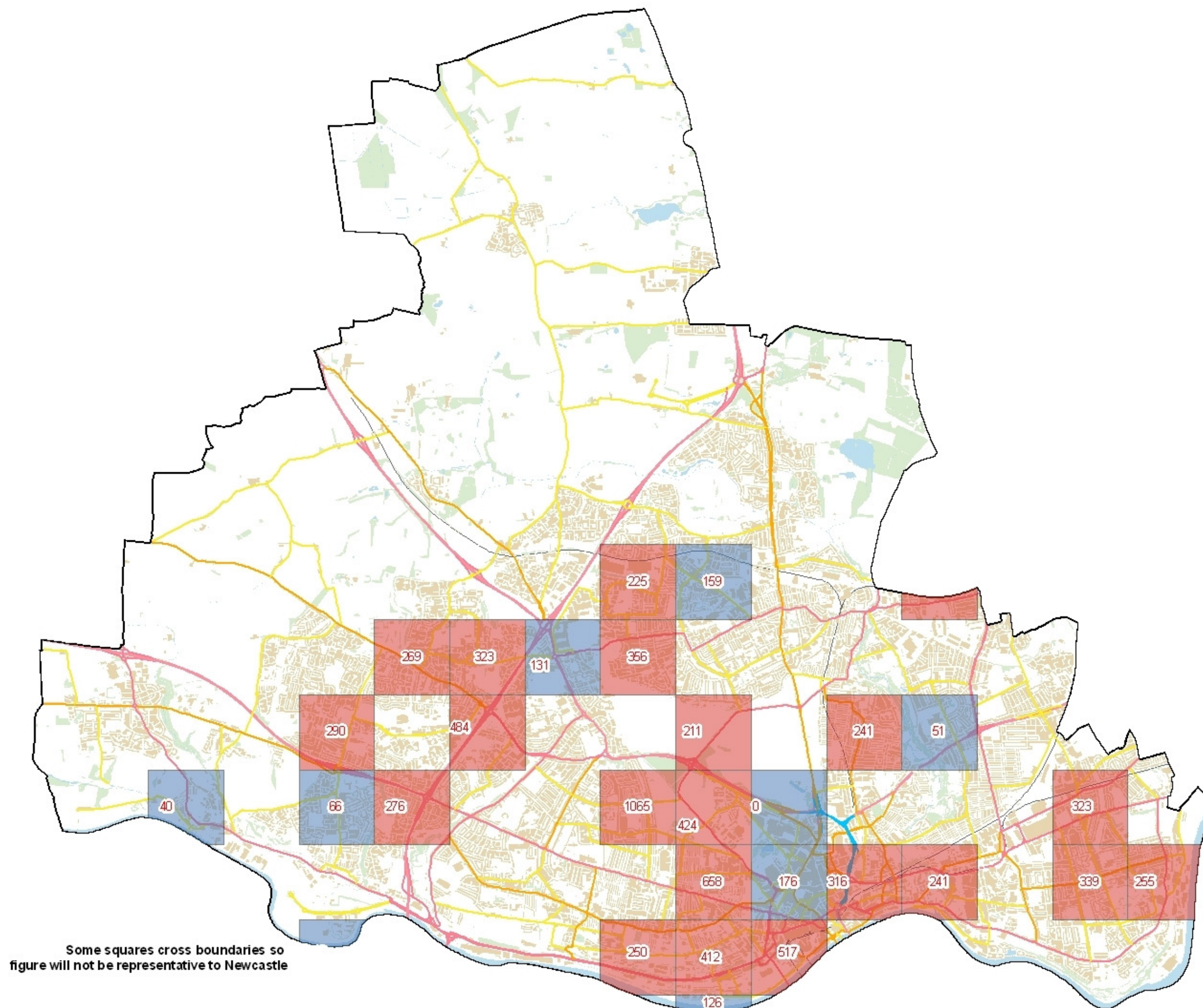


Figure 5-6
Number of critical services
at risk per 1km² from future
flooding

Key:

Future Flood Risk
 Above Critical Service Threshold
 (Data supplied by EA)

Critical Services

0 - 1
 2 - 4



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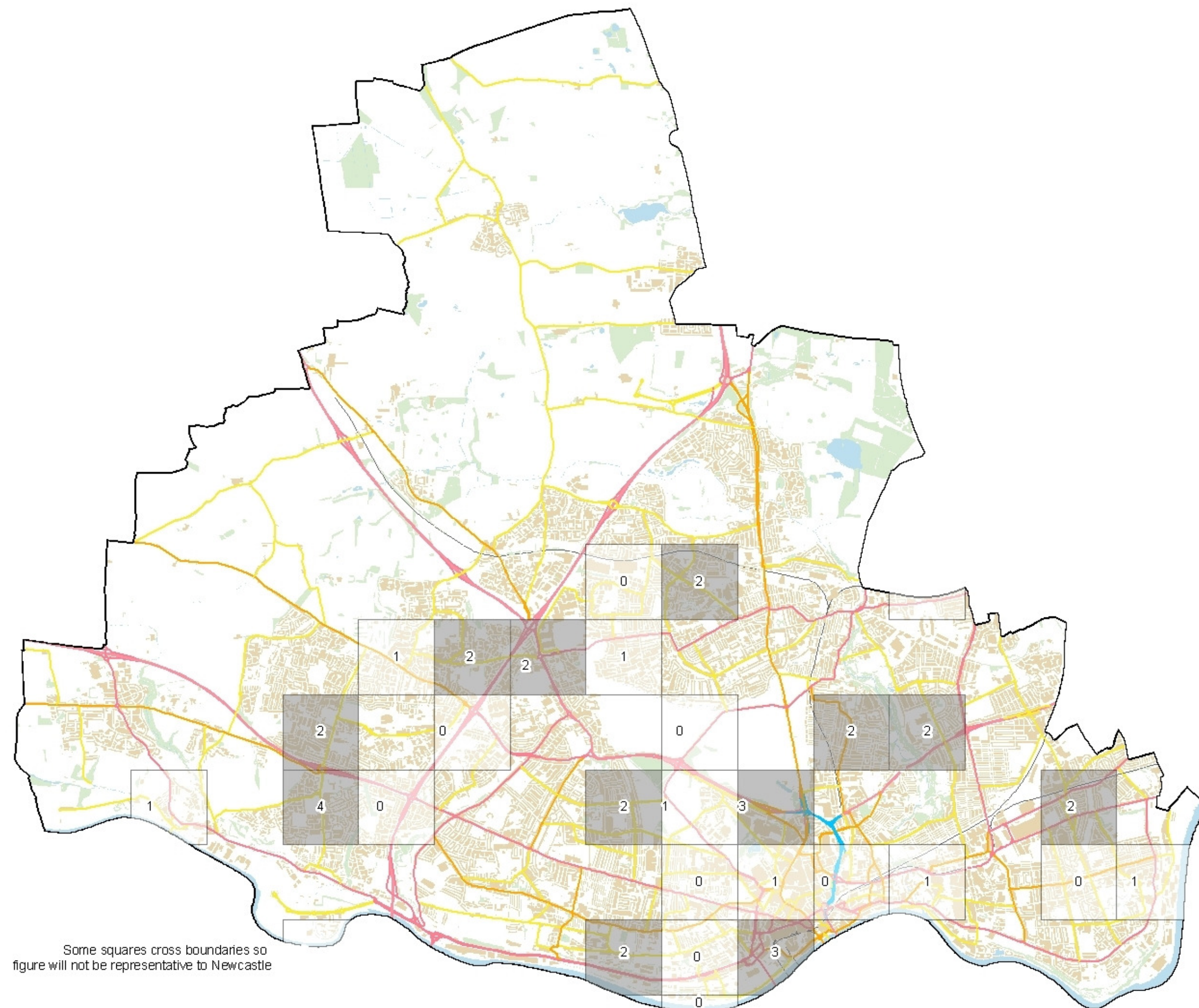
Michael Murphy, Director of Technical Services
 Design Services,
 Environmental & Regeneration Directorate,
 Newcastle City Council,
 City Centre, Barras Bridge, NE99 2BN
 Tel: 0191 211 5950
 michael.murphy@newcastle.gov.uk
 www.newcastle.gov.uk

