Calderdale Metropolitan Borough Council

Draft Preliminary Flood Risk Assessment

Environment Team

Highways and Engineering

April 2011

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Glossary

Blue Square	*a 1 km^2 surface water flood risk area where more than 200 residents or 20 non-residential properties or 2 critical service are at risk*
CFMP	*Catchment Flood Management Plan*
Cluster	*a group of 5 or more touching 1 km^2 Surface Water Flood risk areas (blue squares)*
CMBC	*Calderdale Metropolitan Borough Council*
Critical Service	*Health points (including hospitals), fire stations, police stations, ambulance stations, schools, care-homes, mental homes and utility infrastructure*
DAMS	*Drainage Asset Management System*
DAP	*Drainage Area Plan*
DEFRA	*Department for Environment, Food and Rural Affairs*
DTM	*Digital Terrain Map*
EA	*Environment Agency*
GIS	*Geographic Information System*
HA	*Highways Agency*
FWMA	*Flood and Water Management Act 2010*
IPCC	*Intergovernmental Panel on Climate Change*
Key Stakeholders	*an organisation which has responsibility for assets, buildings or land in the CMBC area which might be at risk from flooding*
LLFA	*Lead Local Flood Authority*

Locally Significant Flood Risk	*a past event deemed, on a case by case basis, to be locally significant by CMBC*
Main Rivers	*watercourses which are the responsibility of the EA to superintend*
National Receptor Database	*mapping datasets supplied by the EA*
OFWAT	*the Water Services Regulation Authority*
Ordinary Watercourses	*any watercourse which is not a main river*
PFRA	*Preliminary Flood Risk Assessment*
SAC	*Special Area of Conservation*
Scrutiny Committee	*CMBC committee asked to review the PFRA report*
SFRA	*Strategic Flood Risk Assessment*
Significant Flood Risk Area	*a cluster of surface water flood risk areas where more than 30,000 residents or 7,500 non-residential properties or 500 critical services are at risk*
SWF	*surface water flooding*
1st Generation SWF Maps	*the surface flood water maps produced by the EA in response to the Pitt Report*
2nd Generation SWF Maps	*Revised SWF maps which are considered to be a better representation of SWF than the 1st Generation SWF Maps*
1 in 200 year shallow	*a second generation SWF map showing flooding from a 1 in 200 year rainfall event. The flood outline shows flood depths of 0.1 metres or greater.*
1 in 200 year deep	*a second generation SWF map showing flooding from a 1 in 200 year rainfall event. The flood outline shows flood depths of 0.3 metres or greater.*

1 in 30 year shallow	*a second generation SWF map showing flooding from a 1 in 30 rainfall event. The flood outline shows flood depths of 0.1 metres or greater.*
1 in 30 year deep	*a second generation SWF map showing flooding from a 1 in 30 year rainfall event. The flood outline shows flood depths of 0.3 metres or greater.*
SPA	*Special Protected Area*
SSSI	*Site of Special Scientific Interest*
SWF Map	*Surface Water Flood Map*
YW	*Yorkshire Water*

List of Tables

List of Figures

Contents

Executive Summary

Completion of a Preliminary Flood Risk Assessment (PFRA) is a statutory obligation arising from the Flood Risk Regulations 2009 (the Regulations) which should be reviewed after six years. This report has been written with reference to the Regulations and also the Final PFRA Guidance, published by the Environment Agency (EA) in December 2010.

The purpose of the PFRA is to assess surface water flooding risk through readily available information about past and future flooding obtained from a data collection exercise. This data has been obtained from within Calderdale Metropolitan Borough Council (CMBC) and from key stakeholders.

A PFRA should identify any flood risk areas of national significance for further study and production of Flood Hazard Maps and a Flood Management Plan. No nationally significant flood risk areas have been identified within the Calderdale Metropolitan Borough so a Flood Hazard Map and Surface Water Management Plan are not required under the Regulations. Defra, however, have separately identified 77 locations nationally where they have deemed Surface Water Management Plans to be necessary. One of these locations (Todmorden) is located within CMBC.

Under the Flood and Water Management Act 2010, however, the Council as Lead Local Flood Authority (LLFA) is required to produce a Local Flood Risk Management Strategy which will require further analysis of the data contained in this report.

