Leeds CITY COUNCIL

A Preliminary Flood Risk Assessment for Leeds

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A PRELIMINARY FLOOD RISK ASSESSMENT FOR LEEDS

CONTENTS

1 EXECUTIVE SUMMARY

This assessment is a high level view of the surface water flood risk faced by the people of Leeds. It does not take direct account of Main River flooding, which is to be dealt with by the Environment Agency in their assessment.

It is part of an assessment of flood risk across the whole of the European Union and only highly significant areas will be shown on the final submission to the Community – in fact Leeds has none of the “Indicative Flood Areas”, of which there are 10 across England.

However the information contained in this report looks at flooding from all sources, many of which are locally significant. This information will form the base information for the Council to prepare a Local Flood Risk Strategy, as required under the Flood & Water Management Act 2010.

There is a six year cycle for assessments under the Flood Regulations 2009, so by the time the next edition is published in 2017 there will be further base information for it to be based upon.

2 INTRODUCTION

2.1 Statutory background

2.1.1 The EU Flood Directive (2007/60/EC) is consolidated into British law in the **Flood Risk Regulations 2009**, which came into force on 10th December 2009.

2.1.2 Under these regulations Leeds City Council (as a unitary authority) is designated as the *'Lead Local Flood Authority'* (LLFA) for the area. As such, it must prepare a **Draft Preliminary Flood Risk Assessment Report** (PFRA) for Leeds by 22nd June 2011 - to be published by the EA 22nd December 2011.

Including information re ordinary watercourses, surface water flows, past floods, harmful consequences of future floods, populated areas and economic activity, anticipated effects of climate change, etc.

2.2 Aims, objectives and purpose of the report

2.2.1 This draft report aims to highlight the key areas at risk of flooding from local sources - such as from surface water flows, ordinary watercourses, groundwater and sewers where it is due to excessive rainfall.

2.2.2 It does not examine the risks from main rivers, the sea or from large raised reservoirs – all these are dealt with by the Environment Agency.

2.3 Leeds topography and drainage

2.3.1 This Preliminary Flood Risk Assessment is for the Leeds Metropolitan District.

2.3.2 Leeds Metropolitan District covers 562 square kilometres and includes approximately 360 square kilometres of countryside designated as Green Belt. The district is hilly and varies in level from 10m above Ordnance Datum at Fairburn on the River Aire and Thorp Arch on the River Wharfe to more than 340m at Hawksworth Moor.

2.3.3 The District is traversed from NW to SE by the River Aire. The northern boundary is roughly marked by the River Wharfe, flowing from West to East. The River Calder forms part of the southern boundary flowing from the south west to join the River Aire at Castleford. An area to the East of the District flows into the River Ouse and a minor area at the NE that drain to the Nidd Two-thirds of the city is to the north of the River Aire.

2.3.4 The rocks underlying the area date from the Upper Carboniferous period: the sandstones and grits of the older, Millstone Grit, series to the north of the city; the alternating shales, mudstones, coal seams and sandstones of the Lower Coal Measures to the south. The soils are mainly clayey or loamey and are relatively impermeable. Sands and gravels predominate however adjacent to the River Aire.

2.3.5 The natural drainage of the area is via a series of becks, some culverted, running in steep sided valleys to the Main Rivers and their flood plains.

2.3.6 The 2001 population of the Metropolitan District was 715,400 (including 301,600 households) - *figures from 2001 Census*. Roughly 80% of this population is in the catchment draining to Knostrop Waste Water Treatment Works.

2.3.7 Although Leeds was initially sewered on a combined (foul and surface water) basis, it has been the policy since the 1950's to ensure that new development and redevelopment would be drained on a separate system basis. As a consequence, a significant part of the city now has separate or partially-separate drainage, with the surface water sewers connected in many cases direct to watercourses.

2.3.8 The original trunk interceptor sewer for Leeds was built c.1850 and drained to the Sewage Treatment Works at Knostrop. This trunk sewer, since extended, renewed and partially duplicated, roughly follows the line of the River Aire from Bridge Road, Kirkstall to Knowsthorpe. The sewer varies from 1370 mm diameter to 2362 x 2438 mm in size. In the 1920s further treatment facilities were built on higher ground at Knostrop and a new interceptor sewer - to the north of the original trunk sewer - was laid between Morris Lane, Kirkstall, and the new facilities. This new sewer drains most of the northern part of the city and is known as the **High Level Sewer**. The High Level Sewer varies from 1143x762mm to 2438mm diameter. The original interceptor sewer has become known as the **Low Level Sewer**. These sewers drain to the High Level and Low Level treatment works respectively. Drawing XXXX shows the route of the High and Low Level Sewers.