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 michael.murphy@newcastle.gov.uk

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Some squares cross boundaries so
 figure will not be representative to Newcastle

Annotations show the actual number within each grid square

5.4 Effects of Climate Change and Long Term Developments

5.4.1 The Evidence

There is clear scientific evidence that global climate change is happening and cannot be ignored. Over the past century sea levels have risen and more of the winter rain in the UK is falling in intense wet spells. Seasonal rainfall is highly variable; it seems to have decreased in summer and increased in winter. These changes may reflect natural variation, but are also in line with projections from climate change models. Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in the 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.

Sufficient confidence exists in large scale climate models to initiate planning for climate change in the future. There is great uncertainty at the local level as to where and when the changes in climate will manifest themselves, but large scale models indicate the changes are on their way. The latest UK climate projections (UKCP09) indicate there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day) by the 2080s. 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%.

5.4.2 Key Projections for Northumbria 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 10% (very likely to be between 0 and 23%).
- Precipitation on the wettest day in winter up by around 11% (very unlikely to be more than 24%).
- Relative sea level at Tynemouth very likely to be up between 7 and 38cm 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 13%.
- Increases in rain are projected to be greater near the coast than inland.

Certain key processes such as localised convective rainfall events are not represented by the national figures. Therefore there is still a great element of uncertainty at the local level. It is more certain that heavy rainfall will intensify in winter than in summer. However, the proportion of summer time rainfall falling as heavy downpours may increase. The implications this has for flood risk is discussed below.

5.4.3 Implications for Flood Risk

Climate change has the potential to affect local flood risk in several ways. The exact impacts will depend on local conditions, but generally the implications are likely to be as follows:

- Wetter winters and more rain falling in wet spells may increase river flooding in both rural and heavily urbanised catchments.
- 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 flooding may increase in summer months.
- Rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

Climate change was considered in the SFRA and has been included in the SFRA maps.

Further studies to understand local climate impacts in detail would be beneficial to anticipating future flood risk. A city-wide Climate Change Risk Assessment and Action Plan are already underway. Sustainable development and drainage are key to aiding the adaptation to climate change and managing the risk of future floods.

5.4.4 Adapting to Change

Past emissions mean some climate change is inevitable. It is essential climate change is planned and accounted for. By understanding the current and future vulnerability to flooding, it is possible to then develop plans for increased resilience and build the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.

As the effects of climate change on a local scale are unknown, a range of management tools should be considered to retain the flexibility to adapt, and avoid increasing vulnerability to flooding. The Climate Change Risk Assessment and Action Plan will play a large part in developing mitigation and adaptation strategies.

5.4.5 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" (as previously defined).

6. FLOOD RISK AREAS

6.1 Introduction

The Environment Agency have assessed flood risk on a national level. This was based on a 'cluster' approach, where the country was divided into 1 km grid squares. Where a cluster of grid squares above future flood risk thresholds produces 30,000 people or more at risk from flooding, the area is deemed an Indicative Flood Risk Area. Newcastle has 20,840 people at risk, but this figure is still well below the 30,000 people threshold required to be an Indicative Flood Risk Area.

Within Newcastle 29 1km grid squares were identified as being 'above future flood risk thresholds'. This means the Newcastle upon Tyne cluster was ranked 29th in England, based on the number of people at risk. Compared to some of the surrounding areas, Newcastle has the greatest number of residential properties, people, critical services and non-residential properties at risk. This can be seen in Table 6-1.

Table 6-1. Flood Risk Area data gathered by the EA.

LOCATION	RESIDENTIAL PROPERTIES	PEOPLE	CRITICAL SERVICES	NON-RESIDENTIAL PROPERTIES
Newcastle	8906	20840	104	1975
South Shields	3216	7525	19	391
Tynemouth	1349	3157	16	139
Sunderland	3595	8412	32	733
Washington	880	2059	14	294
Hartlepool	1276	2986	20	461
Darlington	2121	4963	22	374
Morpeth	814	1905	9	212

Ten national Indicative Flood Risk Areas were identified; these are shown in Figure 6-1. The regional clusters in the North East, with their respective rankings can be seen in Figure 6-2.

