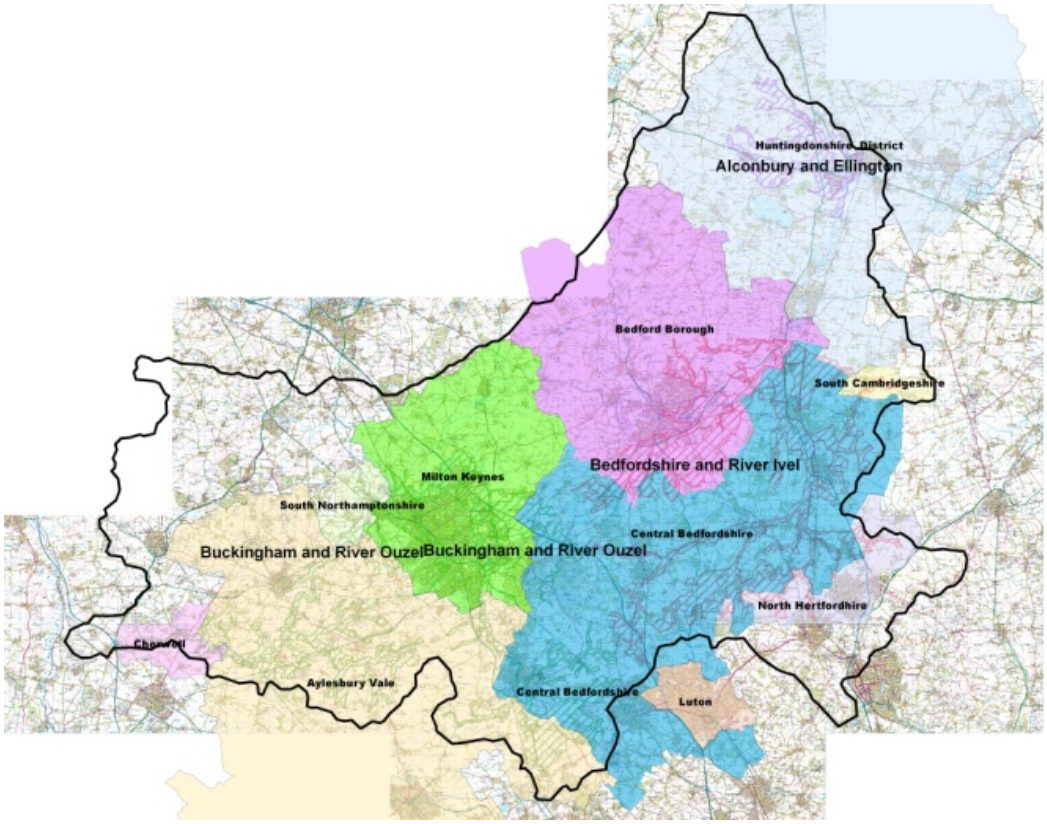
Upper River Great Ouse
Tri Lead Local Flood Authority
Preliminary Flood Risk Assessment
For Bedford Borough Council, Central Bedfordshire Council and Milton Keynes Council

June 2011

Prepared for



Prepared by

Revision Schedule

Preliminary Flood Risk Assessment

June 2011

Rev	Date	Prepared By	Reviewed by	Approved by
draft	May 2011	Trevor Skelding & John Oldfield	Nicola Wilson Martin Usher Bruce Stewart Iain Finnigan Briony Tuthill John Oldfield	BBC CBC MKC EA AWS IDB
Final draft	June 2011	IDB	Review Group of Members and Officers	Review Group

Abbreviations

Abbreviations	Definition
AStSWF	Areas Susceptible to Surface Water Flooding
AWS	Anglian Water Services Limited
BAP	Biodiversity Action Plan
BBC	Bedford Borough Council
BG_IDB	Bedford Group of Drainage Boards
BW	British Waterways
CBC	Central Bedfordshire Council
CFMP	Catchment Flood Management Plan
Defra	Department for Environment, Food and Rural Affairs
DG5	Director General 5
EA	Environment Agency
EC	European Commission
FMfSW	Flood Map for Surface Water
FWMA	Flood & Water Management Act 2010
HA	Highways Agency
IDB	Internal Drainage Board
IUD	Integrated Urban Drainage
LDF	Local Development Framework
LLFA	Lead Local Flood Authority
LoSA	Level of Service Agreement
LPA	Local Planning Authority
LRF	Local Resilience Forum
MKC	Milton Keynes Council
MoU	Memorandum of Understanding
NFCDD	National Flood and Coastal Defence Database
PPS25	Planning Policy Statement 25: Development and Flood Risk
PFRA	Preliminary Flood Risk Assessment
RBD	River Basin District
RFCC	Regional Flood and Coastal Committee
SAB	SuDS Approving Body
SAC	Special Area of Conservation
SFRA	Strategic Flood Risk Assessment
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
WAG	Welsh Assembly Government

Executive Summary

This report has been prepared to assist Bedford Borough Council (BBC), Central Bedfordshire Council (CBC) and Milton Keynes Council (MKC) meet their duties to manage local flood risk and deliver the requirements of the Flood Risk Regulations (2009). BBC, CBC and MKC are each defined as a Lead Local Flood Authority (LLFA) under the Regulations and the Flood and Water Management Act 2010. The Preliminary Flood Risk Assessment (PFRA) is the first stage of the requirements of the Regulations.

The Report has been prepared in accordance with the PFRA final guidance document (07/12/2010) produced by the Environment Agency (EA) and in partnership with BBC, CBC, and MKC, and the EA, Anglian Water Service Ltd (AWS) and the Bedford Group of Drainage Boards (BG_IDB) under a Memorandum of Understanding.

The PFRA is aimed at providing a high level overview of flood risk from local flood sources and includes flooding from surface water, groundwater, ordinary watercourses and canals. The PFRA Guidance issued by Central Government requires that LLFAs exclude flood risk from main rivers, the sea and reservoirs, which are being assessed nationally by the EA (ref. Environment Agency (2010) PFRA -Final Guidance (GEHO1210BTGH-E-E).

The EA has used a national methodology, which has been set out by Defra, to identify areas of significant risk as Indicative Flood Risk Areas across England where 30,000 people or more are at risk from flooding. Accordingly, there are no Indicative Flood Risk Areas within BBC, CBC and MKC.

In order to develop a clear overall understanding of the flood risk across BBC, CBC and MKC, flood risk data and records of historic flooding were collected from at least 20 different local and national sources including the Local Authorities, EA, Internal Drainage Boards, water companies, emergency services and other flood risk management authorities.

