



Report of the Peterborough Flood Risk Assessment (PFRA)

Draft – May 2011

(For Sustainable Growth Scrutiny 7th June and Cabinet 13th June)

Foreword

This important document is a report into the Peterborough Preliminary Flood Risk Assessment (PFRA). Across the whole country, PFRAs are being produced by 'Lead Local Flood Authorities' (LLFA), of which Peterborough City Council is one.

This report must be submitted to the Environment Agency (EA) by 22 June 2011, and then EA will collate it with other PFRA reports at a river basin district level to produce a single report submitted to the European Union.

One of the most important tasks of a PFRA is to determine whether any area within Peterborough is at sufficient risk of flooding to warrant it being classified as a nationally significant 'Flood Risk Area'. If there is such an area identified, considerable work to address the issues arising will be required to be undertaken in future years.

If no Flood Risk Area is identified, it is still likely that more local flood issues will still need investigating and action taken to minimise risk and manage consequences. In this regard, it should be noted that the PFRA is not the only report on flood and water issues for the Peterborough area. Indeed, there are numerous other reports either published or schedule to be prepared shortly, looking at all kinds of water and flood related issues. These various reports and studies are required to meet various pieces of legislation, national and international, with such legislation varied in their scope from planning to environmental protection.

Who Prepared this Document?

This document has been prepared by Peterborough City Council (a Lead Local Flood Authority) in association with partners, including the Environment Agency, local Internal Drainage Boards, and Anglian Water.

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Acronyms and Abbreviations

AStSWF	Areas Susceptible to Surface Water Flooding
AWS	Anglian Water Services
BGS	British Geological Society
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
FMfSW	Flood Map for Surface Water
FWM Act	Flood & Water Management Act 2010
IDB	Internal Drainage Board
LDF	Local Development Framework
LiDAR	Light Detection and Ranging - an optical remote sensing technology
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
PCC	Peterborough City Council
PFRA	Preliminary Flood Risk Assessment
PPS25	Planning and Policy Statement 25: Development and Flood Risk
RFCC	Regional Flood and Coastal Committee
SAB	SuDS Approving Body
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan

Executive Summary

This report has been prepared to assist Peterborough City Council meet their duties to manage local flood risk and deliver the requirements of the Flood Risk Regulations (2009). Peterborough City Council is defined as a Lead Local Flood Authority (LLFA) under these regulations and the Flood and Water Management Act 2010.

The PFRA, comprising this document and the supporting statutory spreadsheet, represents the first stage of the requirements of the Regulations. **The PFRA process is aimed at providing a high level overview of flood risk from local flood sources, including surface runoff, groundwater, ordinary watercourses and public sewers.** This report is not concerned with flooding from main rivers or the sea. As a LLFA, Peterborough City Council must submit their PFRA to the Environment Agency for review by 22nd June 2011. The methodology for producing this PFRA has been based on the Environment Agency's Final PFRA Guidance and Defra's Guidance on selecting Flood Risk Areas, both published in December 2010.

The Environment Agency has identified indicative 'Flood Risk Areas' across England. Of the ten areas of national significance none are located within Peterborough's administrative area.

In order to develop a clear overall understanding of the flood risk across Peterborough, flood risk data, records of historic flooding and modelling of future flood risk were collected, either directly or indirectly, from a variety of different local and national sources including the Council itself, the Environment Agency, the local water and sewerage company, emergency services and other risk management authorities. It is important to note, however, that comprehensive details on flood extents and consequences of past events were largely unavailable.

Based on the evidence that was collected, **this PFRA report supports the national assessment that there is no 'Flood Risk Area' of national significance within Peterborough's administrative area.**

Historic evidence shows that surface water flood events have not been numerous in Peterborough and are more often related to operational issues. On a local scale, however, risk does exist of very localised flooding and the Council and its partners will continue to use the gathered information to best manage these risks. Over the coming months the Council will be developing a Local Flood Risk Management Strategy and this will set out the approach of the Council and its partners to managing flood risk in the authority. This PFRA is a first step in our understanding.

The PFRA requires LLFAs to state whether past flood events and future flood risk could be deemed to have locally significant harmful consequences. Therefore, purely for the purposes of this report and spreadsheet, local thresholds are defined to aid this. A flood of locally significant consequences is considered to be one which meets any of the criteria below:

- 1) cause internal flooding to ten or more residential properties,
- 2) flood two or more large business premises, or five or more small premises,
- 3) flood one or more critical services such as schools or care homes,
- 4) cause a key transport link to be totally impassable for a significant period, or
- 5) cause indirect significant problems (e.g. loss of power) to 200 persons or 20 businesses for 24 hours or more, even if direct flooding of harmful consequence was minimal.

Using this criteria the conclusions reached are that:

- Only one past flood event was considered to have had 'locally significant harmful consequences'.
- It is considered that future flood risk in Peterborough does have the potential for locally significant consequences.

1 Introduction

1.1 Introduction to PFRA Report

- 1.1.1 The European Union has issued the Flood Risk Regulations (2009) in order to implement the European Floods Directive. The aim of the Directive is to provide a consistent approach to managing flood risk across Europe.
- 1.1.2 To meet the requirements of that Directive (and associated Regulations), plus to tackle other national water and flood related issues, the UK government has also enacted the Flood and Water Management Act (FWM Act) (2010).
- 1.1.3 The FWM Act and the Flood Risk Regulations 2009 make Peterborough City Council a 'Lead Local Flood Authority' (LLFA). As a LLFA, a considerable number of new statutory duties have been placed on the council in relation to flood issues (risk assessment, prevention, monitoring, managing, maintaining etc).
- 1.1.4 One such duty is the requirement to undertake a Preliminary Flood Risk Assessment (PFRA), and submit a report of the findings of that Assessment to the Environment Agency (EA) by 22 June 2011. This report meets that requirement.