2.3.9 The catchment draining to the High Level Sewer is largely residential and commercial. Most of the traditional industry is situated south of the River Aire and this drains to the Low Level Sewer.

2.4 Flood risk management in Leeds

2.4.1 The Council has developed a Flood Risk Management Team over the last 10 years, following a number of serious flood incidents across the district.

2.4.2 This team has taken on:

- the role as Lead Local Flood Authority for the Council.
- development of strategies for flood risk management,
- mitigation of flood risk due to the impact of development, through the planning system,
- inspection and maintenance of watercourses,
- construction of flood alleviation schemes,
- records of the drainage system and
- and developed close links with the Environment Agency & Yorkshire Water.

2.4.3 Since the floods of 2007 this work has been developed further, particularly the partnership arrangement with the EA & YW. This has lead to the creation of a Sub-Regional Partnership - this includes senior offices of the 5 LLFAs in West Yorkshire, together with representatives from the EA & YW.

2.4.4 Flood Risk management have also set up district groups for:

- Flood Risk Management Group – an internal Leeds City Council group, with officers from most Departments present to examine policy.
- Planning and Flood Risk – with Planning, Development Control, Emergency Planning, Flood Risk Management, YW & the EA present.
- Technical issues – with attendance of Flood Risk Management, Highways, YW & the EA.

3 PREPARING THE PRELIMINARY ASSESSMENT REPORT

3.1 Overall approach and methodology

The information for the assessment has been gathered from as many sources as possible, so as to gain as full an understanding of the local flood issues as possible.

3.2 Information held by local authority

3.2.1 Location of watercourses

3.2.2 Records of drainage infrastructure

3.2.3 Records of flooding incidents

3.2.4 Records of inspections and investigations

3.2.5 Records of flood mitigation and asset maintenance

3.3 Information provided by Yorkshire Water

3.3.1 Records of public sewers

3.3.2 Records of sewer flooding incidents

3.3.3 Modelling information

3.3.4 Local expertise knowledge exchange

3.4 Information provided by the Environment Agency

3.4.1 Flood Zone Maps for main river floods

3.4.2 Areas susceptible to surface water flood risk

3.4.3 Receptors Database

3.5 Information provided by the public

3.5.1 Records of incidents

3.6 Scrutiny and review procedure

3.6.1 The initial draft of the Preliminary Flood Risk Assessment will be considered by partners and will then be presented to a meeting of the Leeds City Council City Development Scrutiny Board. An appropriate item has been added to the Board's work programme for its meeting on 5th April 2011.

4 PREPARING THE PRELIMINARY ASSESSMENT REPORT

4.1 Data Storage

Data is being stored on the Council's secure data networks to ensure they are only used for Flood Risk Management. Also they are registered as to the sources of the information, its quality and any restrictions on its use.

4.2 Receptors Database

The flood information has then been examined against the Receptors Database to determine the number of receptors that will be affected by any flood event.

4.3 Areas of Significant Flood Risk

From the above data an assessment has been carried out, in accordance with the national methodology, to determine whether the District includes any Areas of Significant Flood Risk, this is based upon 30,000 people being at risk of flooding – known as Indicative Flood Risk Areas.

5 HISTORIC FLOOD RISK

5.1 Notable events

There have been a number of notable floods in the Leeds areas, going back many years:

- 1775 – River Aire, Leeds
- 1866 – River Aire, Leeds – considered to be the worst recorded flood in Leeds.
- 1935 – River Wharfe, Otley
- 1946 – River Aire and Wortley Beck, Leeds
- 1960 – River Calder, Methley
- 1965 – River Wharfe, Otley
- 1975 – River Wharfe, Otley
- 1982 – River Wharfe, Otley
- 2000 – River Aire & Wharfe
- 2002 – River Aire and Wortley Beck
- 2004 – Wyke Beck, Dunhills
- 2005 – Wyke Beck and Wortley Beck
- 2007 – River Aire, Wyke Beck, Wortley Beck and many other locations across the District.