Information relating to 2468 records of flood events, caused by flooding from local sources, was collected and analysed. However, comprehensive details on flood source, extents and consequences of these events were largely unavailable. Based on the evidence that was collected, no past flood events were considered to have had ‘significant harmful consequences’. Therefore, the decision was made to not include any records of past flooding in Annex 1 of the Preliminary Assessment Spreadsheet.

However, it must be noted that there is a high risk of flooding from local sources across BBC, CBC and MKC, particularly from surface water. Based on national surface water modelling, approximately 6,400 properties in BBC, 10,000 properties in CBC and 6,600 properties in MKC are estimated to be at risk from flooding to a depth of 0.3m during a rainfall event with a 1 in 200 annual chance of occurring.

A joint approval panel has been established to review the PFRA comprising two Members from each LLFA who have a special interest in flood risk as they either sit on the RFCC and/or the IDB Boards. Arrangements have also been made within each LLFA to satisfy the PFRA Guidance, as necessary. LLFAs must submit their PFRA to the EA by 22nd June 2011. The EA will carry out a review process by December 2011 to ensure all PFRAs meet the European reporting requirements.

The LLFAs have a plethora of new roles, responsibilities and deliverables under the new Act and Regulations. The Local Flood Risk Management Strategy will seek to collate and consolidate information from the PFRA and the Strategic Flood Risk Assessments (SFRA) to cover flood risks from all sources of flooding and establish a methodology for managing the risks within the partnership framework.

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1 Introduction

This report, and associated spreadsheets, has been prepared by the Bedford Group of Drainage Boards (BG_IDB) to fulfil the requirements of the Flood Risk Regulations for the Preliminary Flood Risk Assessment (PFRA) on behalf of Bedford Borough Council (BBC), Central Bedfordshire Council (CBC) and Milton Keynes Council (MKC). These Councils are Unitary Authorities and comprise the principal Lead Local Flood Authorities (LLFA) in the Upper River Great Ouse catchment (ref. Figure 1-2), and are working in a local partnership to produce a joint PFRA, under a Tri LLFA Memorandum of Understanding (MoU), see Annex 5.

Under the EC Floods Directive, which has been transposed into UK law through the Flood Risk Regulations (2009), BBC, CBC and MKC must undertake a PFRA to assess past floods, to assess the possible harmful consequences of future floods, and to identify areas of significant flood risk (flood risk areas). The national guidance states that a PFRA should consider local sources of flooding and include: surface water; ground water; ordinary watercourse; and, canal flooding. The PFRA should specifically exclude: flooding from main river, reservoirs, and the sea, as these are being assessed by the Environment Agency (EA). However, as drainage systems are inextricably linked it is difficult to compartmentalise flooding.

1.1 Overview of Flood Risk Regulations

The Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities consistent with the Flood and Water Management Act 2010 and provide for the delivery of the outputs required by the directive. The regulations:

- Give responsibility to the EA to prepare Directive deliverables: preliminary assessment report, flood risk maps and hazard maps and flood risk management plans for flood risk from the sea, main rivers and reservoirs.

- Give responsibility to LLFA to do the same for “local flood risk”, which includes surface runoff, groundwater, canals and ordinary watercourses.

- Give responsibility to the EA for collating and publishing the preliminary assessment reports, flood risk maps and hazard maps and flood risk management plans.

The stages of the Flood Risk Regulations are illustrated in Figure 1-1

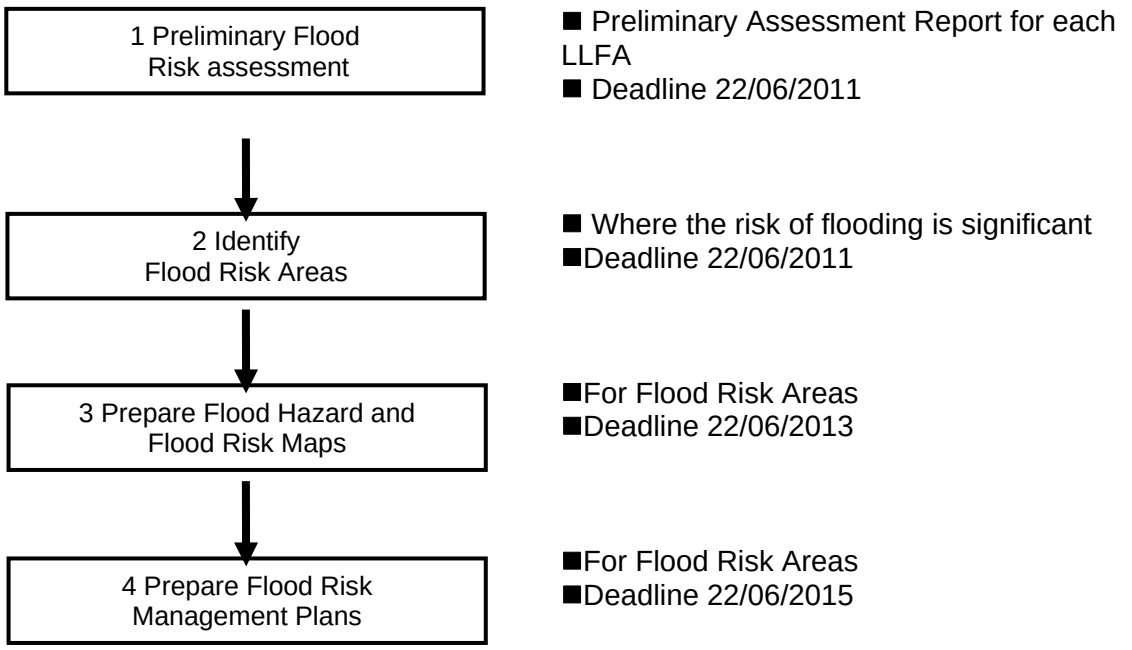

Figure 1-1 Flood Risk Regulations process

1.2 Aims and Objectives of the PFRA

The PFRA is a high level screening exercise to identify areas of most significant flood risk across Europe. The aim of this PFRA is to assess local flood risk in the Tri LLFA area of Bedfordshire and Milton Keynes with respect to past floods and the potential harmful consequences of future floods.

EA guidance states that the PFRA should be based on available and readily derivable information to assess 'local' flood risk. The PFRA has therefore been completed using the following process to assess flooding from local sources only:-

- **Assessment of past floods** – the PFRA should assess past floods which have had harmful consequences for human health, economic activity or the environment, or could have harmful consequences if they were to occur now.
- **Assessment of future floods** – the PFRA should assess the possible harmful consequences of future floods, and must take into account topography, watercourses, floodplains, defences, populated areas, economic centres and the impacts of climate change.
- **Identification of "flood risk areas"** – the PFRA should identify "flood risk areas", which are locations considered to be most significantly at risk of flooding nationally – the EA has defined criteria for identifying "flood risk areas" and has provided "indicative flood risk areas" on a national basis which should be used by LLFA's undertaking their PFRA's.
- **Preliminary assessment report** – all of the information above should be captured in the preliminary assessment report, which is sent to the EA for review and publication.