1.2 Introduction to PFRA Report

- 1.2.1 The EA has issued guidance on the preparation of PFRAs. Such guidance stipulates that a PFRA should comprise a report including specifically requested pieces of information.
- 1.2.2 The PFRA is a high level exercise based on existing and available information. It brings together information from a number of available sources, such as the EA's national products (for example the Flood Maps for Surface Water) and existing local information (such as Strategic Flood Risk Assessments and local partner knowledge).
- 1.2.3 In preparing this PFRA report, Peterborough LLFA is responsible for assessing risk from sources of flooding other than main rivers, the sea and reservoirs. In particular this includes surface runoff, groundwater and ordinary watercourses and any interaction these have with drainage systems and other sources of flooding including sewers. The interaction of flooding from main rivers, the sea and reservoirs with local sources will, however, need to be taken into account, for example where an ordinary watercourse floods when a main river backs up. An extract from the Flood and Water Management Act 2010 (part 1, section 6) is given below, providing the legislative definitions for surface water, groundwater and ordinary watercourse:

- (3) “Ordinary watercourse” means a watercourse that does not form part of a main river.
- (4) “Groundwater” means all water which is below the surface of the ground and in direct contact with the ground or subsoil.
- (5) “Surface runoff” means rainwater (including snow and other precipitation) which –
 - (a) is on the surface of the ground (whether or not it is moving), and
 - (b) has not entered a watercourse, drainage system or public sewer.
- (6) In subsection (5)(b) –
 - (a) the reference to a watercourse includes a reference to a lake, pond or other area of water which flows into a watercourse, and
 - (b) “drainage system” has the meaning given by paragraph 1 of Schedule 3.

1.3 Aim of the PFRA Report and Spreadsheet

- 1.3.1 The aim of this PFRA report and the accompanying spreadsheet is to:
- Provide an overview of readily available information on past (historic) and future (potential) floods;
 - Consider whether there is a need to identify a Flood Risk Area(s) of national significance, and set out the conclusions with reasoning.
 - Form part of a collection of reports, studies and action plans which collectively will help understand local flooding issues, identify areas at potential risk and put in place arrangements to tackle priority areas at risk of damaging floods.
 - Meet the requirements of the Flood Risk Regulations 2009 and European Flood Directive.

1.4 Introduction to the Peterborough area

- 1.4.1 Peterborough is a unitary authority located in the East of England, approximately 125 kilometres (80 miles) north of London. It comprises the City of Peterborough itself, and 25 villages set in countryside extending over an area of approximately 344 square kilometres. The area borders the local authorities of Fenland and Huntingdonshire (in Cambridgeshire), and East Northamptonshire, Rutland, South Kesteven and South Holland (in the East Midlands). The total population of Peterborough is estimated as 169,800 (at mid 2008).
- 1.4.2 There is a long history of settlement in Peterborough, with evidence from the Bronze Age remains at Flag Fen, the nearby Roman town of Durobrivae and the Saxon settlement of Medehamstede. The Norman Cathedral still stands at the heart of the modern city; a city which expanded in Victorian and Edwardian times as Peterborough developed as a significant railway town, and then experienced further rapid growth from 1967 under the New Towns programme. Today, Peterborough is an important regional centre, providing employment, shopping, health, education and leisure facilities for people across a wide catchment area.
- 1.4.3 Peterborough has a diverse economy. Two of the biggest employers are in the public sector and considerable numbers of people are employed in a range of service industries including insurance, publishing, travel, retailing and logistics. Manufacturing still has a significant place in the economy, despite the general decline in this sector nationally, and a particularly important characteristic of Peterborough is the concentration of companies engaged in environment-related activities. There is significant pressure for development to serve the logistics industry, taking

advantage of the area's prime location beside the (north-south) A1 and (east-west) A47. Agriculture remains important to the economy, although the numbers employed on a full-time basis are relatively small. Unemployment levels in Peterborough tend to be marginally higher than those for the UK as a whole, but average figures mask particularly high pockets of unemployment, with a concentration in some inner city wards where other measures of deprivation are higher than average.

- 1.4.4 The City of Peterborough has been growing for many years, with a mixture of redevelopment of vacant and derelict sites within the urban area, and peripheral expansion. One of the most noticeable examples of this is at Hampton, where a major urban extension is underway on reclaimed brickfields. However, there remain vacant and underused sites close to the city centre which offer the opportunity for further investment to regenerate the area.
- 1.4.5 One of the unique characteristics of Peterborough is its situation in the landscape, on the very edge of the Fens. To the east of the City, the fenland landscape is flat and open, with the villages of Eye and Thorney on islands of higher ground and a settlement pattern of dispersed hamlets and farms. To the west and north, the shallow river valleys of the Nene and Welland give way to an undulating limestone plateau, with a denser pattern of attractive stone villages. Historic houses and their grounds, like Burghley and Milton, feature prominently in the landscape, as does the RAF base at Wittering, beside the A1 towards the western edge of the area.
- 1.4.6 In addition to its important built heritage, the area contains a rich biological diversity. There are two Special Areas of Conservation (Orton Pit and Barnack Hills & Holes); part of one Special Protection Area and Ramsar site (Nene Washes); three National Nature Reserves (Castor Hanglands, Bedford Purlieus and Barnack Hills & Holes); five Local Nature Reserves; and a large number of Sites of Special Scientific Interest and other County Wildlife Sites of value.
- 1.4.7 It is against this background that the challenges of local flooding have been considered in preparing this PFRA report.

2 Lead Local Flood Authority Responsibilities

2.1 Introduction to PFRA Report

- 2.1.1 Overall, Peterborough City Council has responsibility for preparing this PFRA report, in its capacity as a Lead Local Flood Authority (LLFA). In his Review of the summer 2007 flooding, Sir Michael Pitt stated that *“the role of local authorities should be enhanced so that they take on responsibility for leading the coordination of flood risk management in their areas”*. The Flood and Water Management Act formally introduced this. As the designated LLFA, Peterborough City Council is therefore now responsible for leading local flood risk management across its administrative area.
- 2.1.2 To assist it in its undertaking of various duties, it helped to establish and now manages the Peterborough Flood Risk Partnership, as detailed below.