5.2 Sources of historical flood data

5.2.1 Leeds CC flooding incident database (2001-10)

Leeds CC Flood Risk Management Section maintains a database of flooding incidents reported to the Section. This has existed since 2001 and records the date, location, and description of each flood incident. Each record is assigned a category, based on an initial assessment of the type of flooding (made when the incident was first reported): sewer, watercourse, highway, overland, groundwater. The location is stored using a 12-digit national grid reference (and, where a property is involved, the OS address point reference is also stored). Approximately 2000 flooding incidents are recorded. Some of these relate to isolated properties and one-off incidents, but others represent clusters of properties and ongoing flood risks or flooding problems. The latter locations are listed in Appendix 15.2 (Principal historical flood risk locations), grouped in accordance with category.

5.2.2 Leeds CC call centre SIEBEL database

The Leeds CC Call Centre keeps of record of all calls that it receives. Records of calls for the Environmental and Highways Services area that are categorised (by Sub-Type) as ‘Flooding’ or ‘Sand Bag Requests’ are mirrored on the GIS system of the Flood Risk Management Section. This has been done since August 2008 and by the summer of 2010 approximately 300 such calls had been logged.

5.2.3 Environment Agency ‘Floodline’ incident records

It is understood that there is no easily accessible archive of ‘Floodline’ calls relating to the Leeds area.

5.2.4 Yorkshire Water DG5 and Area Flooding registers

YW have provided details of surface water flood incidents where they have this information.

5.3 Existing risks associated with asset condition

5.3.1 Blockage 'Hot Spot' list

A significant risk of flooding historically has been created by locations on watercourse systems where blockages can easily form. These are often at physical 'pinch points', such as entrances to culverts or at trash screens, but the *vulnerability* of the location to the accumulation of debris depends also upon the nature of the upstream catchment (for example, does the vegetation generate substantial amounts of natural debris) and the accessibility to fly-tippers. The Flood Risk Management Section has identified 95 blockage 'hot spots', on the basis of detailed flooding records and the amount of debris that tends to accumulate at each one. Each 'hot spot' has been given a risk ranking, in terms of the required clearance frequency (see Figure **1** and Appendix 15.**4**).

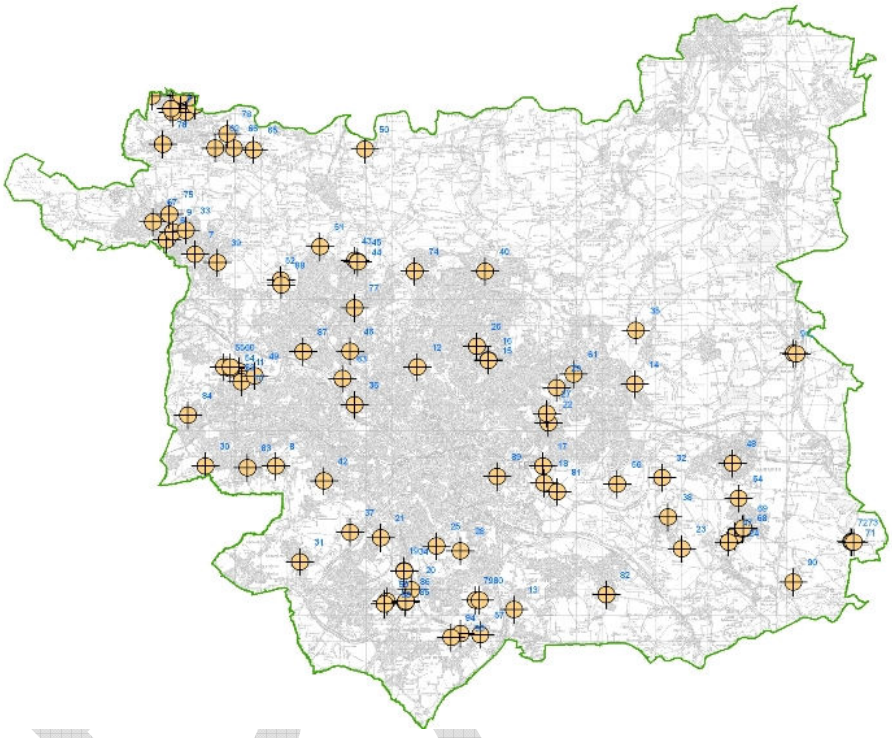

Figure 1 Distribution of blockage 'hot spot' locations

These 'hot-spots' are visited and cleared by our term-contractor at preset frequencies. The frequency appropriate for each location is determined by a risk assessment. The contractor takes a photograph of the location upon arrival and a photograph before departure. These photographs provide a record of conditions, but also assist in fine-tuning visit frequencies, which are currently as shown in the following table:

'HOT SPOT VISITS	
Fortnightly	43
Monthly	26
Two monthly	10
Three monthly	16
TOTAL	95

The 'hot spot' location details and frequencies are made available on the public website of the Council.