1.3 Study Area

The study area for this PFRA is defined by the administrative boundary of BBC, CBC and MKC. The political boundaries of the study area and location of Main Rivers and Ordinary Watercourses are shown in Figure 1-2 and Figure 1-3.

The administrative area of Bedford Borough covers approximately 476 km2

The administrative area of Central Bedfordshire covers approximately 716 km2

The administrative area of Milton Keynes covers approximately 309 km2

The study area falls across the Anglian River Basin District. The study area is currently served by two EA regions, Anglian and Thames regions. The Anglian Region is split into three Committee areas (East, Central and North) with separate Regional Flood and Coastal Committees (RFCC). BBC, CBC and MKC each has 1 member on the Anglian (Central) Regional Committee. There is no membership on the Thames Regional or Anglian (northern) Regional Committees. All County Councils and Unitary Authorities pay a Precept to RFCCs.

The study area is covered by the BG_IDB, in part. The Bedfordshire and River Ivel IDB, Buckingham and River Ouzel IDB, and Alconbury and Ellington IDB form the BG_IDB. BBC has 7 Members on the B&I IDB. CBC has 5 Members on the B&I IDB and 6 Members on the B&O IDB. MKC has 6 Members on the B&O IDB. All Unitary Authorities and District/Borough Councils pay a Special Levy to IDB for the built areas in a drainage district.

The study area is served by Anglian Water, Thames Water and Veolia Water. Anglian Water is the principal water company covering the study area.

BBC is bordered by Northamptonshire, Cambridgeshire, Central Bedfordshire and Milton Keynes.

CBC is bordered by Bedford Borough, Cambridgeshire, Hertfordshire, Luton, Buckinghamshire and Milton Keynes.

MKC is bordered by Northamptonshire, Bedford Borough, Central Bedfordshire and Buckinghamshire.

Figure 1-2 Administration Boundaries

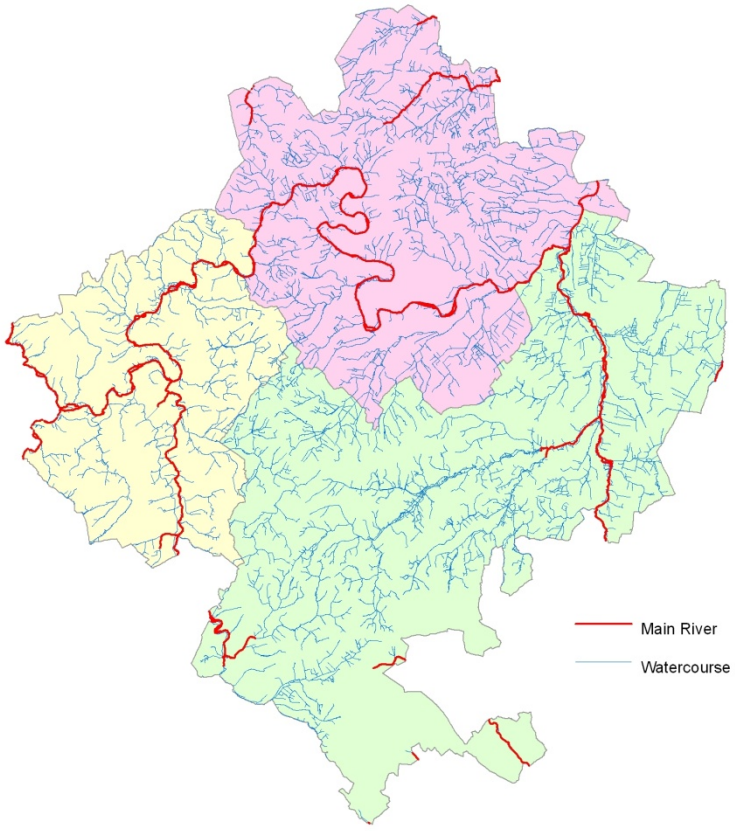

Figure 1-3 Location of Main Rivers / Ordinary Watercourses

2 Lead Local Flood Authority Responsibilities

2.1 Governance and Partnership working

A partnership approach is the most efficient approach to co-ordinate local flood risk management activities addressing local issues with a hydraulic catchment overview. Strong local partnerships enable effective, efficient and integrated flood risk management activities, and also allows for co-ordinated investment savings. Local flood risks can be complex in nature i.e. multiple sources and pathways managed by multiple organisations. Therefore working in partnership is essential to achieving optimum understanding of the risks, as well as integrated and efficient mitigation measures where multiple organisations are involved. By working collaboratively an optimum understanding of local flood risks should be achieved and the most suitable risk management measures will be identified and assessed.

A Memorandum of Understanding was established to record the working partnerships between BBC, CBC and MKC and the EA, Anglian Water Services Ltd (AWS) and the BG_IDB under the new Flood and Water Management Act 2010 and the Flood Risk Regulations 2009 for the production of the PFRA.

Under the new legislation, the EA is responsible for producing an overarching national flood risk management strategy and for managing the Main River network. BBC, CBC and MKC are the LLFA and are responsible for coordinating local flood risk management, such as Preliminary Flood Risk Assessments, local strategies, and for keeping records of flood incidents. The IDB is responsible for the Strategic Ordinary Watercourses system in its drainage district and is focused on local flood Risk Management and local delivery. AWS is the statutory undertaker for water and wastewater provision.

The Flood and Water Management Act 2010, paragraph 13 (4) enables one Flood Risk Management Statutory Authority to arrange for a flood risk management function to be exercised on its behalf by another Flood Risk Management Statutory Authority, who are listed under paragraph 6 (13). Under this mechanism, the BG_IDB has produced a single cross political boundary PFRA for the geographical area administered by the three principal LLFAs in the Upper Great Ouse catchment, as supported by the EA. Each constituent LLFA will, in accordance with its own policy take the assessment through the relevant internal scrutiny process. To achieve consistency a single joint scrutiny and approval group will be established comprising an IDB subcommittee of six LLFA nominated Members representing the three LLFAs, i.e. two members from each authority representing all main parties.

All partners have worked in the spirit of the Act, which is to achieve the aspiration of establishing the need for greater coordination and cooperation between partners within flood risk management. All PFRA data will be shared with all parties, subject to any restrictions agreed with the initial data provider.

2.2 Communication with Partners and the Public

As part of the PFRA, the Tri LLFA partnership referred to in section 2.1 has also sought flood risk data from the Highways Agency (HA) and British Waterways (BW). Data from partners who operate under the Civil Contingencies Act 2004 has also been collected from the Local Authorities Local Resilience Forum representatives, such as information shared by Bedfordshire and Luton Fire and Rescue Service at the Bedfordshire and Luton Local Resilience Forum.