2.2 Governance and Partnership Arrangements in the preparation of this PFRA Report

- 2.2.1 The primary partnership arrangement covering the Peterborough area is the **‘Peterborough Flood Risk Partnership (PFRP)’**. Its members, and their roles, include:
- **Peterborough City Council (officers and a Cabinet Member):** The city council is the local authority for Peterborough and has responsibilities for the management of surface water from public highways and some small channels. Local Authorities have responsibility for the management of surface water, including the creation and implementation of SWMPs. New duties and roles are emerging, as part of the enactment of the Floods and Water Management Act (2010).
 - **Environment Agency:** The Environment Agency is a Non Departmental Public Body and has responsibilities for protecting and enhancing the environment as a whole (air, land and water), and contributing to the government’s aim of achieving sustainable development in England and Wales. Following the Flood and Water Management Act 2010, the Environment Agency was given the strategic overview role for all types of flooding, including surface water.
 - **Anglian Water Services Ltd (AWS):** Anglian Water is the water and sewerage undertaker for the Peterborough area and has a statutory obligation to supply water and wastewater services to its customers. AWS currently has the responsibility to effectually drain their area and maintain their foul, surface and combined public sewers.
 - **Welland and Deepings Internal Drainage Board:** This IDB is an autonomous public body responsible for supervision over all aspects of land drainage within their district (other than Main River). They have regulatory powers in and adjacent to drainage systems and undertake improvements, maintenance and operation of their flood management assets. Their area extends to some 32,400 hectares and stretches from just north of Peterborough to south of Kirton near Boston
 - **North Level District Internal Drainage Board:** This IDB is a land drainage authority responsible for the drainage and evacuation of surplus water from 33,000 hectares of land. The Board is responsible for the improvement and maintenance of some 613 kilometres of drains within the area and for the operation of 12 pumping stations.

- **Whittlesey and District Internal Drainage Board:** This IDB is a land drainage authority responsible for the drainage and evacuation of surplus water from over 8,300 hectares of land. The Board is managed by the Whittlesey Consortium of IDBs.
- **Middle Level Commissioners:** The Middle Level Commissioners are a statutory body with powers and duties under general and local legislation relating to flood risk management and navigation. The Commissioners maintain an arterial system of watercourses and associated apparatus. The Commissioners act as consultants for the Whittlesey and District Internal Drainage Board..
- The **Natural Networks Partnership** has been formed to carry out environmental projects to aid in the implementation of the Peterborough Green Grid Strategy. It includes members of the Environment Agency, Natural England, Peterborough City Council and local wildlife groups.

2.2.2 In addition, other partnership arrangements are set up to deal with specific issues, such as the recent commencement of a Surface Water Management Plan, which has its own sub-group.

2.3 Communication and Consultation

2.3.1 A Communication with stakeholders in preparing this PFRA Report has largely been done through the PFRP partners described above. There has not been any general public wide consultation, though it has been considered by the Environment Capital Scrutiny Committee of the city council.

2.3.2 The city council is currently considering whether there is an opportunity to create a dedicated space on its website for material related to water, wastewater and flood risk. This could assist in raising greater awareness of the issues and an opportunity for feedback.

2.4 Wider LLFA Responsibilities

2.4.1 Aside from forging partnerships and coordinating and leading on local flood management, there are a number of other key responsibilities that have arisen for LLFAs from the FWM Act 2010 and the Flood Risk Regulations 2009. These responsibilities which are being officially enacted between 2010 and 2012, by order of the Minister, include:

- **Investigating flood incidents** – LLFAs have a duty to investigate flooding incidents within their area, to the extent that the LLFA considers it necessary or appropriate.
- **Asset Register** – LLFAs also have a duty to maintain a register of structures or features which are considered to have a significant effect on flood risk, including details on ownership and condition as a minimum. The register must be available for inspection and the Secretary of State will be able to make regulations about the content of the register and records.
- **SuDS Approving Body** – Once the duty has come into force, LLFAs will be designated the SuDS Approving Body (SAB) for any new drainage system, and therefore thereafter must approve, adopt and maintain any new sustainable drainage systems (SuDS) within their area.
- **Local Flood Risk Management Strategy** – LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy

will build upon information such as national risk assessments and will use consistent risk based approaches across different local authority areas and catchments.

- **Works powers** – LLFAs have powers to undertake works to manage flood risk from surface runoff and groundwater, consistent with the local flood risk management strategy for the area.
- **Designation powers** – LLFAs, as well as the Environment Agency and Internal Drainage Boards, have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management.

3 Methodology and Data Review

3.1 Introduction

- 3.1.1 The PFRA is a high-level screening exercise used to identify areas where the risk of flooding is considered to be of national significance and warrants further examination and management through the production of flood risk and flood hazard maps and flood risk management plans.
- 3.1.2 The approach for producing this PFRA was based upon the EA's PFRA Final Guidance, which was released in December 2010. The PFRA is based on readily available or derivable data and with this in mind; the following methodology has been used to undertake the PFRA.

3.2 Methodology and data review

- 3.2.1 To undertake the PFRA data and information was sourced from national and local data collected through the member organisations of the Peterborough Flood Risk Partnership. The data includes Catchment Flood Management Plans, records from emergency services, highway inspectors and water companies and Environment Agency mapping. A full list of data and references used is included in Annex 3.

Assessing Historic Flood Risk

- 3.2.2 Existing datasets, reports and anecdotal information from the stakeholders listed in Chapter 2 were collated and reviewed to identify details of major past flood events and associated consequences including economic damage, environmental and cultural consequences and impact on the local population

Assessing Future Flood Risk

- 3.2.3 A consideration as to whether or not to identify Flood Risk Areas through the PFRA must take into account future floods, defined as any flood that could potentially occur in the future. This definition includes predicted floods extrapolated from current conditions in addition to those with an allowance for climate change. The assessment of future flood risk will primarily rely on a technical review of the Environment Agency's Flood Map for Surface Water which has been recently circulated to Lead Local Flood Authorities. The Flood Map for Surface Water uses a numerical hydraulic model to predict the extent of flood risk from two rainfall events (of annual probability 3.3% (1 in 30) and 0.5% (1 in 200).