Indicative flood risk areas based on clusters formed from all 3km squares that contain 5 or more Places above the Flood Risk Thresholds (1km squares) that are touching.

Indicative flood risk areas are labelled with their location and the number of people at risk. Clusters with fewer than 30,000 people at risk have not been designated as indicative flood risk areas.

The Liverpool indicative flood risk area has been formed by subdividing a larger cluster along the River Mersey.

Indicators used to identify places above the flood risk thresholds :

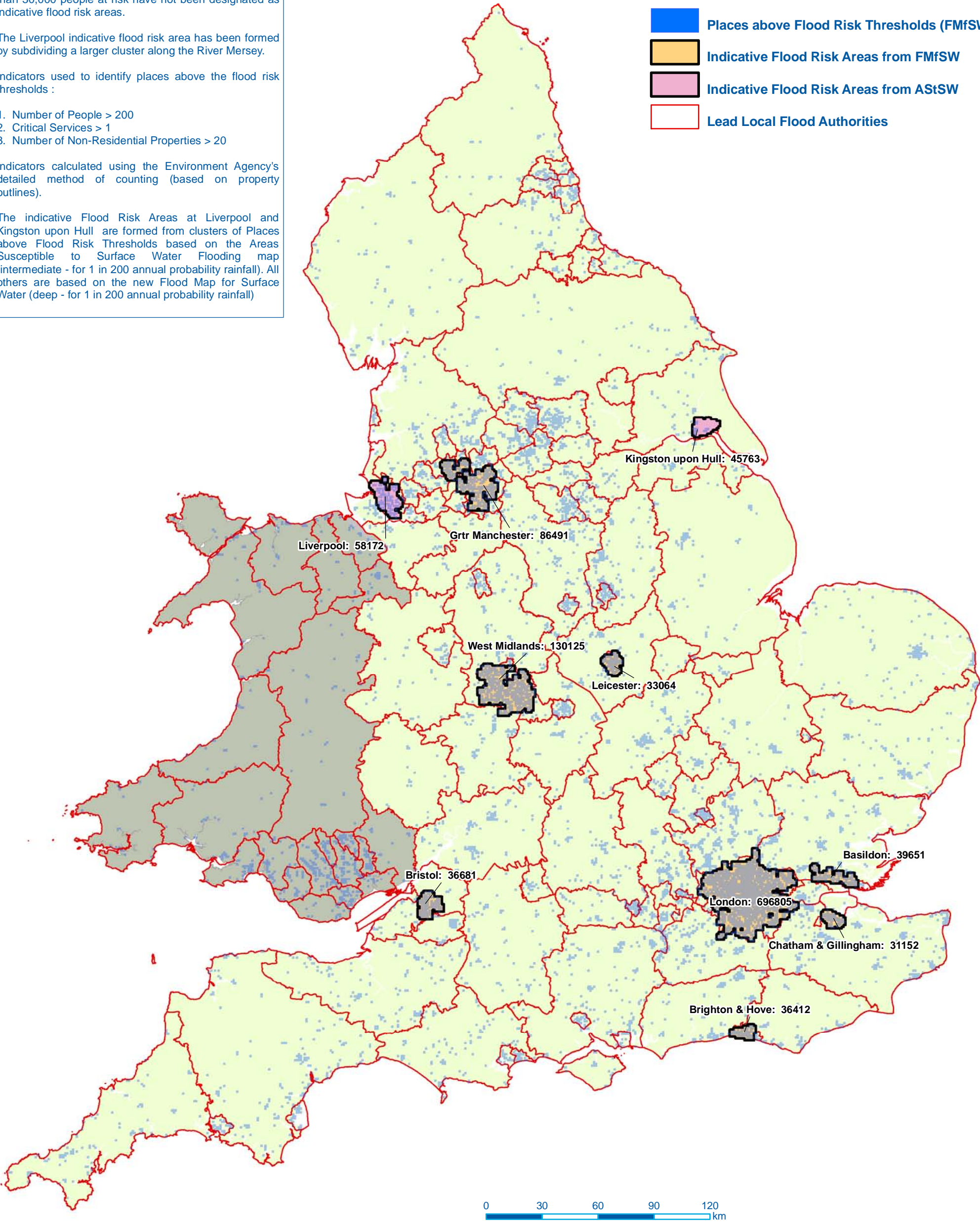
- 1. Number of People > 200
- 2. Critical Services > 1
- 3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting (based on property outlines).

The indicative Flood Risk Areas at Liverpool and Kingston upon Hull are formed from clusters of Places above Flood Risk Thresholds based on the Areas Susceptible to Surface Water Flooding map (intermediate - for 1 in 200 annual probability rainfall). All others are based on the new Flood Map for Surface Water (deep - for 1 in 200 annual probability rainfall)



- Places above Flood Risk Thresholds (FMfSW)
- Indicative Flood Risk Areas from FMfSW
- Indicative Flood Risk Areas from AStSW
- Lead Local Flood Authorities