It is recognised that members of the public may also have valuable information to contribute to the PFRA and to local flood risk management across the individual districts. Stakeholder engagement can afford significant benefits to local flood risk management including building trust, gaining access to additional local knowledge and increasing the chances of stakeholder acceptance of options and decisions proposed in future flood risk management plans.

Past public engagement has taken place at flooding hotspots such as Newport Pagnell, Sandy and Great Barford. This has generally followed flooding incidents and has often involved the partner organisations with the aim to provide a coordinated and collated response to flooding, which generally includes flooding from a multitude of sources. However, it is important to undertake further public engagement when formulating local flood risk management plans as this will help to inform future levels of public involvement. It is recommended that BBC, CBC and MKC follow the guidelines outlined in the EA's 'Building Trust with Communities' document which provides a useful process of how to communicate risk including the causes, probability and consequences to the general public and professional forums such as local resilience forums.

2.3 Further and Future Responsibilities

Aside from forging partnerships and coordinating and leading on local flood risk management, there are a number of other key responsibilities that have arisen for LLFAs from the Flood & Water Management Act 2010 and the Flood Risk Regulations 2009. These responsibilities include:

- Investigating flood incidents – LLFAs have a duty to investigate and record details of significant flood events within their area. This duty includes identifying which authorities have flood risk management functions and what they have done or intend to do with respect to the incident, notifying risk management authorities where necessary and publishing the results of any investigations carried out.

- Asset Register – LLFAs also have a duty to maintain a register of structures or features which are considered to have an effect on flood risk, including details on ownership and condition 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 – LLFAs are designated the SuDS Approving Body (SAB) for any new drainage system, and therefore must approve, adopt and maintain any new sustainable drainage systems (SuDS) within their area.

- Local Strategy for Flood Risk Management – LLFAs are required to develop, maintain, apply and monitor a local strategy for flood risk management in its area. The local strategy will build upon information such as national risk assessments, PFRAs and SFRAs, 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.

- Consenting – LLFAs will take over responsibilities for consenting on Ordinary Watercourses outside Internal Drainage Districts, a role which currently is undertaken by the EA. IDBs will continue to be responsible for consents on Ordinary Watercourses in drainage districts.

- Designation powers – LLFAs, as well as District Councils, IDBs and the EA have powers to designate structures and features that affect flooding or coastal erosion in order to safeguard assets that are relied upon for flood or coastal erosion risk management.

Lead Local Flood Authorities should seek to maximise the technical expertise within their local partnership. The EA, IDB and AWS have extensive experience of: consenting; investigating flooding incidents; advising on, approving and adopting SuDS, development and flood risk; managing assets; and administration of asset registers and GIS. Following delivery of the PFRA, the Tri LLFA partnership will review the success of the current arrangement and develop a governance strategy for the future roles under the Flood and Water Management Act 2010 to align with forthcoming commencement orders and regulations.

Whilst the Act clearly encourages partnership working under Paragraph 13(4) to utilise existing local organisational structures, the supporting guidance acknowledges that local scrutiny by individual LLFAs is likely to be required. Locally, a clearly defined agreement or MoU can be used to establish the roles and activities that one flood risk authority is carrying out for another flood risk authority, so that there will be no doubt as to which party is carrying out what activity, thus reducing the need for excessive duplication, whilst ensuring control is retained at key stages by those legally responsible for delivery. This has the potential to deliver significant savings to each LLFA through partnership working while retaining local control.

3 Methodology and Data Review

3.1 Introduction

The PFRA is a high-level screening exercise used to identify areas where the risk of 'local' flooding is considered to be significant and warrants further examination and management through the production of flood risk and flood hazard maps and flood risk management plans.

The approach for producing this document 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 it.

3.2 Methodology

Data Collection from Partner Organisations

The following authorities and organisations were identified and contacted to share data for the preparation of the PFRA: BBC, CBC, MKC, EA, BG_IDB, AWS, BW and HA. Data was also sought from the emergency services through the existing data sharing arrangements under the Civil Contingencies Act 2004.

Assessing Historic Flood Risk

Existing datasets, reports and anecdotal information from the stakeholders listed above were considered to identify details of major past surface water flood events and associated consequences including economic damage, environmental and cultural consequences and impact on the local population.

Assessing Future Flood Risk

The identification of local Flood Risk Areas through the PFRA should also 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 EA'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 (1 in 30 annual chance and 1 in 200 annual chance).

The following factors were considered when assessing future flood risk across the study area; topography, location of ordinary watercourses, location of flood plains that retain water, characteristics of watercourses (lengths, modifications), effectiveness of any works constructed for the purpose of flood risk management, location of populated areas, areas in which economic activity is concentrated, the current and predicted impact of climate change and the predicted impact of any long-term developments that might affect the occurrence or significance of flooding, such as proposals for future development.

Identifying Flood Risk Areas

Information regarding historic and future flood risk will be used to formally identify local Flood Risk Areas. To achieve this, flood risk indicators will be 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. Key flood risk indicators are summarised in Table 3-1.

Table 3-1: Key Flood Risk Indicators

Impacts of flooding on:	Flood Risk Indicators
Human Health	Number of residential properties. Critical services (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 (World Heritage Sites).
Environment	Designated sites (SSSIs, SACs, SPAs, etc) and BAP habitat.

The above indicators have been selected and analysed by Defra and the EA 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 Data Sources

Table 3-2 catalogues the relevant information and datasets held by partner organisations and provides a description of each of the datasets.

Table 3-2: Relevant Information and Datasets

	Dataset	Description
EA	Indicative Flood Map (Rivers and the Sea)	"Blue" indicative flood maps show the extent of flooding from all watercourses (Main rivers and Ordinary Watercourse) with a catchment of more than 3km2 and from the sea.
	Areas Susceptible to Surface Water Flooding	The first generation national mapping, outlining areas of risk from surface water flooding across the country with three susceptibility bandings (less, intermediate and more).
	Flood Map for Surface Water	The updated (second generation) national surface water "purple" flood mapping which was released at the end of 2010. This dataset includes two flood events (with a 1 in 30 and a 1 in 200 chance of occurring) and two depth bandings (greater than 0.1m and greater than 0.3m).
	Areas Susceptible to Groundwater Flooding	Coarse scale national mapping showing areas which are susceptible to groundwater flooding.
	National Receptors Dataset	A national dataset of social, economic, environmental and cultural receptors including residential properties, schools, hospitals, transport infrastructure and electricity substations.
	Indicative Flood Risk Areas	Areas Nationally identified as flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG.
	Historic Flood Map	Map attributed spatial flood extent data from all