Identifying Flood Risk Areas

- 3.2.4 Information regarding historic and future flood risk has been used by the Environment Agency to formally identify Flood Risk Areas. To achieve this, *flood risk indicators* were used to determine the impacts of flooding on human health, economic activity, cultural heritage and the environment. The use of flood risk indicators helps to develop understanding of the impacts and consequences of flooding.

- 3.2.5 **Key Flood Risk Indicators** are as follows:

- Human Health (number of residential properties and critical services such as hospitals, Police/Fire/Ambulance stations, schools, nursing homes, etc).
- Economic Activity (number of non-residential properties / length of road or rail / area of agricultural land)
- Cultural Heritage (cultural heritage sites)
- Environment (designated sites (SSSIs, SACs, SPAs, etc) and BAP habitat)

3.2.6 The above indicators have been selected and analysed by Defra and the Environment Agency in order to identify areas where flood risk and potential consequences exceed a pre-determined threshold. The areas that have been identified using this methodology and exceed 30,000 people at risk have been mapped and identified as Indicative Flood Risk Areas. For further details, please refer to Defra's Guidance for selecting and reviewing Flood Risk Areas for local sources of flooding (December 2010).

3.3 Quality Assurance, Security, Data Licensing And Restrictions

3.3.1 A number of specific agreements have been put in place to facilitate the sharing of data between partners, such as:

- AWS licence agreement setting out the terms under which their data can be used
- GIS licences for mapping and data supplied by PCC
- British Geological Society (BGS) licence for geological data supplied by BGS
- Environment Agency standard data licence
- Environment Agency licence for Flood Map for Surface Water
- Environment Agency licence for Areas Susceptible to Surface Water
- Environment Agency LiDAR licence

3.4 Data Limitations

3.4.1 A brief assessment of the data collection process is included in this chapter to provide transparency with respect to the methodology. By flagging up the issues identified in the data collection phase it is hoped this could serve as a catalyst to improve the collection of flood risk data going forward. A number of issues arose during the data collection process, as described below:

3.4.2 **Inconsistent Recording Systems:** The previous lack of a consistent flood data recording system across Peterborough has led to inconsistencies in the recording of flood event data. This has resulted in incomplete, or sometimes nonexistent, flood record datasets. The city council intends to rectify these issues in the future, to ensure consistent recording of events is undertaken as a matter of course.

3.4.3 **Incomplete Datasets:** As a result of the lack of consistent flood data recording arrangements (as described above) flood records are incomplete. Some of the datasets collated are not exhaustive and it is felt that they are unlikely to accurately represent the complete flood risk issues in a particular area. The corresponding gaps in flood data will hinder also the identification of accurate flood risk areas.

3.4.4 **Varied Quality of Data:** Based upon the data collected from all sources described above, there was found to be varied quality in historic flood records and information.

3.4.5 **Records of Consequences of Flooding:** Very few data providers were able to provide comprehensive details of the consequences of specific past flood events, which made accurately assessing the consequences of historic flooding difficult.

4 Defining Significant Consequences

4.1 Introduction

4.1.1 The next section summarises relevant information on past floods, and in particular seeks to determine whether there has been any floods with national or local significant harmful consequences. This report is concerned only with floods caused by surface runoff, groundwater and ordinary watercourses. Before summarising such floods, we first need to define what we mean by 'national' and 'local' significant harmful consequences.

Definition of Nationally Significant Harmful Consequences

4.1.2 Nationally significant harmful consequences are not explicitly defined in the legislation. However, there are useful thresholds that have been identified by Defra and the Environment Agency as part of their process of identifying indicative Flood Risk Areas. More details are provided in the Defra guidance document "Selecting and reviewing Flood Risk Areas for local sources of flooding". These thresholds, described next, were used to assist Peterborough in understanding what thresholds might be appropriate locally.

4.1.3 The following thresholds were used by Defra to identify 1km grid squares where 'flood risk is an issue'. These were identified wherever one of the following might be flooded to a depth of 0.3 metres by a rainfall event with a chance of 1 in 200 of occurring in any given year:

- 1) Greater than 200 people (equivalent to approximately 85 dwellings) or
- 2) More than 1 critical services (includes critical infrastructure) or
- 3) More than 20 non-residential properties.

4.1.4 The thresholds set for creation of a Flood Risk Area were as follows:

- 30,000 or more people (equivalent to around 12,800 residential properties) affected by a 1 in 100 chance of flooding (derived from the Environment Agency Flood Maps for Surface Water). This was the overall deciding factor for a Flood Risk Area.
- A nominal thresholds of 150 critical services (schools, hospitals, power and water services etc) at risk
- A nominal thresholds of 3,000 non-residential premises at risk.
- Significant consequences of flooding to agricultural land or designated environmental or heritage assets.

Definition of Floods Causing Locally Significant Harmful Consequences

4.1.5 Some floods may not have nationally significant harmful consequences but they nevertheless could have harmful consequences at the local level. These we refer to these as floods with local significant harmful effects. No guidance has been issued for defining locally significant harmful consequences and it is up to each LLFA to set its own definition as is appropriate. It has been suggested by the EA that the threshold should be an order of magnitude below the significance criteria for determining national flood risk areas. They also recommend that, as a minimum, it should involve flooding of a number of properties, on more than one occasion.