5.3.2 CCTV surveys of culvert condition

The Flood Risk Management Section investigates reported flooding incidents and carries out a pro-active programme of CCTV inspection for both publicly and privately owned watercourse culverts, which has been very effective in revealing blockages and defects that pose a serious flood risk. These have included excessive silt, structural

weaknesses, collapses, statutory undertaker's apparatus, and more unusual obstructions. In 2009-10 a total length of 15,858 metres of culvert was CCTV surveyed. Culvert desilting is often required before a CCTV camera can enter. Thus, the very act of facilitating a survey, by clearing the culvert, itself makes a significant contribution to flood risk reduction. Details of each survey are held on a database and GIS system. Each culvert length is assigned a structural condition grade service conditional grade.

5.3.3 Beck condition surveys

The Flood Risk Management Section carries out routine inspections of the condition of both council-owned and privately owned watercourse channels. These inspections are arranged on a risk basis, with higher risk reaches being visited more frequently. The inspection schedule (see Appendix 15.**XX**) constitutes an assessment of the flood risk associated with each reach. A log sheet of each visit – describing the condition of the channel – is completed, and a record of each visit is kept on a database.

5.3.4 CCTV surveys of public sewer condition

YW carryout CCTV surveys of public sewers where either condition issues exist or where regular flood incidents occur. Flood Risk Management has access to these where applicable.

6 FUTURE FLOODING – PREVIOUS STUDIES

6.1 Integrated Urban Drainage (IUD) pilot studies

6.1.1 West Garforth

The West Garforth Drainage Area has a history of flooding, going back to the 1980s and earlier. An IUD pilot project, sponsored by DEFRA, was carried out in 2006-08 by a partnership involving Leeds City Council, Bradford Metropolitan District Council, Yorkshire Water, the Environment Agency and the Pennine Water Group (Bradford and Sheffield Universities). The aim was to examine a range of approaches to develop more integrated urban drainage management, including examples of best practice in both technical terms and stakeholder collaboration.

Shared record data, along with supplementary surveys, was used to build a computer model of the surface water drainage and the model was verified by use of observational data from a new short-term flow survey, along with historic data. Engagement with the residents by means of newsletters and two public meetings also produced a wealth of incident data as well as proposals for remedial measures.

The carrying out CCTV surveys for the project necessitated silt and obstruction removal that will have reduced flood risk. Excavation to construct new manholes for survey access revealed constricted pipe junctions that have now been removed. Investigation of sewer connectivity, for modelling purposes, enabled the explanation and resolution of some long-standing, non-hydraulic, sewer flooding problems.

A significant number of the blockages in culverts and highway drains were caused by services severing them. Some of these still remain to be dealt with, but if they were removed in isolation from further measures, these could exacerbate downstream flood risk.

Modelling identified six areas in West Garforth with significant flood risk (Lowther Road, Oak Drive, Barleyhill Road/ Queensway/ Alandale Drive, Ninelands Lane, Richmond Road/ Glebelands. The use of a design rainfall event with a return period of 2 years indicated that significant flooding would be likely to occur at two of these locations with minor flooding at two others. If a rainfall event with a return interval of 30 years was used significant flooding would be expected at all six areas. Modelling was also used to predict changes in future flood risk. Future rainfall predictions indicated that flood volumes, from a rainfall event with a 30 year return period, would have increased in this catchment by around 50%, by 2085. Flooding would also become more widespread, especially in the south eastern part of the study area.

During or subsequent to the IUD project, works have been carried out to improve the highway drainage at Ninelands Lane and to upgrade the culvert crossing of Barleyhill Road.

6.1.2 Leeds & Bradford River Aire Studies

The River Aire Integrated Urban Drainage pilot project covered two large urban areas, the cities of Leeds and Bradford, which are linked by the River Aire. The project included the same partners as the West Garforth project and took place at the same time (2006-08).

The focus was mainly on strategic level, and longer term impacts of flooding in these two major urban areas. Methods were developed to use existing knowledge and models to identify, at a strategic level, surface flooding locations, given a particular level of risk.