		sources of flooding.
	Great Ouse, Nene and Thames Catchment Flood Management Plans (CFMP)	CFMPs consider all types of inland flooding, from rivers, groundwater, surface water and tidal flooding and are used to plan and agree the most effective way to manage flood risk in the future.
Unitary Councils (BBC, CBC & MKC)	Strategic Flood Risk Assessments (SFRA)	SFRAs contain useful information on historic flooding, including local sources of flooding from surface water, groundwater and flooding from canals, as well as flooding from main river. Also includes extensive consultation with flood risk partners and records data such as IDB flood records and DG5 records.
	Water Cycle Strategy	Focuses on water and waste water requirements for growth areas, but also includes useful data on flood risk.
	Historical flooding records	Historical records of flooding from surface water, groundwater and ordinary watercourses.
	Anecdotal information relating to local flood history and flood risk areas	Anecdotal information from authority members and officers regarding areas known to be susceptible to flooding from excessive surface water, groundwater or flooding from ordinary watercourses.
	Highways Flooding Reports	Highways Flooding Reports from officers, some with commentary of the flooding problem.
IDB	Ordinary watercourse flooding records	Local Officer and Member knowledge is recorded on GIS, as well as flood incident log data. Useful data for maintenance programming, development control, and general management.
Parish Councils	Parish Councils Anecdotal information from Parish Councils	Anecdotal information on flood risk, flood history and local flood hotspots. Data is often captured by principal Local Authorities, EA, IDB as Parish Councils work closely with other partners.
AWS	DG5 Register	DG5 Register logs and records of sewer flooding incidents in AWS's area.
BW	British Waterway's canal network	Detailed GIS information on the British Waterway's canal network, including the location of canal centrelines, sluices, locks, culverts, etc.
	Records of canal breaches and overtopping events	Records of historical canal breaches and canal overtopping events from Grand Union Canal in CBC and MKC.
HA	Records of trunk road flooding.	Records of flooding problems on the Trunk Road network operated by the Highways Agency and analysis into improvement and mitigation proposals
Resilience Forums/Emergency planning	Flooding occurrences and emergency responses	Data from actual flooding incidents where local residents have sought the help from the emergency services or local authorities. Data shared via LA emergency planners and/or local resilience forums.

3.4 Data Limitations

A brief assessment of the data collection process for the PFRA is included in this chapter to provide transparency with respect to the methodology. The three LLFAs have collected, collated and analysed a considerable amount of data previously during the preparations of their respective SFRAs. By flagging up the issues the partners discussed whilst consolidating all the data, it is hoped that this will serve as a catalyst to improve the collection of flood risk data in the future. A number of issues were identified during the data collection process, as described below:

Inconsistent Recording Systems

The three unitary authorities of BBC, CBC and MKC have different methods and systems for capturing data, which can even be inconsistent between different departments within an organisation. This leads to major inconsistencies in the recording of flood event data. This has resulted in incomplete or unmanageable flood record datasets. Further information on addressing this issue in the future is included in Chapter 7.

Incomplete Datasets

Some of the datasets collated are not exhaustive and it is felt that they are unlikely to accurately represent the complete local flood risk issues in a particular area. The corresponding gaps in flood data will also hinder the identification of accurate flood risk areas.

Records of Consequences of Flooding

Often it is not possible to clearly identify and compartmentalise flooding, particularly from engineered systems that are typically interconnected, which results in flooding from a combination of sources. As a consequence data records were not able to provide comprehensive details of specific past flood events, which made it difficult to accurately assess the consequences of historic local flooding.

3.5 Quality Assurance, Scrutiny and Data

Data has been provided by a range of organisations that all operate their own quality assurance systems. The Data has been provided for the preparation of the PFRA only. The Tri LLFA Partnership was developed from historic relationships and formalised under the MoU. The Local Strategy will develop from this framework and will require further agreement.

The PFRA Guidance directs LLFAs to review the PFRA by an Overview and Scrutiny committee. This is incompatible with the philosophy of the Flood and Water Management Act, which promotes local flood risk being managed locally by the partners so as to best utilise local skills and expertise. A joint approval panel has been established to review the PFRA comprising two Members from each LLFA who have a special interest in flood risk as they either sit on the RFCC and/or the IDB Boards. Arrangements have also been made within each LLFA to satisfy the PFRA Guidance with an appropriate level of review and scrutiny.

4 Assessment of Past Floods

4.1 Overview of Historic Flooding

Flood event records were collected across the three districts of BBC, CBC and MKC from the data sources as discussed in Table 3-2. Records of 2468 historical flood events and flooding hotspots were collected and collated across the study area. The records comprise 646 from BBC, 572 from CBC and 850 from MKC. Additional records of 400 were recorded from the EA, IDB, AWS and other consultees, although there may be duplication in datasets from a multitude of partners responding to flood incidents.

These flood event records came from a range of sources, and in many cases the source of flooding was unknown or not recorded, possibly due to the nature of the interaction and inter-dependencies of our local system of main rivers, ordinary watercourses, public and private sewers, and highway drainage. In addition there are the complexities of flooding caused by asset failures, exceedance, obstruction from blockages and capacity issues, which may have subsequently been alleviated with maintenance, emergency measures or capital works. A summary of information specific to each source of flooding considered as part of the PFRA is included below.

Strategic Flood Risk Assessment Data

The Bedford Borough SFRA Level 2 prepared by Atkins, contains extensive information regarding historic flooding, including the 1947, 1980, 1983, 1987, 1992, 1998 and 2003 events. It reports that there are 5,280 properties at risk of surface water flooding and that there were 36 locations of reported sewer flooding.

The Central Bedfordshire Council has two SFRAs from its pre unitary authority Districts: the Mid Bedfordshire District Council's SFRA Level 1 prepared by WSP Consultants and the Luton and South Bedfordshire District Council SFRA was prepared by Halcrow. These contain extensive information regarding historic flooding information from 1875, 1907, 1947, 1996, 1998, 2002, 2003, 2005 and 2006. The document reports on a range of flood incidents from blocked culverts to main river flooding and includes 5 locations of sewer flooding reports.

The Milton Keynes Council SFRA Level 1 prepared by Halcrow, contains extensive information regarding historic flooding, including the 1947, 1968, 1973, 1980, 1984, 1992, 1998, 2002, 2004 and 2007 events. The report reviews a number of locations which are susceptible to historic flooding and records that there were 9 locations of reported sewer flooding.

Surface Water Flooding

Surface water flooding occurs when heavy rainfall exceeds the capacity of local drainage networks and water flows across the ground. Information on surface water flooding incidents was obtained from a number of sources, as discussed in Table 3-2. Key sources of surface water records came from the Partners in the three districts of BBC, CBC and MKC.

Groundwater Flooding

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.