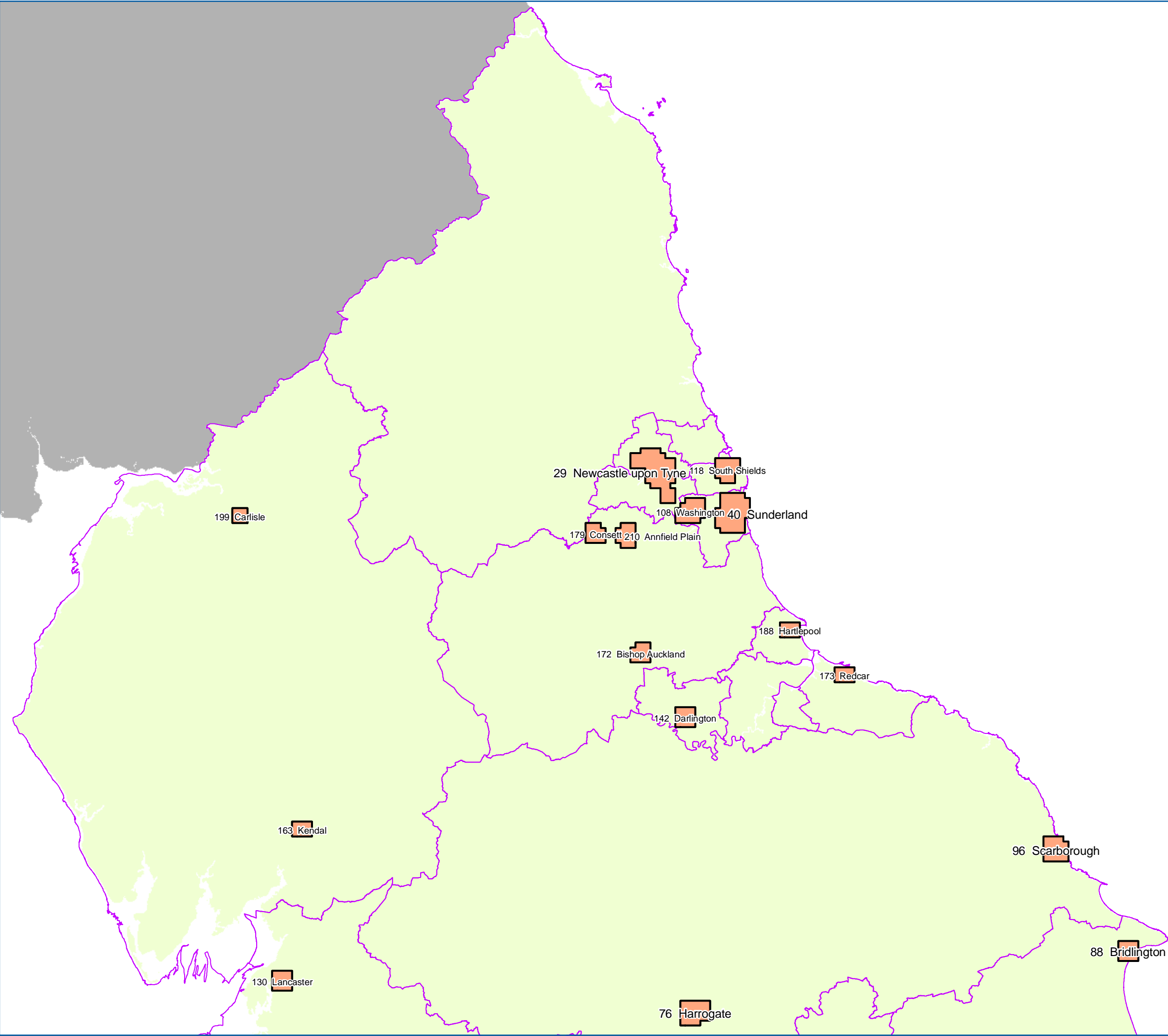


Indicative Flood Risk Areas for England

These are to be used by Lead Local Flood Authorities as part of the process for identifying Flood Risk Areas under the Flood Risk Regulations as set out in the Environment Agency and Defra & WAG guidance on PFRAs.

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Date:	14/12/2010
Status:	FINAL
File Name:	...ArcGIS\Projects\IFRA Maps England.mxd
Drawing Number:	IFRA_E3
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- English Clusters
- Lead Local Flood Authorities
- # Number refers to rank in terms of number of people at risk

These clusters are formed from all 3km squares that contain 5 or more Places above the Flood Risk Thresholds (1km squares) that are touching.

The clusters are labelled with their rank in terms of the number of people at risk. Cluster no. 1 contains the highest number of people at risk, cluster no. 219 the lowest.

The following clusters have been formed by subdividing a larger cluster: 1/17/34/77; 10/16/52; 27/33; 13/73.

Places above the Flood Risk Thresholds are 1km grid squares where at least one of the following flood risk indicators is above the threshold given below:

1. Number of People > 200
2. Critical Services > 1
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting (based on property outlines) for the new Flood Map for Surface Water (deep - for 1 in 200 annual probability rainfall).



Preliminary Flood Risk Assessment for England

Clusters of Places above the Flood Risk Thresholds in England

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Date:	15/12/2010	
Status:	FINAL	
File Name:	...ArcGIS\Projects\Clusters Wales.mxd	
Drawing Number:	C1	
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6.2 Review of Indicative Flood Risk Areas

The Indicative Flood Risk Areas are based on surface water flooding and significance criteria that can be measured at the national level. It is therefore important that the Indicative Flood Risk Areas are reviewed using local information on past and future flood risk. This has been done for the area of Newcastle upon Tyne, by considering the following questions in Table 6-2.

Table 6-2. Indicative Flood Risk Area Review.

QUESTION	RESPONSE	ACTION
Is the FMfSW the most appropriate source of information?	Yes. Other local model outputs are available; however the FMfSW is the 'locally agreed surface water information'. NCC agrees with this data being used to identify indicative Flood Risk Areas.	No Action
Are the consequences of flooding from other sources e.g. groundwater, ordinary watercourses likely to lead to significant Flood Risk Areas?	There are a number of areas which are at risk from multiple sources of flooding. However, the consequences of flooding in these locations are not large enough to exceed the Environment Agency thresholds. Local risks will be assessed within NCC's local flood risk management strategy.	No Action
Is there information on past floods which had significant harmful consequences?	It is assumed that whilst there have been historical flood incidents in Newcastle, none are considered to have had significant harmful consequences worthy of identifying a new Flood Risk Area in Newcastle.	No Action
Is there any other information on the possible harmful consequences of future floods?	No	No Action

As no action has been identified from the key questions, Newcastle City Council agrees with the Environment Agency's Indicative Flood Risk Areas. A Flood Risk Area is not present within Newcastle.

As a result, none will be recorded in Annex 3 of the Preliminary Assessment Spreadsheet.

7. NEXT STEPS

7.1 Introduction

No Flood Risk Area has been identified in Newcastle for this high-level screening exercise. Therefore there is no need to produce Flood Hazard and Risk Maps, or a subsequent Flood Risk Management Plan. However, Newcastle City Council is still committed to local flood risk management.

The PFRA cycle will start again in 2016, so it is important to ensure that information is maintained and kept up to date for future use. In the next cycle, more information will be mandatory for floods that occur after 22 December 2011. The information will also be used to support future stages of the SFRAs and SWMP, as well forming a basis for formulating a Local Strategy.