This PFRA is to be submitted to the EA before the 22nd June 2011 for review and then submitted finally to Europe to show compliance with the EU Floods Directive for the management of surface water flooding.

The PFRA recommendations are summarised below:-

- Study the interfaces between Main River and other surface water infrastructure
- Work with Yorkshire Water to understand risks posed by the sewer network
- Compile a consistent database of events and asset records from which to manage the infrastructure
- Develop improved protocols with Planning Services to minimise the impact of development on flood risk
- Continue to work with all appropriate stakeholders
- Develop a rapport with Natural England with regard to land management
- Draw up a Local Flood Risk Management Strategy compliant with the Flood and Water Management Act 2010

1.0 Introduction

1.1 Legislation

The PFRA is a statutory obligation stated in the Flood Risk Regulations 2009. The purpose of the Flood Risk Regulations 2009 (the Regulations) is to transpose the EC Floods Directive (Directive 2007/60/EC on the assessment and management of flood risks) into domestic law and to implement its provisions. In particular, it places duties on the Environment Agency (EA) and the Lead Local Flood Authorities to prepare preliminary flood risk assessments, flood risk maps and flood risk management plans.

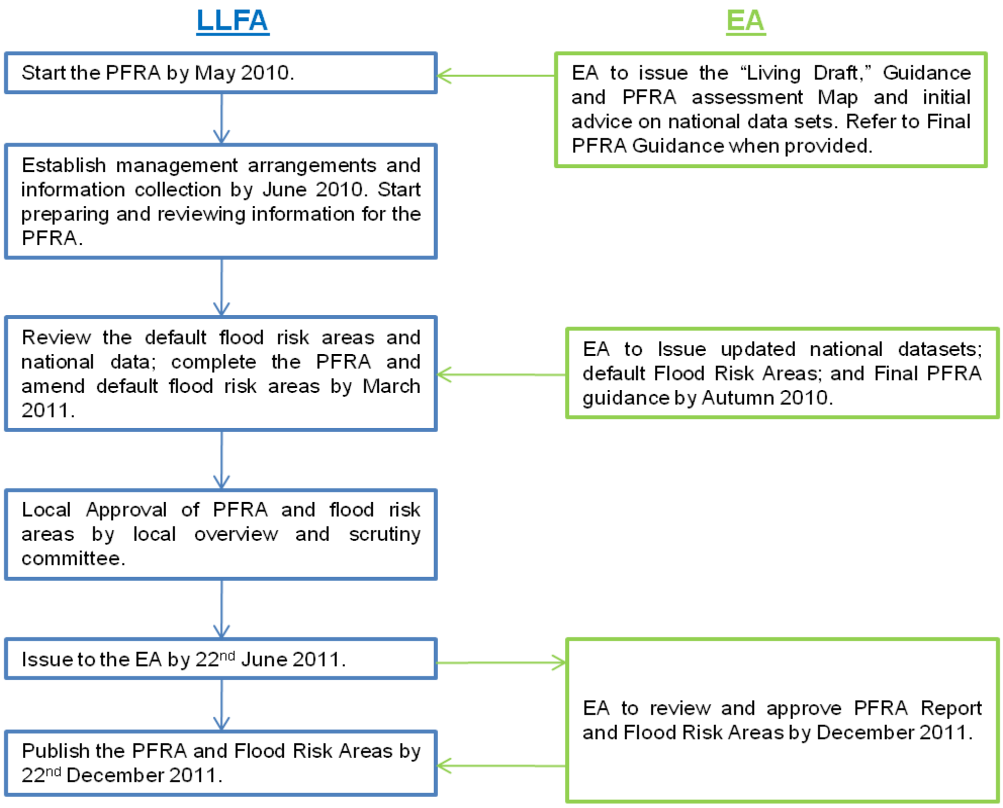
In the Regulations, the Lead Local Flood Authority (LLFA) is the County Council or Unitary Authority as appropriate.

1.2 The duty of the LLFA to produce a PFRA

The duty placed on the LLFA to produce a PFRA along with an outlined methodology is stated in the Regulations. In response to this legislation, the EA provided an initial detailed PFRA methodology in the "PFRA living draft guidance," published in May 2010 and clarified in the "PFRA final guidance," in December 2010.