Strategic Flood Risk Assessments have been completed by the three districts of BBC, CBC and MKC. No incidents of groundwater flooding were recorded. Therefore for the purposes of this PFRA document, there is no historic groundwater flooding records with significant consequences.

Sewer Flooding

Sewer flooding is often caused by excess surface water entering the drainage network causing sewers to surcharge. Anglian Water maintains a DG5 register of properties which experience flooding (both internal and external) from rainfall events of less than a 1 in 30 chance of occurring due to hydraulic incapacity. Anglian Water records had 54 properties in BBC, 86 properties in CBC, and 6 properties in MKC on the DG5 registers. The location of these properties has not been provided so no comment can be made about their spatial extent and distribution. Once a property is identified on the DG5 register, water companies can typically put funding in place to address the issues and hence enable the property to be removed from the register.

Ordinary Watercourse Flooding

The main strategic network of Ordinary Watercourses is overseen by the BG_IDB within the IDB drainage district and by BBC, CBC and MKC elsewhere in the study area. Some Ordinary Watercourses are also defined as Award Drains. The IDB has 170 records of flooding incidents, although regular flooding onto the flood plain is generally not recorded.

Canal Flooding

Information was obtained from BW which details the canal network throughout CBC and MKC, including the location of canals, weirs, sluices and locks. BW also provided details of a historic breach in Milton Keynes and 5 overtopping events in Leighton Buzzard.

Trunk Road Flooding

Information was obtained from HA who are responsible for the main trunk road network. Their Highway Agency Drainage Data Management System has 78 flood events recorded as moderately high and moderate within their Area 8 operational unit. The data is very operationally specific and not considered to be of significant consequence for the PFRA.

Interaction with Main Rivers

Evidence suggests that all flooding is exacerbated in areas adjacent to Main River, as elevated water levels in the Main River also elevate levels in the adjoining systems which can't discharge. It is therefore difficult to compartmentalise flooding when a local community floods from a combined event.

4.2 Analysis of Historic Flooding

There are significant variations in recorded historical flood events within each District. However, it must be noted that these variations are due to differences between the authorities recording and storing of data and the geographical size of the three districts and should not be taken as a true representation of the range in frequency or severity of flood risk across the administrative area.

4.3 Consequences of Historic Flooding

As a result of the issues discussed in Chapter 3.4, insufficient data is available to draw definitive conclusions on the impacts and consequences of historic flood events on people, the economy and the environment, as this information has not been recorded in the past to collect the current level of detail required.

Due to the variability of the information available, no historic 'local' flood events have been considered to have had 'significant harmful consequences' and therefore none will be recorded in Annex 1 of the Preliminary Assessment Spreadsheet.

4.4 Future Data

A complete record of locations where flooding has occurred will be kept by the three Authorities of BBC, CBC and MKC as a future evidence base. The data will be further analysed along with the conclusions of the SFRAs and will be used to form a robust basis for the Local Flood Risk Strategy. A methodology for capturing future data will be established to ensure full details of future flood events are recorded; this will then be used to support and inform future PFRA cycles as well as BBC, CBC and MKC's Local Flood Risk Management Strategy's. The local strategy will form the basis for identifying locally important flood risk areas and local action plans.

5 Assessment of Future Floods

5.1 Overview of Future Flood Risk

Local data sets

Local partnerships are long established in the study area, with the partners working together to deliver flood risk management at officer and member level, with local authority member representation on the RFCC and IDB Boards.

A Surface Water Management Plan exists for Marston Vale which covers an area within both BBC and CBC. The Marston Vale Surface Waters Plan was published in 2002.

A Drainage Supplementary Planning Document was prepared for MKC and published in 2004.

Strategic Flood Risk Assessments and Water Cycle Strategies have been prepared by all three LLFAs.

No further local information is currently available on surface water flood risk in Bedfordshire and Milton Keynes.

National data sets

The EA 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 (AStSWF), contains three susceptibility bandings for a rainfall event with a 1 in 200 chance of occurring. The national methodology has since been updated to produce the Flood Map for Surface Water (FMfSW), a revised model containing two flood events (1 in 30 annual chance and 1 in 200 annual chance) and two depth bandings (greater than 0.1m and greater than 0.3m). The Flood Map for Surface Water is illustrated in Figures 5-1, 5-3 and 5-5, highlighting areas at risk of surface water flooding in the future.

Using this dataset, the number of properties at risk of surface water flooding within BBC, CBC and MKC has been estimated. For a rainfall event with a 1 in 200 annual chance of occurring, 23,500 properties are at risk from flooding to a depth of 0.1m within BBC, 32,500 within CBC and 23,500 within MKC and 6,400 properties are at risk from flooding to a depth of 0.3m within BBC, 10,000 within CBC and 6,600 within MKC. Of these properties at risk, over three quarters are residential properties. Further details on the potential harmful consequences of future flooding are included in Annex 2 of the Preliminary Assessment Spreadsheet.

Table 5-1 includes a comparison of the estimated number of properties at risk of surface water flooding across BBC, CBC and MKC.

Table 5-1: Properties at risk from surface water flooding

		Bedford Borough	Central Bedfordshire	Milton Keynes
Flood Map for Surface Water (FMfSW) - 1 in 200 rainfall - Flooding greater than **0.1m** depth	**all** properties	23,500	32,500	23,500
	residential	18,300	25,200	18,800
	non-residential	5,200	7,300	4,700
Flood Map for Surface Water (FMfSW) - 1 in 200 rainfall - Flooding greater than **0.3m** depth	**all** properties	6,400	10,000	6,600
	residential	4,700	7,400	5,200
	non-residential	1,700	2,600	1,400
Areas Susceptible to Surface Water Flooding (AStSWF) - **Less**	**all** properties	22,100	25,500	21,200
	residential	17,400	19,700	16,400
	non-residential	4,700	5,800	4,800
Areas Susceptible to Surface Water Flooding (AStSWF) - **Intermediate**	**all** properties	8,400	10,900	6,700
	residential	6,400	8,400	5,100
	non-residential	2,000	2,500	1,600

This table shows that the three LLFA areas in combination representing the majority of the Upper Great Ouse catchment have a total of 79,500, which is the highest amount of properties at risk from surface water flooding in the East of England.

The EA's national dataset, Areas Susceptible to Groundwater Flooding, has been used to form the basis of the assessment of future flood risk from groundwater. This dataset is illustrated in Figures 5-2, 5-4 and 5-6 and areas at high risk from groundwater flooding are identified.

There is no available information on future flood risk from canals. However, BW is currently working on a study to better understand the future flood risk from canals, which will be available to inform the second cycle of the PFRA process.