The first review cycle of the PFRA will be led by Newcastle City Council and must be submitted to the Environment Agency by the 22nd of June 2017. The Environment Agency will then submit it to the European Commission by the 22nd of December 2017.

7.2 Local Flood Risk Management Strategy

The Act requires Newcastle City Council, as an LLFA, to develop, maintain, apply and monitor a strategy for local flood risk management in its area. The LLFA will be responsible for ensuring the strategy is put in place, while the local partners can agree how to develop it in the way that suits them best. The Act sets out the minimum that a local strategy must contain, and the LLFA is required to consult on the strategy with risk management authorities and the public. It is hoped community involvement and engagement will play a large part in developing the Strategy from an early stage.

As part of the development of the Local Strategy, a full Equality Impact and Needs Assessment (EINA) will be carried out. The EINA will ensure that equality, social inclusion and community cohesion issues are considered and reflected in the Local Strategy. In particular this is likely to include ways of communicating flood risk to people whose first language is not English, and integrating the needs of disabled or less-abled people into the Strategy. A Health Impact Assessment (HIA) will also be conducted in order to highlight any health implications flood risk may have.

Local partnerships between other risk management authorities (including Northumbrian Water, the Environment Agency and neighbouring LLFAs) will be critical. It is the aim of Newcastle City Council to continue to develop, strengthen and formalise these existing partnerships.

Local flood risk includes surface runoff, groundwater, and ordinary watercourses (including lakes and ponds). This PFRA has identified a number of flood risk areas in Newcastle. Whilst the clustering approach has not identified an area that exceeds the 30,000 people threshold to create a Flood Risk Area, it has found 29 1km grid squares that are above future flood risk thresholds. These areas should be the focus of the Local Strategy.

The full range of measures consistent with a risk management approach will be considered when developing the local flood risk strategy. Resilience and other approaches which minimise the impact of flooding are expected to be a key aspect of the measures proposed.

Other local flood risk studies, such as the SFRA Level 1 and Level 2 and the Newcastle Gateshead SWMP will be essential building blocks for the delivery of integrated local flood risk management in Newcastle and should be fully integrated into the Strategy along with flood management works planned by the Environment Agency and Northumbrian Water.

7.3 Flood Incident Investigations and Register

In order to continue to fulfil the role as LLFA, Newcastle City Council is required to investigate flood events in the future, and ensure continued collection, assessment and storage of flood risk data and information.

As part of the PFRA process, a new database has been created with all sources and details of historical information entered. The fields of this database have been created with a view to reflecting the requirements of the PFRA, so future reviews can be done easily and quickly. This database will become the flood incident register, as new incidents that occur will be added. Table 7-1 indicates the fields that will be used for the Register.

Table 7-1. Flooding Incident Register format.

FIELD	DESCRIPTION
Start date	Date and time of flood.
Duration	Hours/days.
Location	Address and postcode, grid reference.
Probability	Estimate return period.
Main source	Main rivers, surface runoff, groundwater, ordinary watercourses and any interaction these have with drainage systems and other sources of flooding including sewers.
Additional source	Main rivers, surface runoff, groundwater, ordinary watercourses and any interaction these have with drainage systems and other sources of flooding

	including sewers.
Main mechanism	Natural exceedance, defence exceedance, failure, blockage etc.
Flooding consequences	Number of residential/commercial/people/ critical services affected.
Risk of flooding	Low, medium or high.
Response	Action taken e.g. evacuation.
Source of information	Who supplied the data.

8. References

Allied Exploration & Geo-techniques Ltd (2009) SFRA Groundwater Study

Coal Authority (2008) Letter Report – Newcastle Flood Risk Response

Communities and Local Government (2010) PPS25: Practice Guide

Defra (2010) Surface Water Management Plan Technical Guidance

Defra / WAG (2010) Selecting and reviewing Flood Risk Areas for local sources of flooding – Guidance to Lead Local Flood Authorities. Available at:
<http://www.defra.gov.uk/environment/flooding/documents/research/flood-risk-method.pdf>

Environment Agency (2008) Tyne Catchment Flood Management Plan

Environment Agency (2010) Preliminary Flood Risk Assessment: Final Guidance (Report – GEHO1210BTGH-E-E). Available at: <http://publications.environment-agency.gov.uk/pdf/GEHO1210BTGH-e-e.pdf>

Environment Agency (2011) Preliminary Flood Risk Assessment: Annexes to the Final Guidance Version 2 (Report – GEHO1210BTHF-E-E). Available at:
<http://publications.environment-agency.gov.uk/pdf/GEHO1210BTHF-e-e.pdf>

Environment Agency Building Trust with Communities

Newcastle City Council (2009) Newcastle Level 1 Strategic Flood Risk Assessment – Final Report

Newcastle City Council (2010) Newcastle Gateshead SWMP Engagement Plan. Available at:
<http://www.gateshead.gov.uk/DocumentLibrary/Building/PlanningPolicy/Evidence/SurfaceWaterManagementPlan-EngagementPlan-February2011.pdf>

Newcastle City Council (2011) Newcastle Level 2 Strategic Flood Risk Assessment - Draft

Newcastle City Council (2011) Newcastle Gateshead Surface Water Management Plan
Stage 2 - Options: Draft Interim Report