4.1.6 For the purpose of the Peterborough PFRA only, the following definition is proposed for a flood event with local significant harmful consequence. However, through the development of and consultation on Peterborough's upcoming Local Flood Risk Management Strategy, thresholds will be more formally agreed. These thresholds will influence how the Council and its partners record flood events in future PFRA cycles and with regards to LLFAs' new responsibility to investigate floods events (FWM Act 2010, part 1, section 19). The thresholds may also be used to set out

how different procedures will be put in place for different flood events, although this will need much further consultation to ensure this would be appropriate. For example, the response of the Emergency Services and the Council's Resilience Team must be determined by the actual impact, rather than a specific number of properties. Their response is therefore usually dealt with on a case by case basis. A flood is defined as having locally significant harmful consequences if it meets any of the criteria below:

- 1) causes internal flooding to ten or more residential properties, or
- 2) floods two or more large business premises, or five or more small business premises, or
- 3) floods one or more critical services, or
- 4) causes a transport link to be totally impassable for a significant period or
- 5) causes indirect significant problems (e.g. loss of power) to 200 persons or 20 businesses for 24 hours or more, even if there were minimal direct flooding of harmful consequence

4.1.7 For the purposes of this PFRA and with regards to section 4.1.6., the definition of "significant period" is dependant on the transport link affected. The highway categories are as set out in Table 1 of the UKRLG Code of Practice for Highway Maintenance, but the timings for significant period have been derived purely for the purpose of this PFRA. They are as follows:

- Category 1 Motorway - over 2 hours
- Category 2 Strategic Route (Trunk Roads and some Principal "A" roads) – over 4 hours
- Category 3a Main Distributor (Major Urban Network and Inter-Primary Links) – over 4 hours
- Category 3b Secondary Distributor (Classified Road (B and C class) – over 10 hours
- Category 4a Link Road (Roads linking the main distributor network to the Secondary Distributor) – over 10 hours
- Category 4b Local Access Road (Roads serving limited numbers of properties carrying only access traffic) – over 24 hours

4.1.8 The reasoning behind these criteria is as follows:

- Defra set a threshold of 200 persons or 20 businesses per km grid square flooded to a depth of 300mm during a flood of annual probability of 1%.
- For residential, an order of magnitude less can be considered as 20 persons, which would average 8.5 properties (based on a national occupancy rate of 2.34 persons per property). An alternative option was to use the thresholds for identification of a national Flood Risk Areas. However, an order of magnitude less would result in a threshold of 3,000 persons or 1,300 properties which is considered too high a threshold for an event to be classified as locally significant, and therefore rejected.
- 10 or more properties is the definition of 'major development' in town planning guidance, and this would support the use of this threshold as being appropriate to define 'significant' local flood events. 10 dwellings are therefore selected for consistency.
- A order of magnitude lower for business premises would be two. However, given the varying size of commercial properties the threshold is set at 2 large businesses or 5 small businesses.
- In terms of businesses 'large' is defined according to town planning guidance of greater than 1000 m² or greater than 1 ha. 'Small' is therefore defined as businesses smaller than 1000m² or of less than 1 ha.
- The transport thresholds are considered reasonable, and are similar to other thresholds being adopted by other LLFA.

5 Past Flooding

5.1 Overview of Past Floods

Surface Runoff

- 5.1.1 Flooding due to surface water runoff occurs when heavy rainfall exceeds the capacity of local drainage networks and water flows across the ground.
- 5.1.2 The number of homes that have flooded from surface runoff in Peterborough is low compared to other parts of the country. Although small number of individual properties have been flooded historically, it is more common to get flooding of highways or gardens, where the water does not reach the property itself. Several of the floods recorded over the years are also known to have been due to operational issues such as burst water mains or blockage rather than actually due to heavy rainfall exceeding the capacity of drainage systems.

Ordinary Watercourse Flooding

- 5.1.3 Ordinary watercourse flooding can be caused when heavy rainfall results in water overtopping the banks of the channel on to surrounding land. Peterborough has several small ordinary watercourses that crisscross the urban and rural areas and therefore which have a flood risk associated with them.
- 5.1.4 It is important to note that Peterborough City Council is only responsible for managing some of the small watercourses in the Unitary Authority. Many small watercourses in Peterborough have been previously taken on by the Environment Agency and have hence been designated as main rivers. Main River flooding is not included in this assessment as the Environment Agency provides information on this flood risk. For clarification the following are all classed as main rivers in Peterborough and hence are not included specifically in the discussion about past flood events, unless the flooding was either from one of their ordinary watercourse tributaries or was a combination of main river and ordinary watercourse flooding:

- | | |
|------------------|--------------------|
| - Billing Brook | - Orton Dyke |
| - Brook Drain | - Padholme Drain |
| - Castor Splash | - Paston Brook |
| - Car Dyke | - River Nene |
| - Fletton Spring | - River Welland |
| - Folley River | - Stanground Lode |
| - Marholm Brook | - Thorpe Meadows |
| - Maxey Cut | - Werrington Brook |
| - Mortons Leam | |

- 5.1.5 Peterborough has experienced two cases of ordinary watercourse flooding with 'locally significant consequences', the most significant by far being in 1986, when tributaries of Brook Drain overtopped. Surface water runoff and surcharging of sewers may also have occurred during the 1986 event. Although two other references also mention that flooding occurred that year, only the River Nene Catchment Flood Management Plan discusses the number of properties flooded. 293 properties are believed to have been affected.
- 5.1.6 In 1998, 100 properties were flooded from the River Nene and Thorpe Meadows. There may also have been flooding from the small tributary drains of Thorpe Meadows so this record is being recorded as locally significant, even though it may duplicate Environment Agency Main River flood records.

Flooding due to operational issues, such as fly tipping in watercourses, has also been reported in Peterborough but not with consequences above the threshold for locally significant impacts.