The fluvial flood map has been used to assess the risk of flooding from ordinary watercourses. The Detailed River Network was used to identify ordinary watercourses and this was cross referenced with the Flood Map for Rivers and the Sea to assess future flood risk from this source. Based on this methodology, no areas were identified that seemed to be at significant risk from ordinary watercourses.

5.2 Locally Agreed Surface Water Information

A definition of 'locally agreed surface water information' has been considered in conjunction with the EA, IDB and water companies in order to agree what surface water information best represents local conditions across Bedfordshire and Milton Keynes.

As there is no local quality controlled information on future flooding available, the 'locally agreed surface water information' is the Flood Map for Surface Water dataset, which gives an overview of the future flood risk from surface water across Bedfordshire and Milton Keynes and is considered to be the most appropriate source of information. These datasets

provide nationally consistent and recognisable maps which align with the EA's Flood Maps for flooding from rivers, and are illustrated in Figures 5-1, 5-3 and 5-5. The Local Strategy will further analyse and assess the locally available information contained within the SFRAs to meet locally important criteria.

5.3 Potential Consequences of Future Flooding

The Environment Agency has used the Flood Map for Surface Water mapping and the National Receptors Database to identify a number of areas across the country that exceed a given threshold, as described in Table 5-2 below.

Table 5-2: Flood risk threshold 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 (or 0.5%)*
20 businesses or	
1 critical service	

This assessment was carried out based on 1km^2 national grid squares by the EA, and the grid squares that exceed this criterion were identified. The grid squares within BBC, CBC and MKC where flood risk is considered to exceed this threshold were used to produce Annex 2. The maps are not shown in the PFRA as the study area has no significant flood risk areas identified.

5.4 Effect of Climate Change and Long Term Developments

The Evidence

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

Key Projections for Anglian River Basin District

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

Implications for Flood Risk

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

Adapting to Change

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

Long Term Developments

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk. In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall." In Wales, Technical Advice Note 15 (TAN15) on development and flood risk sets out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is "to direct new development away from those areas which are at high risk of flooding." 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).

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6 Flood Risk Areas

6.1 Overview

In order to ensure a consistent national approach, Defra and WAG have 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 Flood Risk Areas.

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 as an Indicative Flood Risk Area, an area of significant flood risk. There are no nationally significant flood risk areas within the study area, as shown in Figure 6-1.

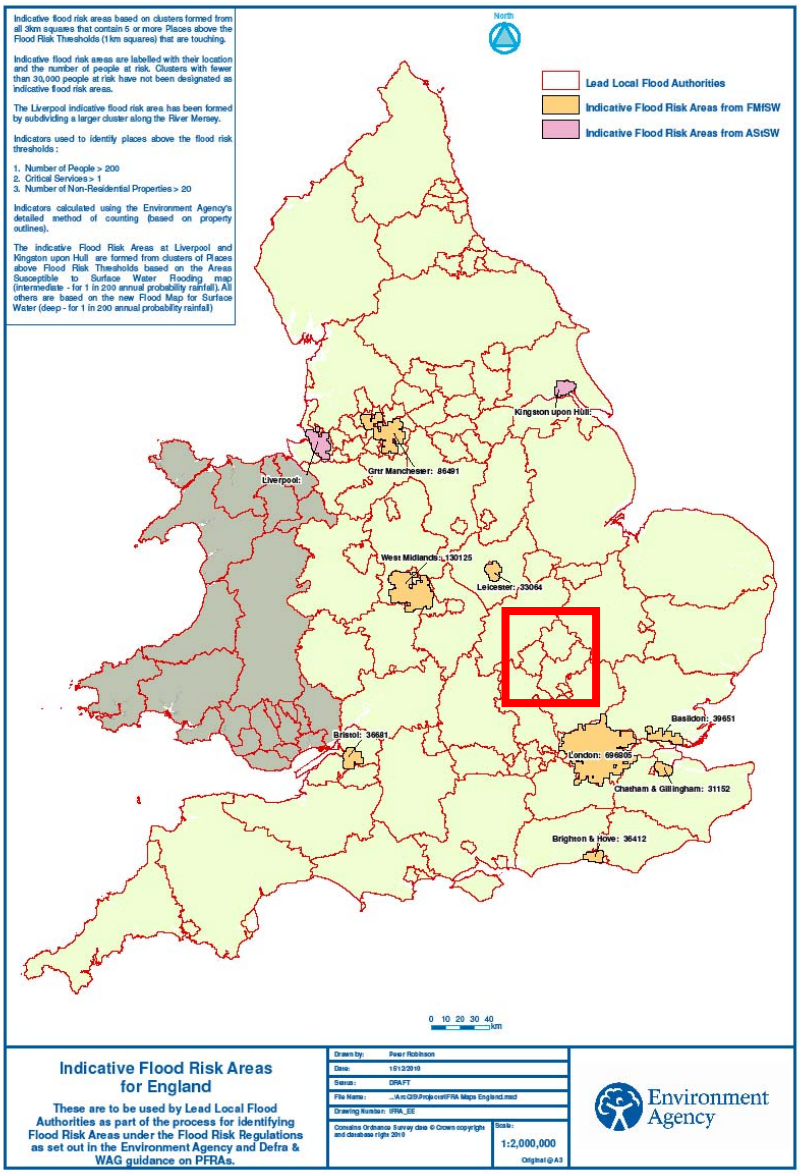

Figure 6-1 Indicative Flood Risk Areas in Bedfordshire and Milton Keynes

7 Next steps

7.1 Future Management Arrangements

In accordance with the Flood Risk Regulations the PFRA is to be reviewed on a 6 yearly cycle, as directed. To fulfil their new responsibilities of data management and investigating flooding under the Flood and Water Management Act and Flood Risk Regulations, BBC, CBC and MKC will be:

- Developing a GIS mapping tool to capture, view and edit relevant information on flood risk management, including flood incident and asset data, as illustrated below in Figure 7-1 and 7-2. A GIS system should be compatible with national asset management systems, such as NFCDD. All local flood risk management partners will be able to access the tool to view, edit and add flood incident and asset data relevant to local flood risk management.

- Continue to build close working partnerships with local flood risk management partners to better understand and alleviate flood risk in BBC, CBC and MKC.

- Explore the development of a cross boundary framework to deliver future flood risk management activities jointly to maximise local expertise and to minimise costs by utilising pooled resources and skills.