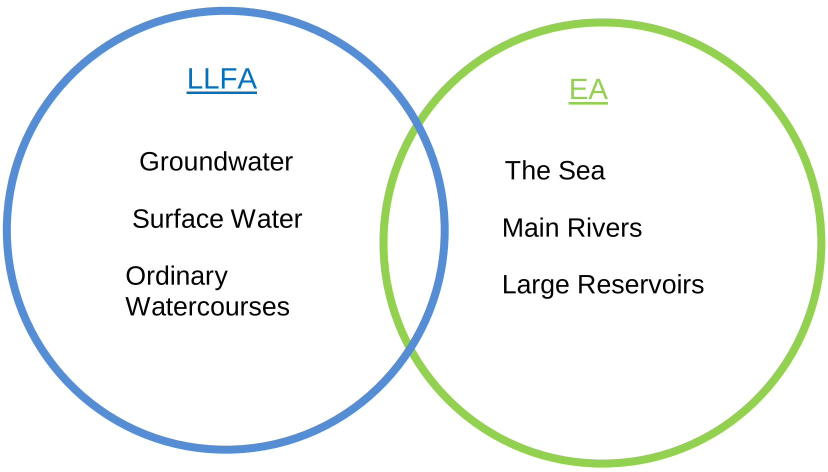
The EA's recommended delivery programme, in order for the PFRA to be completed and submitted to the EA by the 22nd June 2011 is shown in Figure 1 below. The diagram highlights the roles of the EA and the LLFA in the delivery of this PFRA.

Figure 1: The EA's recommended programme to complete the PFRA



The responsibilities which have been placed on the EA and the LLFA regarding flood management have been clarified in the Flood Water and Management Act 2010 and are illustrated in Figure 2 below.

Figure 2: Flood Management Responsibilities of the EA and LLFA



In some instances these responsibilities may be shared e.g. when flooding to a locality is caused by a main river and surface water interaction.

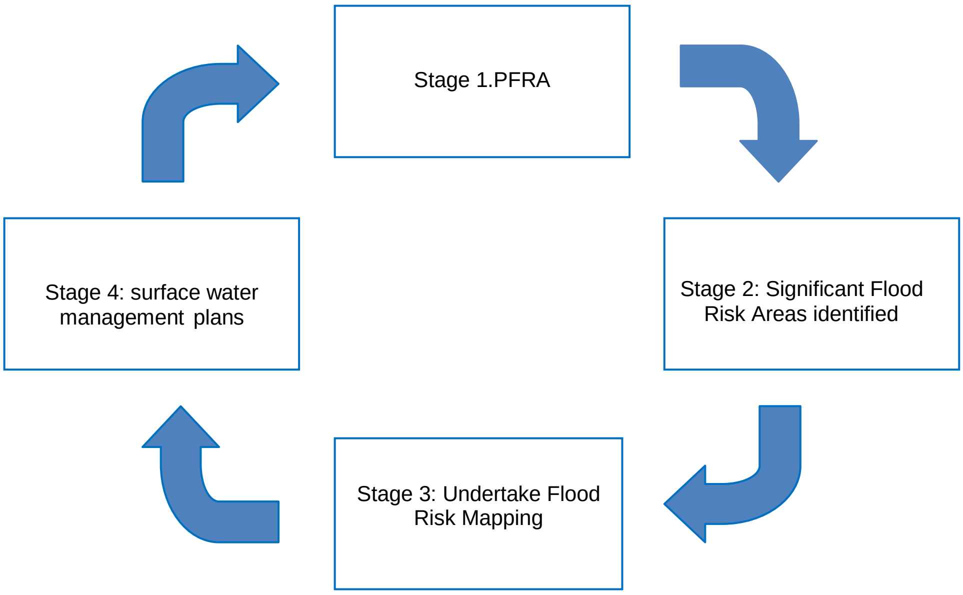
1.3 The PFRA Cycle

The aim of the European Floods Directive is to provide a consistent approach to managing flood risk across Europe. It establishes four stages of activity within a six year flood risk management cycle.

The PFRA report is the first stage of this cycle. This PFRA assesses past and future surface water flooding within the Council boundary. The second stage (which will be part of the conclusions of this PFRA) is to identify any flood risk areas of "national significance." The criterion for an area of national significance has been specified by DEFRA and is detailed in Section 3 of this report.