Sewer Flooding

- 5.1.7 Sewer flooding is often caused by excess surface water entering the drainage network.
- 5.1.8 Peterborough does experience sewer flooding from time to time, when rainfall exceeds the design capacity of the sewers. Sewers have been largely built to cope with rainfall events having a 3.3% (1 in 30) chance of occurring in any one year. Some areas of Peterborough, partly within the urban boundary, have combined foul and surface water sewers and as a result can be more susceptible to flooding should there be large quantities of rainfall entering the system.
- 5.1.9 Readily available records do not demonstrate that any of the historic sewer flooding events would reach local thresholds for events of significant consequences.
- 5.1.10 Some locally reported flood events from have been due to operational issues such as such as pipe blockage in the public sewer system. While operational issues with the sewerage system remain will be managed by the local water and sewerage provider, the Peterborough Flood Risk Partnership actively works together to report and resolve such issues as quickly as possible.
- 5.1.11 Anglian Water is obliged to report to Ofwat where there are properties at risk of internal flooding due to hydraulic incapacity in the system. This is known as the DG5 register and there are properties on the register which are located in Peterborough. This information is provided here only for clarification as internal foul flooding is the responsibility of water and sewerage providers and not Lead Local Flood Authorities.

Groundwater Flooding

- 5.1.12 Groundwater flooding occurs as a result of water rising up from the underlying aquifer or from water flowing from abnormal springs. This tends to occur after long periods of sustained high rainfall, and the areas at most risk are often low-lying where the water table is more likely to be at shallow depth. Groundwater flooding is known to occur in areas underlain by major aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.
- 5.1.13 Although saturated open space has been noted at locations within Peterborough, no verified records of groundwater flooding are currently available. No groundwater flooding to properties has therefore been recorded.

Summary

- 5.1.14 Only a small number of events are classified as having had locally 'significant harmful consequence'. One of these events was very significant, one was much smaller and one was mainly due to Main River flooding, but has been included due to possible additional surface water effects. These views are cautioned by the fact that a lack of readily available data on past flood events means it is not possible to draw definitive conclusions on the impacts and consequences of historic flood events on people, the economy and the environment.
- 5.1.15 In order to better understand the local situation, further work will be carried out into historic flood risk as part of the Council's role as a Lead Local Flood Authority. This will involve wider consultation to improve the records we currently hold. More detailed records will also be made of future flood events. The data will form an evidence base and will be used to support and inform future PFRA cycles as well as Peterborough's Local Flood Risk Management Strategy.

6 Future Flood Risk

6.1 Introduction

- 6.1.1 This section summarises relevant information on future floods, and in particular seeks to determine whether there may be any future floods with national or local significant harmful consequences, the definitions for which were set out in chapter 4.

6.2 Locally Available Information Sources

Environment Agency 'Areas Susceptible to Surface Water Flooding' map

- 6.2.1 The 'Areas Susceptible to Surface Water Flooding' map shows flooded areas in a rainfall event with a 1 in 200 chance of occurring in any year. The map use three bandings indicating areas which are 'less', 'intermediate' and 'more' susceptible to surface water flooding. The first generation map (Areas Susceptible to Surface Water Flooding) were updated and republished in January 2009. The modelling used to create the map is fairly coarse, using crude assumptions which mean that the map is generally too conservative (i.e. total area of land at risk shown was too large). The map is not suitable for identifying individual properties at risk of surface water flooding.

'Flood Maps for Surface Water'

- 6.2.2 These second generation maps have been provided by the Environment Agency for this PFRA. These maps better represent the mechanisms that cause surface water flooding than the 2009 Areas Susceptible to Surface Water Flooding map. There are four maps available:

- Flood depths greater than 0.1m, from a rainfall event with a 3.3% (1 in 30) chance of occurring in any given year,
- Flood depths greater than 0.3m, from a rainfall event with a 3.3% (1 in 30) chance of occurring in any given year,
- Flood depths greater than 0.1m, from a rainfall event with a 0.5% (1 in 200) chance of occurring in any given year,
- Flood depths greater than 0.3m, from a rainfall event with a 0.5% (1 in 200) chance of occurring in any given year.

- 6.2.3 The Environment Agency's surface water flood maps give an indication of the broad areas likely to be at risk of surface water flooding. They are part of a national assessment which takes broad account of drainage and typical storms which are likely to cause flooding, but these will vary locally and are therefore not appropriate everywhere. The maps are not suitable for identifying whether an individual property will flood. This is because the modelling only gives an indication of broad areas at risk, and because information is not held on floor levels, construction characteristics or designs of properties. This, and other detailed information, would be needed to be able to say whether flooding of certain depth would enter into an individual property and cause damage.

Strategic Pluvial Modelling

- 6.2.4 Two dimensional pluvial modelling (without taking into account underground sewerage or drainage systems) was carried out for the Peterborough main urban area as part of an Urban Surface Water Management Plan Screening Report. The bare earth topography was updated to include buildings and roads and two storm events run; 30-year and 100-year with climate change each with a duration of 30 minutes. This mapping is very coarse and is superseded by the Environment Agency mapping.

Strategic Flood Risk Assessment (SFRA) Level 2 and Critical Drainage Areas

- 6.2.5 The Areas Susceptible to Surface Water Flooding and the Strategic Pluvial Modelling were both used to identify Critical Drainage Areas in the Peterborough Level 2 SFRA. Critical Drainage Areas are defined as areas of flood risk where land is in an area within Flood Zone 1 which have critical drainage problems and which have been notified to the local planning authority by the Environment Agency, in this case through the SFRA process. Critical drainage areas were identified in the SFRA through desktop review, modelling and consultation with the stakeholders. These areas were highlighted for further consideration and assessment through surface water management planning and site specific Flood Risk Assessments.

Environment Agency 'Areas Susceptible to Groundwater Flooding' map

- 6.2.6 Areas Susceptible to Groundwater Flooding is a strategic scale map showing groundwater emergence areas on a 1km square grid. The data set is hazard, not risk-based, i.e. it does **not** show probabilities of locations flooding, only possible areas where geological and hydrological conditions show that groundwater may emerge. In common with the majority of datasets showing areas which may experience groundwater emergence, this dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding. It is therefore not appropriate to use these maps to identify specific localisations of flood risk. Actual flow routes and end locations of ponding or flooding would be dependent on local topography and therefore may bear more resemblance to the results of the Flood Maps for Surface Water.