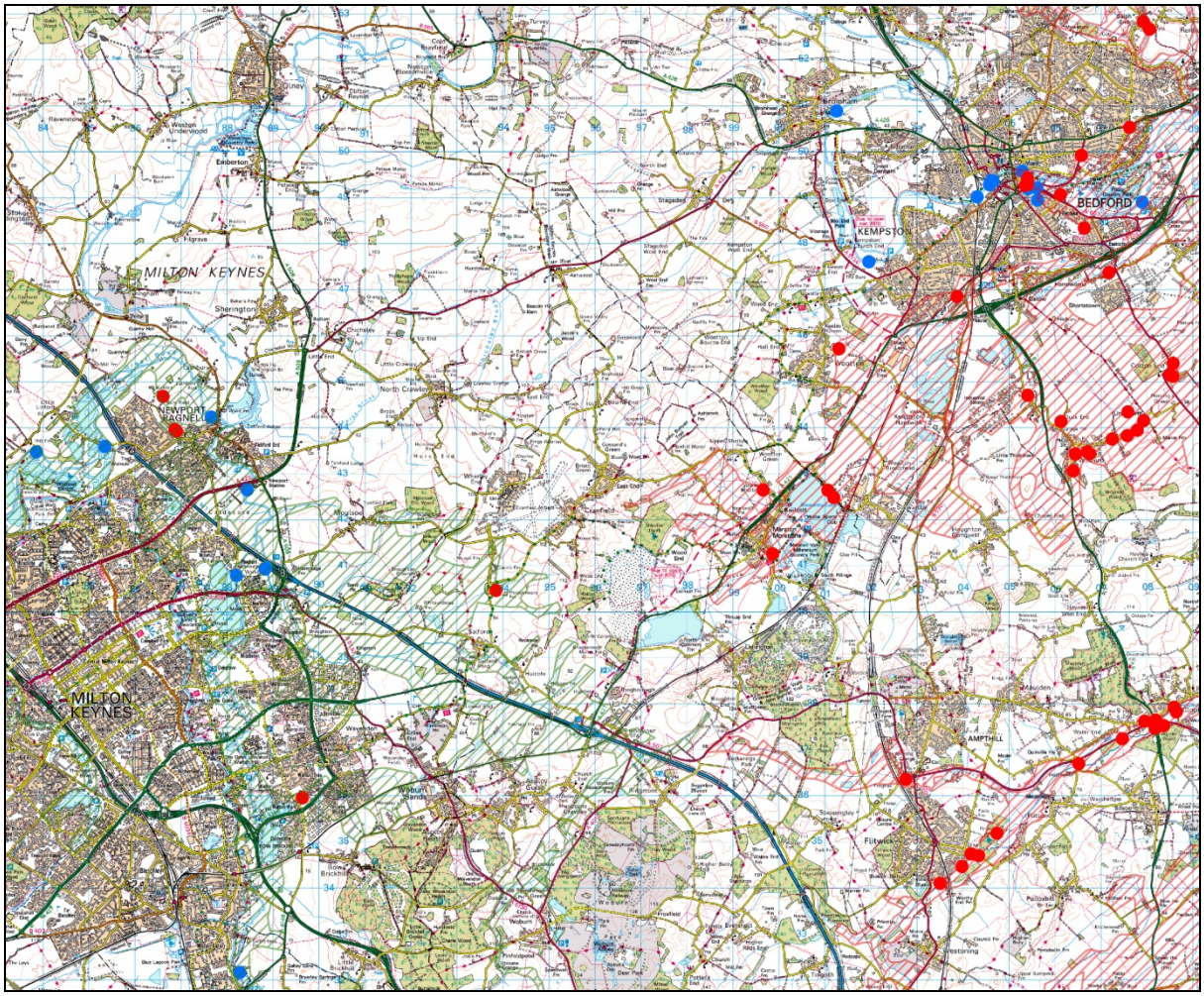

Figure 7-1 Example of GIS Asset Management System Recording Local Flood Incidents

			Flood Event						Flood Data				
Easting	Northing	LLFA	Ref. Name	Ref. No.	date	Address	Post code	Comments	Flood Duration	Flood Depth	Flood Level AoD	Flood return period	flooding source

Rainall data				Damage Assessment					Action Plan		
Rainfall depth	rainfall duration	rainfall return period	confidence of source	residential properties flooded	commercial properties flooded	critical infrastruture	damage caused	photos	Actions recommend	Actions taken	Issue resolved

Figure 7-2 Example of Flood event log with geospatial references for GIS.

7.2 Scrutiny and Review Procedures

The scrutiny and review procedures when producing a PFRA are set out in the PFRA Guidance document published by the EA. 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.

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.

Local Authority Review

The first part of the review procedure is through a Local Authority review of the PFRA, in accordance with appropriate locally agreed review procedures, so as to best utilise local skills and expertise. Local approval should be obtained to ensure the PFRA meets the required quality standards, before it is submitted to the EA.

A single joint approval panel has been established to review the PFRA comprising two Members from each LLFA who have a special interest in flood risk as they either sit on the RFCC and/or the IDB Board. Arrangements have also been made internally within each LLFA to satisfy the PFRA Guidance with an appropriate level of review and scrutiny.

Environment Agency Review

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 RFCC for endorsement. RFCCs will make effective use of their local expertise and ensure consistency at a regional scale. Once endorsed, the relevant EA Regional Director will sign it off, before all PFRAs are collated, published and submitted to the European Commission.

8 References

British Waterways (2011) email correspondence regarding canal network and overtopping events

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Brown, S. Beswick, M. et al. (2008) Met Office Submission to the Pitt Review -Executive Summary, The extreme rainfall of Summer 2007 and future extreme rainfall in a changing climate

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Bedford Borough Council Level 1 Strategic Flood Risk Assessment

Bedford Borough Council Level 2 Strategic Flood Risk Assessment

Mid Bedfordshire District Council Strategic Flood Risk Assessment

South Bedfordshire and Luton Strategic Flood Risk Assessment

Milton Keynes Council Level 2 Strategic Flood Risk Assessment

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

Annex 1: Records of past floods (Preliminary Assessment Spreadsheet)

Please refer to Annex 1 of the Preliminary Assessment Spreadsheet attached with this report. However, as discussed in Chapter 4.3, due to the lack of data that was available regarding the consequences of past flooding, no flood events have been considered to have 'significant harmful consequences', so none have been recorded in this section.

Annex 2: Records of future floods (Preliminary Assessment Spreadsheet)

Please refer to Annex 2 of the Preliminary Assessment Spreadsheet attached with this report. This spreadsheet includes a complete record of future flood risk within BBC, CBC and MKC, including details of the potential consequences of flooding to key risk receptors within the county.

Annex 3: Records of Flood Risk Area (Preliminary Assessment Spreadsheet)

Please refer to Annex 3 of the Preliminary Assessment Spreadsheet attached with this report

Annex 4: Review Checklist

Please refer to Annex 4 attached to this report, which contains the Review Checklist that has been provided by the Environment Agency to act as a checklist for reviewing PFRA submissions.

Annex 5: Memorandum of Understanding

Please refer to Annex 5 attached to this report, which contains the joint Memorandum of Understanding between the key partners.