When locations of nationally significant flooding have been identified, stage three of the cycle is to produce Flood Hazard and Flood Risk Maps. The final and fourth stage is to produce Flood Risk Management Plans for specific locations identified in the Flood Risk Maps. This final stage will seek to recommend solutions to surface water flooding at a specific locality. Figure 3 below illustrates this six year cycle.

Figure 3: PFRA six year cycle process



If a LLFA does not identify any flood risk areas of national significance, they are not required to undertake stages 3 and 4 of this cycle. However, the LLFA are required to review their PFRA in six years and the Flood and Water Management Act 2010 (the FWM Act) requires a local Flood Risk Management Strategy to be produced consistent with the National Strategy produced by the EA.

1.4 Scope of the Study

The final PFRA guidance provided by the EA in December 2010 states that the LLFA should include all sources of flooding except that from the sea, main rivers and large reservoirs. The flooding in this assessment therefore includes:-

a. Surface water flooding from the following sources:-

   - Run-off from impermeable surfaces due to very heavy rain
   - Groundwater in areas where water has percolated into the soil on high ground and then emerges as springs or just rises to the surface in lower areas
   - Flooding from small streams or drainage ditches
   - Water which has gone into drains or sewers in one place and then flooded out in another
   - Water that is prevented from draining away owing to high water levels in rivers and streams

b. Canals

c. Small impounding reservoirs. These have been classified as any reservoir with a volume capacity less than 25,000 m^3.

d. Any surface water which is prevented from entering a main river, due to the water levels in the main river being too high

Key stakeholders were contacted to obtain any local knowledge of surface water flooding they may hold. The organisations which have been contacted are detailed Section 4.0. Reference has also been made to the “Calder Catchment Flood Management Plan,” the latest draft produced in January 2010, and the “Calder Valley Strategic Flood Risk Assessment,” produced in November 2008.

The PFRA base data has been provided by the EA in the form of surface water flood outlines. These maps are used to indicate areas which are susceptible to surface water flooding. The local knowledge gathered has been used to verify and also to supplement these surface water flood maps.

The report includes in summary a report and spreadsheet detailing past flood events which have been assessed to be of “local significance.” Local significance has been defined in Section 3.

The final PFRA guidance also stressed that no additional hydraulic modelling or acquisition of new information is needed.

1.5 Geographic Location

The extent of the CMBC boundary is also the geographical extent of this PFRA study which is a total area of approximately 362 km^2. The latest government figures which were produced in 2009 estimate a total resident population of 201,600. Figure 4 in Appendix 1 shows the extent of the CMBC boundary. The most densely populated towns are Todmorden, Halifax, Hebden Bridge, Mytholmroyd, Brighouse, Ripponden, Elland and Sowerby Bridge and there are various other smaller urbanised areas.

Calderdale is characterized by steep terrain. Typical flooding occurs in the valley bottoms when rivers come out of channel or when high river levels prevent discharge of surface water. Figure 5 in Appendix 1 shows the surface terrain. Large areas of moorland are located within Calderdale, particular at higher elevations in the north-west and south-west of the Council's area.

The main rivers are some or all reaches of the River Calder, Dulesgate Water, Walsden Water, Hebden Water, Cragg Brook, Luddenden Brook, River Ryburn, Hebble Brook, Ovenden Brook, Clifton Beck, Jumble Dyke, Jumble Hole Beck, Major/Oak Hill Clough, Redwater Clough, Scaitcliffe Clough, Beater Clough, Tower Clough, Ramsden Clough and Red Beck. Figure 6 in Appendix 1 shows their location. Although flooding from main rivers is outside the scope of this study, flooding caused by the interaction with a main river should be considered.

Twenty-nine reservoirs above 25,000 m^3 are located within CMBC. These are owned and maintained by Yorkshire Water (23), the EA (1), United Utilities (3) or by private individuals/organisations (1). Of these 13 are classed as high priority which require on site plans by the owner and off-site plans by the Emergency Planning Section of the Council. Of the 13, 10 belong to Yorkshire Water and 3 belong to United Utilities.

Past or future flooding from these reservoirs is outside the scope of this report but reservoir inundation maps are available for these reservoirs from the EA.