The study demonstrated the impact of current land use practices and climate change on flood risk within the urban areas in the Aire valley. Modelling identified that over a time scale up to 2085 in the study area there will be an:

- Increase in the frequency of surface water flooding at vulnerable locations by around 100%

- Increase in the number of vulnerable locations by approximately 40%
- Increase the surface water flow volume by around 100%

The study identified that these increases were caused both by climate change and increased urbanization, with each of these factors have a similar level of influence. A key finding was that permitted development had the most significant impact in terms of urbanization. The study also identified that increased surface water flooding from urban areas would impact on the water quality of local receiving waters.

The project team identified actions that a range of stakeholders could take to mitigate and adapt to these pressures. These included both structural and non structural approaches. The role of development control was examined, and this highlighted the need for better training and the need to examine the impacts from permitted development at a strategic level. Emergency planning in the response to flooding was well developed, but the need for better engagement with vulnerable communities before flood incidents was highlighted. Some flood risk management practices appear to be more beneficial than others at a strategic level, and the study identified a need for improved knowledge in this area

6.2 EA s.105 Flood Risk Mapping

The EA have carried out a number of Flood Risk Mapping excercises for key locations, where there has been a history of flooding over the years, these have included:

- Fir Green Beck
- Meanwood Beck
- Cock Beck
- Wortley/Farnley Beck
- Wyke Beck

6.3 East Leeds Flooding – August 2004 (joint Leeds CC – YW report)

During the evening of 12th August 2004 serious flooding occurred at numerous locations throughout the eastern part of Leeds. An investigation into the circumstances of the flooding was carried out jointly by technical staff from Yorkshire Water and Leeds City Council.

On the basis of rainfall radar data, it was calculated that the worst 2-hour rainfall was of a depth that would be expected to occur on average about once in every 180 years. In other words, there is a 0.6% chance of such a depth of rain, in such a duration, occurring in any one year. This caused internal flooding to about 240 households. As could be expected, it overwhelmed becks, sewers, and highway drains.

The investigation concentrated on identifying additional factors (besides the extraordinary rainfall) that increased the risk at the following locations:

The Dunhills estate (Halton): The primary source of the flooding was Wyke Beck. The key additional factor causing the flooding was the poor condition of the watercourse channel. Large amounts of debris – some washed downstream by heavy storm flows – were present in the channel. The debris included natural material and a substantial amount of flytipped rubbish, including more than 30 supermarket trolleys. The capacity of the channel has been reduced by tree growth since the estate was built in the late 1930s, whilst at the same time flows in Wyke Beck have increased due to the large scale development of upstream areas.

Wykebeck Valley Road/Foundry Lane (Gipton): The flooding from public sewers was primarily due to problems relating to the operation and design of a new storage facility in Wykebeck Valley Road. This has since been replaced by a new one in Oakwood Lane. Overland flow from King George's playing fields

caused some flooding to property in Foundry Lane. This has since been mitigated with a new swale and land drain along the edge of the fields. Flooding of St Nicholas's primary school has since been mitigated by installing a new land drainage system, connected into the public sewers.

Skelwith Walk/Sandway (Seacroft): The primary source of the flooding was the public sewerage system. This was due to a blockage caused by debris – introduced by a third party – and a subsequent collapse of another public sewer. The sewer was to be reconstructed

Parkway Vale/South Parkway (Seacroft): A blockage in the combined sewer near 129 Parkway Vale caused an escape of water. Flooding also occurred from several locations on the combined sewer system due to sheer volume of flow, exacerbated by backing up from the trunk combined sewer in the valley bottom. The latter sewer was adversely affected by the entry of flood flows from Wyke Beck, via a collapsed private sewer (serving the Seacroft Hospital site) near Pembroke Grange and via a pipe defect (now repaired) near Wetherby Road. High flows and backing up from high levels in Wyke Beck are likely to have caused flooding from the public surface water sewer and the culverted watercourse. Debris and other obstructions in the beck channel were probably also a significant factor.

Kirkfield View/ Kirkfield Drive/ Chantry Garth/ Garland Drive (Colton): The prime source of the flooding at Kirkfield View and Chantry Garth was natural run-off from the public open-space to the north, supplemented by surface water escaping from the public surface water sewer system (via manholes in the open space and possibly in Garland Drive). The flooding at Garland Drive was possibly caused by a blocked surface water sewer that has now been cleared. The flooding from the combined sewer at Kirkfield Drive was likely to have been caused by surface water entering this sewer as a result of people in Kirkfield View lifting manhole covers on the foul sewers in order to relieve local flooding.