Anglian Water information

- 6.2.7 Anglian Water provided information on the following factors which they consider could have an influence on surface water flood risk within the Peterborough urban area:
- Cross Connections; possible cross connections between foul and surface water sewer systems
 - Areas of high runoff; areas generating high amounts of runoff during model simulations
 - Overflows; locations of Combined Sewer Overflows (CSO)

Assets

- 6.2.8 Information on assets has been provided by stakeholders which can also be used as potential indicators of flood risk:
- Culverts which may be susceptible to blockage
 - Urban watercourses which can become blocked and full of debris
 - Flood defences along urban watercourses which could overtop during storm events
 - Pumping stations which could fail
 - Overflows which discharge to watercourses during periods of high flow
 - Sewers whose capacity is exceeded during extreme storm events

As part of Peterborough City Council's duty under the Flood and Water Management Act 2010, an asset database has been created which identified drainage assets which influence or are influenced by surface water flooding.

Local Agreed Surface Water Information

- 6.2.9 EA guidance on using surface water flood risk information recommends that LLFAs should: review, discuss, agree and record, with EA, water companies, IDBs and other interested parties, what surface water flood data best represents local conditions. This is known as 'locally agreed surface water information'. 'Locally agreed surface water information' could be made up from both:

- local information on future flooding from surface runoff for part of the LLFA (such as one District Council, or one town, or an IDB district)
- one of the national datasets provided by the EA (for the remainder of the LLFA).

6.2.10 For Peterborough, the locally agreed surface water information is agreed to be the Flood Map for Surface Water dataset, which gives an overview of the future flood risk from surface water across Peterborough and is considered to be the most appropriate source of information.

6.2.11 In future any appropriate updates to mapping, provided through Surface Water Management Plans, could form part of the 'locally agreed surface water information'.

6.3 Overview of Future Flood Risk

Surface Water Flooding

6.3.1 In Peterborough, the Environment Agency's Flood Maps for Surface Water show that the risk of surface water flooding is spread across both rural and urban areas in the Authority. Few areas are at risk from flooding in rainfall events of an annual probability of 3.3% (1 in 30 chance). However, as would be expected, with a greater rain event the risk of flooding in Peterborough does increase. The flood map picks out natural drainage channels, rivers, low areas in the floodplain and flow paths between buildings.

6.3.2 It is important to note that these maps, which are taken from a national assessment, provide a general indication of the broad areas that may be at risk of surface water flooding. Due to the method use to generate these maps, they are not suitable for use at an individual property scale.

6.3.3 The Flood Maps for Surface Water are agreed to be the best 'locally agreed surface water data' currently available and are illustrated in Annexes 1 and 2. It is possible that future flood events could impact on numbers of properties or services that are above the thresholds that have been set for this PFRA. These events could therefore be considered to have locally significant harmful consequences.

Groundwater Flooding

6.3.4 As detailed in 5.1.13, there is no local information which provides evidence of past groundwater flood events to property in Peterborough. However, this does not mean that no risk exists. The Environment Agency's national dataset, Areas Susceptible for Groundwater Flooding, has therefore been used to form the basis of the assessment of risk from groundwater emergence. In areas of Peterborough which are identified as having the potential for groundwater emergence, this is suspected to be related to the existence of alluvial deposits in river valleys.

Ordinary Watercourse Flooding

6.3.5 There are small ordinary watercourses within Peterborough that do have a flood risk associated with them. At the moment, no more detailed information exists which separates out the flood risk from ordinary watercourses from risk associated with surface water or other river channels. This issue will be considered further during Peterborough's Local Flood Risk Management Strategy.

6.3.6 Flood risk from watercourses in Peterborough which have been designated as Main Rivers, is included in the Environment Agency's Main River Flood map. This is available on their website. A list of Main Rivers in Peterborough is provided in section 5.1.5.

6.4 Climate Change and Long Term Developments

The Evidence

- 6.4.1 There is clear scientific evidence that global climate change is happening now. It cannot be ignored.
- 6.4.2 Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation; however the broad trends are in line with projections from climate models.
- 6.4.3 Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.
- 6.4.4 We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can't be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance, or rarer) could increase locally by 40%.

Key Projections for Anglian River Basin District

- 6.4.5 If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are:
- Winter precipitation increases of around 14% (very likely to be between 3 and 31%)
 - Precipitation on the wettest day in winter up by around 14% (very unlikely to be more than 29%)
 - Relative sea level at Felixstowe very likely to be up between 10 and 41cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
 - Peak river flows in a typical catchment likely to increase between 8 and 16%

Implications for Flood Risk

- 6.4.6 Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability. Wetter winters and more of this rain falling in wet spells may increase river flooding. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.
- 6.4.7 Drainage systems in the district have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but may also need to be managed differently. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses. Even small rises in sea level could add to very high tides so as to affect places a long way inland.
- 6.4.8 Where appropriate, we need local studies to understand climate impacts in detail, including effects from other factors like land use. Sustainable development and drainage will help us adapt to climate change and manage the risk of damaging floods in future.

Adapting to Change

- 6.4.9 Past emissions mean some climate change is inevitable. It is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits.
- 6.4.10 Although the broad climate change picture is clear, we have to make local decisions against deeper uncertainty. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding.

Long Term Developments

- 6.4.11 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.
- 6.4.12 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."
- 6.4.13 Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).

7 Nationally Significant Flood Risk Areas

Identification of Flood Risk Areas

- 7.1.1 In order to ensure a consistent national approach, Defra has identified significance criteria and thresholds to be used for defining Flood Risk Areas. Guidance on applying these thresholds has been released in Defra's document "Selecting and reviewing Flood Risk Areas for local sources of flooding". In this guidance document, Defra have set out agreed key risk indicators and threshold values which must be used to determine these areas of flood risk.
- 7.1.2 The methodology is based on using national flood risk information to identify 1km squares where local flood risk exceeds a defined threshold. Where a cluster of these grid squares leads to an area where flood risk is most concentrated, and over 30,000 people are predicted to be at risk of flooding, this area has been identified by Defra as an Indicative Flood Risk Area.
- 7.1.3 The EA has applied the Defra guidance to identify indicative 'Flood Risk Areas' across England. **Of the ten areas of national significance none are located within Peterborough's administrative area. Having reviewed available local information, this PFRA report supports this assessment.**
- 7.1.4 It must be noted, however, that there are still pockets of surface water flood risk within the Peterborough administrative area. These are identified through this PFRA report, but will be considered in more detail through the development of other relevant studies such as the future Local Flood Risk Management Strategy.