The Pitt Review (2008) Learning lessons from the 2007 floods

9. Annexes

Spreadsheet 2 – Future Floods

Annex 2 Future floods

ANNEX 2: Records of future floods and their consequences (preliminary assessment report spreadsheet)											
Field:	Flood ID	Description of assessment method	Name of Location	National Grid Reference	Location Description	Name	Flood modelled	Probability	Main source of flooding	Additional source(s) of flooding	Confidence in main source of flooding
Mandatory / optional:	Mandatory	Mandatory	Mandatory	Mandatory	Optional	Optional	Optional	Mandatory	Mandatory	Optional	Optional
Format:	Unique number between 1-9999	Max 1,000 characters	Max 250 characters	12 characters: 2 letters, 10 numbers	Max 250 characters	Max 250 characters	Max 250 characters	Max 25 characters	Pick from drop-down	Max 250 characters, same source terms	Pick from drop-down
Notes:	A sequential number starting at 1 and incrementing by 1 for each record.	Description of the future flood information and how it has been produced. Cover Regulation 12(6) requirements of (a) topography, (b) the location of watercourses, (c) the location of flood plains that retain flood water, (d) the characteristics of watercourses, and (e) the effectiveness of any works constructed for the purpose of flood risk management. Information from other relevant fields (<u>Probability</u> , <u>Main source</u> , <u>Name</u>) should be repeated here.	Name of the locality associated with the flood, using recognised postal address names such as streets, towns, counties. If the flood affects the whole LLFA, then record the name of the LLFA.	National Grid Reference of the centroid (centre point, falls within polygon) of the flood extent, or of the area affected if there is no extent information. If the flood affects the whole LLFA, then record the centroid of the LLFA.	A description of the general location that could be flooded.	Name of the model or map product or project which produced the future flood information	Background, or additional information on the probability of the flood modelled - such as whether <u>Probability</u> refers to probability of rainfall or water on the ground.	The chance of the flood occurring in any given year - record X from "a 1 in X chance of occurring in any given year".	Pick the source which generates the majority of flooding. Refer to the PFRA guidance for definitions of sources.	If the flood is generated by, or interacts with, any other sources (other than the <u>Main source of flooding</u>), report the source(s) here, using the same source terms.	Pick a broad level of confidence in the <u>Main source of flooding</u> from; 'High' (compelling evidence of source - about 80% confident that source is correct), 'Medium' (some evidence of source but not compelling - about 50% confident that source is correct) 'Low' (source assumed - about 20% confident that source is correct) or 'Unknown'. High
Example:		1 See records below for examples of description of assessment method.	Essex	SX1234512345		Flood Map for Surface Water - 1 in 200 deep	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.3m depth.	200	Surface runoff		
Records begin here:		1 • Topography is derived from LIDAR (in larger urban areas, on 1, 2 and 3m grids; original accuracy ± 0.15m) and Geoperspective data (original accuracy ± 1.5m), processed to remove buildings and vegetation, then degraded to a composite 5m DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; no allowance made for manmade drainage. The DTM may miss flow paths below bridges. • Areas that may flood are defined by dynamically routing a 6.5 hour duration storm with 1 in 200 chance of occurring in any year, over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 is used throughout, to allow broad scale effects of buildings and other obstructions to be approximated. • No allowance made for drainage, pumping or other works constructed for the purpose of flood risk management. • The 'less susceptible' layer shows where modelled flooding is 0.1-0.3m deep; you must not interpret this as depth of flooding, rather as indicative of susceptibility to flooding because of modelling uncertainties.	Newcastle	NZ2199769010		Areas Susceptible to Surface Water Flooding (AStSWF) - Less	Probability refers to the probability of the rainfall event. This identifies areas which are 'less susceptible' to surface water flooding. For more information refer to "What are Areas Susceptible to Surface Water Flooding" Environment Agency December 2010.		200 Surface runoff		High
		2 • Topography is derived from LIDAR (in larger urban areas, on 1, 2 and 3m grids; original accuracy ± 0.15m) and Geoperspective data (original accuracy ± 1.5m), processed to remove buildings and vegetation, then degraded to a composite 5m DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; no allowance made for manmade drainage. The DTM may miss flow paths below bridges. • Areas that may flood are defined by dynamically routing a 6.5 hour duration storm with 1 in 200 chance of occurring in any year, over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 is used throughout, to allow broad scale effects of buildings and other obstructions to be approximated. • No allowance made for drainage, pumping or other works constructed for the purpose of flood risk management. • The 'intermediate susceptibility' layer shows where modelled flooding is 0.3-1.0m deep; you must not interpret this as depth of flooding, rather as indicative of susceptibility to flooding because of modelling uncertainties.	Newcastle	NZ2199769010		Areas Susceptible to Surface Water Flooding (AStSWF) - Intermediate	Probability refers to the probability of the rainfall event. This identifies areas with 'intermediate susceptibility' to surface water flooding.		200 Surface runoff		High
		3 • Topography is derived from LIDAR (in larger urban areas, on 1, 2 and 3m grids; original accuracy ± 0.15m) and Geoperspective data (original accuracy ± 1.5m), processed to remove buildings and vegetation, then degraded to a composite 5m DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; no allowance made for manmade drainage. The DTM may miss flow paths below bridges. • Areas that may flood are defined by dynamically routing a 6.5 hour duration storm with 1 in 200 chance of occurring in any year, over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 is used throughout, to allow broad scale effects of buildings and other obstructions to be approximated. • No allowance made for drainage, pumping or other works constructed for the purpose of flood risk management. • The 'more susceptible' layer shows where modelled flooding is >1.0m deep; you must not interpret this as depth of flooding, rather as indicative of susceptibility to flooding because of modelling uncertainties.	Newcastle	NZ2199769010		Areas Susceptible to Surface Water Flooding (AStSWF) - More	Probability refers to the probability of the rainfall event. This identifies areas which are 'more susceptible' to surface water flooding.		200 Surface runoff		High