Kennerleigh Avenue (Cross Gates): The initial investigation concluded that the prime cause of flooding was likely to have been the inability of the highway gullies, although clear, to deal with the high volume of flows travelling down the carriageway. Subsequent investigation, however revealed local defects in the combined sewer and an intrinsic lack of capacity. A 100 metre length of combined sewer was upsized in 2008.

Green Lane (Halton): The primary sources of flooding were highway run-off and overland flow from local allotments. A major blockage in the public surface water sewer was responsible for some of the water escaping from several highway gullies onto the highway and the failure of these gullies to deal with any other highway flows. Subsequently, tree roots have been discovered in the surface water sewer and removed several times.

Whitkirk Lane/Austhorpe Lane (Whitkirk): No defects or blockages were found in the public or private drainage systems. Properties below road level were flooded by water backing up from the public sewer system. Downstream combined sewer capacity was subsequently determined to be inadequate. Works have been carried out by Yorkshire Water to divert the connection of the local drainage system to a new outfall (in the public combined sewer in Selby Road). The highway authority has installed a series of new gullies in Austhorpe Lane, which didn't have any.

7 FUTURE FLOODING – CURRENT ASSESSMENTS

7.1 Climate Change and Long Term Developments

7.1.1 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 rainstorms 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%.

7.1.2 Key Projections for Humber 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 12% (very likely to be between 2 and 26%)

• Precipitation on the wettest day in winter up by around 12% (very unlikely to be more than 24%)

• Relative sea level at Grimsby very likely to be up between 10 and 41 cm 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 14%.

7.1.3 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.

7.1.4 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.

7.1.5 Long Term Developments

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

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).

7.2 Urban Creep

7.2.1 In recent decades Leeds has had one of the one of the fastest developing economies in the UK, accounting for almost 27% of the 423,000 net jobs created in Yorkshire and Humber over the 20 years prior to 2007. This has naturally brought with it an extension

of the developed area (both business and housing premises) onto 'brownfield' and 'greenfield' land. This will have inevitably increased the volume of storm run-off into local drainage systems, thus potentially increasing the flood risk for areas downstream of the development.

7.2.2 In common with most urban areas, Leeds has seen a significant increase in the density of impermeable surfaces within existing developed areas as a result of property owners paving over gardens and other permeable land in order to create drives, patios and other hardstandings. Quantification of this phenomenon is hard to obtain, but there is anecdotal evidence that it is a factor in the increasing incidence of flooding in some parts of the city, such as Halton in east Leeds. On the suggestion of the Flood Risk Management Section a study was carried out in the Halton area by students at the School of Geography, Leeds University. In this investigation, aerial photographs from 1971 and 2004 were used to map changes in the impervious cover of a 1.16 km^2 suburban area. The finished report (*An Investigation into the Extent and Impacts of Hard Surfacing of Front Gardens in an area of Leeds*, 2006, Thomas Perry and Rizwan Nawaz) indicated a 13% increase in impervious surfaces over the 33 year study period. Of the increase in impervious surfaces, 75% was due to paving of residential front-gardens. It is likely that a similar trend has been followed in other residential areas.

7.2.3 A restriction on the paving of front gardens was introduced in an amendment to the Town and Country Planning (General Permitted Development) Order 1995, on 1 October 2008. The implementation of this restriction will be a major challenge and efforts will have to be made to ensure that householders are aware of the restriction. To this end, Leeds CC Highways has produced an advice note (*Your Front Garden: Save it, Don't Pave it! – Advice for Constructing Drives, Patio's and Parking Spaces*, 2010).

7.3 Environment Agency Flood Zone Maps

Though Main River flooding is not directly assessed as part of the PRFA, the EA's Flood Zone Maps are included as Apppendix ###.

7.4 Leeds Strategic Flood Risk Assessment

As part of the Council Local Development Framework a Strategic Flood Risk Assessment has been produced, which though it mainly deals with Main River flood risk it also refers to surface water risk.

7.5 Areas Susceptible to Surface Water Flooding (EA)

The EA have produced two surface water flood maps, . It is felt that the second of these is most relevant to Leeds and has therefore been used in the assessments carried out.