8 Scrutiny and Next Steps

Scrutiny

- 8.1.1 The scrutiny and review procedures that must be adopted when producing a PFRA are set out by the European Commission. Meeting quality standards is important in order to ensure that the appropriate sources of information have been used to understand flood risk and the most significant flood risk areas are identified.
- 8.1.2 Another important aspect of the review procedure is to ensure that the guidance is applied consistently; a consistent approach will allow all partners to understand the risk and manage it appropriately. The scrutiny and review procedure will comprise two key steps, as discussed below.
- 8.1.3 The first part of the review procedure, for this and future PFRAs, is for it to be taken to the Peterborough Flood Risk Partnership, as discussed earlier. This PFRA was taken to the PFRP in May 2011. It is then taken for scrutiny by the Sustainable Growth Scrutiny Committee of the city council (June 2011) before going to Cabinet. It will then be delivered to the Environment Agency.

Environment Agency Review

- 8.1.4 Under the Flood Risk Regulations, the EA has been given a role in reviewing, collating and publishing all of the PFRAs once submitted. The EA will undertake a technical review (area review and national review) of the PFRA, which will focus on instances where Flood Risk Areas have been amended and ensure the format of these areas meets the provide standard. If satisfied, they will recommend submission to the relevant Regional Flood and Coastal Committee (RFCC) for endorsement. RFCCs will make effective use of their local expertise and ensure consistency at a regional scale. Once the RFCC has endorsed the PFRA, the relevant EA Regional Director will sign it off, before all PFRAs are collated, published and submitted to the European Commission.

Future PFRA Review

- 8.1.5 The first review cycle of the PFRA will be led by the city council and must be submitted to the EA by the 22nd June 2017. EA will then submit it to the European Commission by the 22nd December 2017 using, at the time of writing, the same review procedure described above.

Next steps

- 8.1.6 In order to continue to fulfil their role as LLFA, the city council is required to investigate future flooding incidents to the extent that it is considered necessary and appropriate and ensure continued collection, assessment and storage of flood risk data and information.
- 8.1.7 In this respect, it is crucial that all records of flood events are documented consistently. It is intended that a centralised database will be kept up to date by the city council, in its capacity as having the overall responsibility to manage local flood data. This can be used as an evidence base to inform future assessments and reviews and for input into the mapping and planning stages.
- 8.1.8 A starting point for recording incidents will be to use the thresholds for events which are classed as having a locally significant harmful consequence (as defined in this PFRA). It should be noted that these will be further consulted on and may be amended in future as part of the development of the Local Flood Risk Management Strategy.
- 8.1.9 The city council expects to begin work on the Local Flood Risk Management Strategy this year. There is no statutory deadline for the completion of the strategy. Information in the PFRA will be

used in its development and wider consultation will be undertaken to ensure the development of an effective strategy.

Staff resources

- 8.1.10 To ensure the city council meets its PFRA and other new duties as LLFA, the city council is in the process of recruiting three officers to flood and drainage related posts. These should be in place by summer 2011.

9 Annexes

Annex 1: Flood Map for Surface Water - Flood depths from rainfall with a 1 in 30 chance of occurring in any given year

Please refer to Annex 1 attached with this report.

Annex 2: Flood Map for Surface Water - Flood depths from rainfall with a 1 in 200 chance of occurring in any given year

Please refer to Annex 2 attached with this report.

Annex 3: Data List

Overleaf.

Annex 3: Data List

- Anglian Water, network plans and asset data
- Anglian Water, records of flood events
- Cambridge Fire and Rescue, flood records
- Defra, Selecting and reviewing Flood risk Areas for local sources of flooding, 2010
- Defra, Surface Water Management Plan Technical Guidance, 2009
- Environment Agency, Areas Susceptible to Groundwater Flooding mapping
- Environment Agency, Areas Susceptible to Surface Water mapping
- Environment Agency, Flood Maps for Surface Water
- Environment Agency, Flood Zone Maps
- Environment Agency, Indicative Flood Risk Areas for England, 2010
- Environment Agency, LiDAR data
- Environment Agency, Main River Network map
- Environment Agency, network plans and asset data
- Environment Agency, Peterborough Brooks Flood Investigation Preliminary Study Report, 1998
- Environment Agency, Preliminary Flood Risk Assessment (PFRA) Guidance and Annexes, 2010
- Environment Agency, River Nene Catchment Flood Management Plan, 2008
- Environment Agency, Using Surface Water Flood Risk Information, 2010
- Environment Agency, Welland Catchment Flood Management Plan, 2008
- Environment Agency, What is the Flood Map for Surface Water, 2010
- Evening Telegraph, various local newspaper articles
- Flood and Water Management Act 2010, www.legislation.gov.uk
- Flood Risk Regulations 2009, www.legislation.gov.uk
- Local rainfall hydrographs
- Middle Level Commissioners, network plans and asset data
- North Level Internal Drainage Board, Network plans and asset data
- Ordnance Survey, mapping licensed to Peterborough City Council, 2010
- Peterborough City Council, Adopted Core Strategy, 2010
- Peterborough City Council, Highways Inspector records
- Peterborough City Council, Local anecdotal evidence from Councillors and Council officers
- Peterborough City Council, Peterborough Strategic Flood Risk Assessment Update - Level 1, 2008
- Various Parish Council minutes
- Welland and Deeping Internal Drainage Board, network plans and asset data

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