Annex 2 Future floods

4 • Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height of 5m based on OS MasterMap 2009 building footprints, then resampled to a 5m grid DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 70% in urban areas. • Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 30 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 in rural areas; 0.03 in urban areas, to reflect explicit modelling of buildings in urban areas. • No allowance made for local variations in drainage, pumping or other works constructed for the purpose of flood risk management. • The '>0.1m' laver shows where modelled flooding is greater than 0.1m deep.	Newcastle	NZ2199769010	Flood Map for Surface Water (FMfSW) - 1 in 30	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.1m depth.	30 Surface runoff	High
5 • Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height of 5m based on OS MasterMap 2009 building footprints, then resampled to a 5m grid DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 70% in urban areas. • Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 30 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 in rural areas; 0.03 in urban areas, to reflect explicit modelling of buildings in urban areas. • No allowance made for local variations in drainage, pumping or other works constructed for the purpose of flood risk management.	Newcastle	NZ2199769010	Flood Map for Surface Water (FMfSW) - 1 in 30 deep	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.3m depth.	30 Surface runoff	High
6 • Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height of 5m based on OS MasterMap 2009 building footprints, then resampled to a 5m grid DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 70% in urban areas. • Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 200 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 in rural areas; 0.03 in urban areas, to reflect explicit modelling of buildings in urban areas. • No allowance made for local variations in drainage, pumping or other works constructed for the purpose of flood risk management. • The '>0.1m' layer shows where modelled flooding is greater than 0.1m deep.	Newcastle	NZ2199769010	Flood Map for Surface Water (FMfSW) - 1 in 200	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.1m depth.	200 Surface runoff	High
7 • Topography is derived from 64.5% LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m) and 35.5% NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation, then combined on a 2m grid; buildings added with an arbitrary height of 5m based on OS MasterMap 2009 building footprints, then resampled to a 5m grid DTM. Manual edits applied where flow paths clearly omitted e.g. below bridges. • Flow routes dictated by topography; a uniform allowance of 12mm/hr has been made for manmade drainage in urban areas. Infiltration allowance reduces runoff to 39% in rural areas and 70% in urban areas. • Areas that may flood are defined by dynamically routing a 1.1 hour duration storm with 1 in 200 chance of occurring in any year over the DTM using JBA's JFLOW–GPU model. • Manning's n of 0.1 in rural areas; 0.03 in urban areas, to reflect explicit modelling of buildings in urban areas. • No allowance made for local variations in drainage, pumping or other works constructed for the purpose of flood risk management.	Newcastle	NZ2199769010	Flood Map for Surface Water (FMfSW) - 1 in 200 deep	Probability refers to the probability of the rainfall event, in this case producing flooding of greater than 0.3m depth.	200 Surface runoff	High

Annex 2 Future floods

8 • Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid • This data has used the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map, which was developed on a 50m grid from: • NEXTMap 5m grid DTM. • National Groundwater Level data on a 50m grid • BGS 1:50 000 geological mapping, with classifications of permeability • It covers consolidated aquifers (chalk, limestone, sandstone etc.) and superficial deposits. • Flood plains are not explicitly identified; the mapping identifies where groundwater is likely to emerge, and not where the water is subsequently likely to flow or pond. • No allowance is made for engineering works, or for groundwater rebound or abstraction to prevent groundwater rebound. • Shows the proportion of each 1km grid square which is susceptible to groundwater emergence, using four area categories.	Newcastle	NZ2199769010	Areas Susceptible to Groundwater Flooding (AStGWF)	Does not describe a probability, but shows places where groundwater emergence more likely to occur.	Unknown	Groundwater		High
9 • Modelling developed from combination of national (2004) and local (generally 1998-2010) modelling. • Topography derived from LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m), NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation. For local modelling, topography may include ground survey. • Location of watercourses and tidal flow routes dictated by topographic survey. • Areas that may flood are defined for catchments >3km² by routing appropriate flows for that catchment through the model to ascertain water level and thus depth and extent. • Manning's n of 0.1 used for national fluvial modelling; variable (calibrated) values for national tidal modelling; appropriate values selected for local modelling. Channel capacity assumed as QMED for national fluvial modelling; local survey methods used for local modelling. • For the purpose of flood risk management, models assume that there are no raised defences	Newcastle	NZ2199769010	Flood Map (for rivers and sea) - flood zone 3	Fluvial 1 in 100, tidal 1 in 200		100 Main rivers	Sea, ordinary watercourses	Medium
10 • Modelling developed from combination of national (2004) and local (generally 2004-2010) modelling. • Topography derived from LIDAR (on 0.25m-2m grids; original accuracy ± 0.15m), NEXTMap SAR (on 5m grid; original accuracy ± 1.0m), processed to remove buildings & vegetation. For local modelling, topography may include ground survey. • Location of watercourses and tidal flow routes dictated by topographic survey. • Areas that may flood are defined for catchments >3km² by routing appropriate flows for that catchment through the model to ascertain water level and thus depth and extent. • Manning's n of 0.1 used for national fluvial modelling; variable (calibrated) values for national tidal modelling; appropriate values selected for local modelling. Channel capacity assumed as QMED for national fluvial modelling; local survey methods used for local modelling. • For the purpose of flood risk management, models assume that there are no raised defences	Newcastle	NZ2199769010	Flood Map (for rivers and sea) - flood zone 2	Extreme flood outline is 1 in 1000, and includes some historic where judged that this gives an indication of areas at risk of future flooding.		1000 Main rivers	Sea, ordinary watercourses	Medium



Annex 2 Future floods

Main mechanism of flooding	Main characteristic of flooding	Significant consequences to	Human health consequences -	Property count method	Other human health consequences	Significant economic consequences	Number of non-residential properties	Property count method	Other economic consequences	Significant consequences to the	Environment consequences	Significant consequences to	Cultural heritage consequences
Mandatory	Mandatory	Mandatory	Optional	Optional	Optional	Mandatory	Optional	Optional	Optional	Mandatory	Optional	Mandatory	Optional
Pick from drop-down	Pick from drop-down	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters
Pick a mechanism from; 'Natural exceedance' (of capacity), 'Defence exceedance' (floodwater overtopping defences), 'Failure' (of defences or infrastructure, or of pumping), 'Blockage or restriction' (natural or artificial blockage or restriction of a conveyance channel or system), or 'No data'. Natural exceedance	Pick a characteristic from; 'Flash flood' (rises and falls quite rapidly with little or no advance warning), 'Natural flood' (due to significant precipitation, at a slower rate than a flash flood), 'Snow melt flood' (due to rapid snow melt), 'Debris flow' (conveying a high degree of debris), or 'No data'. Most UK floods are 'Natural floods'. Natural flood	Would there be any significant consequences to human health if the future flood were to occur?	Record the number of residential properties where the building structure would be affected either internally or externally if the flood were to occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there would be other <u>Significant consequences to human health</u> , describe them including information such as the number of critical services flooded.	Would there be any significant economic consequences if the future flood were to occur?	Record the number of non-residential properties where the building structure would be affected either internally or externally if the flood were to occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there would be other <u>Significant economic consequences</u> , describe them including information such as the area of agricultural land flooded, length of roads and rail flooded.	Would there be any significant consequences to the environment if the future flood were to occur?	If there would be <u>Significant consequences to the environment</u> , describe them including information such as national and international designated sites flooded, and pollution sources flooded.	Would there be any significant consequences to cultural heritage if the future flood were to occur?	If there would be <u>Significant consequences to cultural heritage</u> , describe them including information such as the number and type of heritage assets flooded.
		Yes	12000	Detailed GIS		No				No		No	
Natural exceedance	Natural flood	Yes	Available from EA			Yes	Available from EA			No		No	
Natural exceedance	Natural flood	Yes	Available from EA			Yes	Available from EA			No		No	
Natural exceedance	Natural flood	Yes				Yes				No		Yes	