7.6 Areas Susceptible to Surface Water Flooding (LCC)

Flood Risk Management has also mapped two areas in detail to examine the surface water flood risk. These are at Potter Newton and Guiseley.

7.7 Wyke Beck Surface Water Management Plan

Wyke Beck is one of the most susceptible areas in Leeds to flooding and a number of studies have been carried out to assess the level of flood risk and means of alleviating it. This is now a Main River and the EA are leading on flood management.

7.8 Groundwater Flooding

A desk top assessment of flooding has been carried out for the Talbots, where there are a fair number of properties with cellars and a history of water in them.

The result of the assessment was that this is unlikely to lead to major flooding but some residents will continue to have water ingress into cellars, particularly during very wet periods.

7.9 Reservoir breach assessments

7.9.1 Environment Agency have prepared national assessment on the 100 most risky reservoirs in the country, only 2 of these are in Leeds and though the impact would be potentially catastrophic the chance of this occurs is adjudged as minimal. All such reservoirs are registered under the Reservoirs Act and overseen by the EA Reservoirs team.

7.9.2 Leeds CC has also prepared breach assessments for two of their reservoirs, both of which are subject to regulation under the Reservoirs Act and therefore the chance of any failure is adjudge as minimal. However there are a number of smaller reservoir, which don't come under the Act, and we have concerns over the conditions of some of them. We will continue to raise these issues with the owners – it should be noted that the F&WM Act has a clause in to extend the Reservoirs Act down from 25,000 cum to 10,000 cum and this will mean many of these will have to be assessed on a regular basis.

7.10 Existing sewer capacity issues have been examined based on an appraisal of existing models. There are a number of problem areas but particularly for high return period storms, for which sewers are not designed.

7.11 Yorkshire Water are proposing to carry out Drainage Area Plans, these will allow a better understanding of how the sewer network will cope during larger storms.

8 REVIEW OF DEFAULT FLOOD RISK AREAS

8.1 Review of the provisional national assessment

A review of the two local flood risk maps has been carried out for Leeds and it has been decide that the Flood Map for Surface Water, released in November 2010, gives the best representation for most catchments in Leeds – so this has been adopted for this study.

8.2 Required amendments

There are areas where the earlier Areas Susceptible to Surface Water might give a better representation of local flood risk, particularly in flatter low lying areas, but it the time available it has not been possible to define this sufficiently.

Also there are records for historic flood incidents that would allow the amendment of the standard mapping but there was not sufficient time to determine the causes of these and the risk that they posed, so changes have not been made at this time.

Therefore currently the standard Flood Map for Surface Water is being used to determine the flood risks for this exercise.

8.3 Consistency with neighbouring LLFA areas

As yet the consistency with adjoining LLFAs has not been looked at in detail, it is felt that there is unlikely to be any major issues with regard to surface water flood risk. The greatest amount of connectivity is along the Main Rivers and these are not considered in detail within this exercise.

9 PROPOSED FLOOD RISK AREAS

9.1 Description of proposed flood risk areas

The assessment of the various information has lead to a the production of two maps – firstly the Flood Map for Surface Water, that show areas where surface water is likely to cause flooding, and secondly a map showing the most significant areas of flood risk, taking into account the impact on the communities effected – this is what the PFRA process uses to determine the ten nationally significant areas of flood risk, based on 30,000 people at flood risk.

The main area within Leeds has 26,821 people at risk of flooding and therefore does not meet the cut-off for “national significance”, though all these areas are significant locally and Leeds City Council will be taking steps over the coming years to mitigate the impact and risk that the people of Leeds face.

9.2 Location and extent

See Appendices XX & XX for the maps of flood risk.

10 PROPOSALS FOR MANAGEMENT AND MAINTENANCE OF DATA

Leeds City Council already has close partnership arrangements with all the other agencies involved in flood risk management and these will continue to be developed. All agencies are commited to ensuring that we manage data for the benefit of the people of Leeds and ensuring that better information is available for assessments of flood risk are an essential part of this.

11 COMMUNICATIONS WITH PARTNERS

11.1 Division of responsibilities for assessing local flood risk and flooding incidents

Under the Flood & Water Management Act LLFAs have the lead responsibility to investigate flood incidents but it is essential that all agencies work together to ensure that resources are used to their optimum. To this end a working group has been set up as part of the Yorkshire & Humber Learning Alliance, a loose working group of all interested parties in the region, to draw up guidance for how these issues should be dealt with by the various partners.