Annex 2 Future floods

Natural exceedance	Natural flood	Yes		No		No	No
Natural exceedance	Natural flood	Yes		No		No	No
Natural exceedance	Natural flood	Yes	Available from EA	Yes	Available from EA	No	No
Natural exceedance	Natural flood	Yes	Available from EA	Yes	Available from EA	No	Yes

Annex 2 Future floods

Natural exceedance	Natural flood	No	Yes	No	No
Natural exceedance	Natural flood	Yes	Yes	No	No
Natural exceedance	Natural flood	Yes	Yes	No	No



Annex 2 Future floods

Comments	Data owner	Area flooded	Confidence in modelled outline	Model date	Model Type	Hydrology Type	Lineage	Sensitive data	Protective marking descriptor	European Flood Event Code
Optional Max 1,000 characters	Optional Max 250 characters	Optional Number with two decimal places The total area of the land flooded, in km ²	Optional Pick from drop-down	Optional 'yyyy' or 'yyyy-mm' or 'yyyy-mm-dd'	Optional Max 250 characters	Optional Max 250 characters	Optional Max 250 characters	Optional Pick from drop-down	Optional Max 50 characters	Auto-populated Max 42 characters
Any additional comments about the future flood record.			Pick a broad level of confidence in the modelled flood outline from; 'High' (good match to past flood extents - about 80% confident that outline is correct), 'Medium' (reasonable match - about 50% confident that outline is correct), 'Low' (poor match, sparse data - about 20% confident that outline is correct) or 'Unknown'.		Type of software used to create future flood information.	Type of hydrology method used to create future flood information.	Lineage is how and what the data is made from. Has this data been created by using data owned or derived from data owned by 3rd party (external) organisations? If yes please give details.	Has the information been classified under the Government's Protective Marking Scheme? Include protective marking time limit where known. Note: If "Approved for Access" then report "Unmarked".	For use where organisations apply the Government's Protective Marking Scheme.	This field will autopopulate using the LLFA name provided on the "Instructions" tab, and the <u>Flood ID</u> . It is an EU-wide unique identifier and will be used to report the flood information. Format: UK<ONS Code><P or F><LLFA Flood ID>. "ONS Code" is a unique reference for each LLFA. "P or F" indicates if the event is past or future. "LLFA Flood ID" is a sequential number beginning with 0001.
	Epping Forest District Council		Medium-Low	2008-08	2D-TuFlow	FEH (Revised Rainfall Runoff)	Ordnance Survey AddressPoint; CEH 1:50k River Centreline; NextMap DTM.	Unmarked	Private	UKE10000012F0001
	JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE09000002F0001
	JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE09000002F0002
	JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE09000002F0003

Annex 2 Future floods

Environment Agency	Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:30 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See " Description of assessment method " for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked	UKE09000002F0004
Environment Agency	Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:30 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked	UKE09000002F0005
Environment Agency	Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked	UKE09000002F0006
Environment Agency	Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked	UKE09000002F0007

Annex 2 Future floods

Data developed specifically for PFRA, and is unlikely to be suitable for any other purposes.	Environment Agency	Low	2010-11	ArcGIS	Uses data which is developed from published BGS groundwater level contours, groundwater levels in BGS WellMaster database and some river levels. No probability is associated with this data.	British Geological Society (BGS) DiGMapGB-50 [Susceptibility to Groundwater Flooding].	Unmarked		UKE09000002F0008
Data updated quarterly. To understand the likelihood of future flooding, taking account of defences, refer to Areas Benefitting from Defences and National Flood Risk Assessment (NaFRA) data. Marked 'Protect' for complete national dataset only.	Environment Agency	Medium	2010-11	Varies but mainly JFLOW, ISIS, HEC-RAS, TUFLOW for fluvial, and HYDROF for tidal.	National methodology described in "National Generalised Modelling for Flood Zones - Fluvial & Tidal Modelling Methods - Methodology, Strengths and Limitations". A national dataset (for England and Wales) of fluvial flood peak estimates was derived from the Flood Estimation Handbook (FEH) to generate a 1 in 100 chance fluvial flood. Local fluvial modelling uses FEH methods. Peak tidal water levels from either Dixon & Tawn (DT3) or local data sets to derive 1 in 200 chance tide levels including surge from POL CSX model.	NextMap SAR DTMe, UKHO Admiralty Charts, 1:50K CEH River Centre Line, CEH FEH Q(T) Grids, POL CSX Peak Extreme Water Levels, POL CS3 Astronomical Tides, UKHO Admiralty Tide Time-Series Calibration Locations, OS 1:10 Boundary Line MHW	Protect	Commercial	UKE09000002F0009
Data updated quarterly. To understand the likelihood of future flooding, taking account of defences, refer to National Flood Risk Assessment (NaFRA) data. Marked 'Protect' for complete national dataset only.	Environment Agency	Medium	2010-11	Varies but mainly JFLOW, ISIS, HEC-RAS, TUFLOW for fluvial, and HYDROF for tidal.	National methodology described in "National Generalised Modelling for Flood Zones - Fluvial & Tidal Modelling Methods - Methodology, Strengths and Limitations". A national dataset (for England and Wales) of fluvial flood peak estimates was derived from the Flood Estimation Handbook (FEH) to generate a 1 in 1000 chance fluvial flood. Local fluvial modelling uses FEH methods. Peak tidal water levels from either Dixon & Tawn (DT3) or local data sets to derive 1 in 1000 chance tide levels including surge from POL CSX model.	NextMap SAR DTMe, UKHO Admiralty Charts, 1:50K CEH River Centre Line, CEH FEH Q(T) Grids, POL CSX Peak Extreme Water Levels, POL CS3 Astronomical Tides, UKHO Admiralty Tide Time-Series Calibration Locations, OS 1:10 Boundary Line MHW, Historic	Protect	Commercial	UKE09000002F0010