11.2 Means of stakeholder engagement

11.2.1 Local flood action groups

In Leeds there are a number of active local flood groups and the Flood Risk Management and Emergency Planning Teams work closely with these groups – both in setting them up and also to support them in their operation. Such group are an important part in being able to manage flood risk.

12 EXISTING MITIGATORY ACTIONS

12.1 Existing risk-based maintenance and inspection regimes

12.1.1 Leeds City Council has a well organised system of maintenance for watercourses and grids. There is a regular and routine system of inspection and maintenance works carried out. Where issues crop up outside this system, then maintenance is organised and programmed dependant upon priority.

Also crucial to the proper drainage of the District are the approximately 150,000 gullies on the Highway Network, these are maintained on a regular cycle by Neighbourhoods & Environment. The multitude of connecting pipes are then maintained by Highways Management.

12.1.2 Environment Agency has a system to inspect and maintain all Main River, again where issues crop up they will inspect and add it to the regular maintenance.

12.1.3 Yorkshire Water has a huge programme of maintenance and improvement that they carryout ever year.

12.2 Development Control

12.2.1 Planning and Flood Risk

The Council's Planning and Flood Risk Management Team work very closely on ensuring that development mitigate the risk of flooding related to development, as per PPS25. A as part of this they have developed a SuDS and Supplementary Planning Guidance note 22, which states clearly the need for developer to consider fully the use of Sustainable Drainage Systems in mitigation of flood risk.

12.2.2 Furthermore Flood Risk Management has produced a minimum standards chart for drainage.

12.2.3 Planning has a part of the LDF draw up new guidance for developers in the Natural Resources and Waste Development Plan Document, which covers flood risk.

12.3 Partnership protocols and forums

As previously referred to Leeds City Council has set up a number of forums, where the various partners can meet to discuss the flood risk management of issues. Furthermore they have signed a protocol with YW for the transfer of data.

13 EMERGENCY RESPONSE

13.1 West Yorkshire Major Flood Incident Plan

The Council's Emergency Planning Team has been at the fore in drawing up the WY Major Flood Incident Plan, which sits beside the Council's own Emergency Plan documents. Recently this was tested as part of the Watermark exercise.

13.2 Community flood action plans

Also Emergency Planning have a programme of drawing up Community Flood Action Plans with the various action groups. The following have been prepared or are in the process of being developed:

- Collingham
- Dunhills estate

- West Garforth
- Methley
- Thorner
- Wortley Beck

13.3 Reservoir Emergency Plans

The Council's Emergency Planning Team is in close contact with the EA's Reservoirs Team in ensuring that there are Emergency Plans for all the main reservoirs in the District.

13.4 Leeds City Council sandbag policy

The Council has a policy to only provide sandbags to the most vulnerable in society and will deal with requests as necessary during flood events.

13.5 Call centres – Leeds CC, Yorkshire Water, and EA Floodline

All these agencies have call centres that will during flood events take calls from the public – providing advice and assistance where possible. These are also an important source of data as to where flooding is occurring and after the event to record information.

13.6 Actions of partners on receipt of severe rainfall warnings

There is a standard protocol for the receipt of severe rainfall warnings, where it is expected that this could lead to a major flood event. In the first instance the various partners will discuss how they intend to react and whether Control Centres should be set up or just to put staff on standby for any possible event.

14 PROPOSED FLOOD ALLEVIATION SCHEMES

14.1 Leeds City Council

The Council's Flood Risk Management Team are currently looking at a programme of flood alleviation schemes, these include:

- West Garforth recreation ground (local levy)
- Leeds Road (Allerton Bywater) pumping station (local levy)
- Ramsden Street (Kippax) flood alleviation scheme (local levy)
- Station Road (Morley) culvert renewal scheme

14.2 Environment Agency

The EA have a number of flood alleviation schemes under consideration at present, these include:

- Leeds flood alleviation scheme
- Wyke Beck flood alleviation scheme
- Collingham Beck flood alleviation scheme
- Farnley Wood Beck flood alleviation scheme

14.3 Yorkshire Water

Under their DG5 programme YW have a number of major schemes under consideration and also a large number of smaller schemes that come under their revenue funding.

15 SELF-HELP STRATEGY

15.1 Advice sheets on self-help (LCC/YW/EA)

There is various information available to the public, which during flood events is supplemented by other guidance on health and safety.

- Groundwater problems
- Property level flood protection
- National Flood Forum role