Flooding caused by groundwater has not been identified as a significant problem due to the geology in the locality. The geology of Calderdale includes Lower Carboniferous rocks outcropping at the surface, these being overlaid in areas by more recent drift material, peat on the uplands and sands and gravels in the valley bottoms, particularly in the east of the District. The Carboniferous strata are typified by an ever-changing succession of sandstones, gritstones, shales and mudstones.

The EA have provided a map (Figure 7 in Appendix 1) showing areas which may be susceptible to ground water pollution. This will be significant in the future if percolating surface water solutions are being considered, such as SUDS (Sustainable Drainage Systems).

The Calder and Hebble Navigation and the Rochdale Canal are owned and maintained by British Waterways. Any breach or overtopping of these canals would contribute to surface water flooding and have been included as part of this assessment.

2.0 Methodology

This PFRA has been undertaken with reference to the Flood Risk Regulations 2009 and the Final PFRA guidance published in December 2010 by the Environment Agency (EA). The key stages necessary to complete a PFRA have been outlined below:-

1. Develop partnerships and information sharing with stakeholders

Stakeholder data was collected and partnerships between CMBC and its key stakeholders have started to be developed. These partnerships are something which CMBC will seek to develop further in later stages of Flood Risk Management. The Calderdale Flood Risk Management Group has been set up to encourage closer working partnerships and data sharing. Currently this group includes internal services within CMBC, the EA and Yorkshire Water (YW). All of Calderdale's key stakeholders will be encouraged to join this group.

Some of the challenges in the data collection were as follows:-

- Some information was not in a form which could be easily obtained and used in this study i.e. it was knowledge not formally recorded but held by key stakeholder personnel. This made obtaining this information difficult.

- Some stakeholders had useful information but due to its sensitive nature, they were unwilling or unable to provide it.

- Some stakeholders had useful information but were only willing to provide it on the condition agreements were signed and protocol followed. This resulted in delays in receiving information.

- Some stakeholders provided information which was incomplete, limiting the usefulness of the information.

It should be noted that under the Regulations stakeholders are obliged to share with the LLFA when requested any information they may hold which is relevant to a PFRA study**.**

2. Collect information on past flooding

Most of the data collection exercise focused on obtaining information on past flooding. All of the stakeholders contacted and the information received has been detailed in Section 3.

The information of past flooding has been obtained from various sources and its location mapped on top of predicted surface water flood maps provided by the EA. This was used to verify and supplement the modelled surface water flood maps provided by the EA, which are discussed in more detail in Section 5. Along with the information collected from key stakeholders these provide a good basis for assessing surface water flooding across the CMBC area.

3. Collect any other relevant data for this study

In addition to information on past flooding, the locations of sites important for human health, the environment, cultural heritage and the economy were also requested from stakeholders if CMBC did not already have this information.

All data collected was obtained in GIS format (Map-Info) where possible.

4. Determine a locally significant threshold for past flood events

Any past flood event which met or exceeded an internally agreed threshold was recorded in Annex 1 of the PFRA spreadsheet, along with its consequence to cultural heritage, the economy, the environment and human health. More discussion on locally significant past flood events has been detailed in Section 4.

5. Collect information on future flooding

Future surface water flooding is something which has been determined from the national datasets which the EA have provided. These national data sets included the following;

- Flood zones outlines
- 1st Generation Surface Water Flood Maps
- 2nd Generation Surface Water Flood Maps

In addition to the national datasets provided, CMBC have also used the locations of future development to help assess which locations have potential for increased future surface water flooding.

All future surface water flooding locations have been included in Annex 2 of the PFRA spreadsheet and have been completed with the help of the EA.

Future surface water flooding has been detailed more fully in Section 6.

6. Estimate consequences of flood events

The receptor data base version 1.1 (superseding version 1.0) was obtained from the EA in a GIS (Map Info) Format. A receptor is any infrastructure, area of land or asset, which is locally important when assessing flood risk. These receptors can be classified in four distinct categories which are Cultural Heritage, Economy, Environment and Human Health and are listed in Table 1 below.

Table 1: Flood Risk Indicators included in the PFRA study

Category	Key Flood Risk Indicator
Cultural Heritage	Listed Buildings, Ancient Monuments, Historical Event Location, Scheduled Ancient Monuments, Registered Parks and Gardens
Economy	Businesses (Non-Residential Properties), Canals, Roads, Railways, Agricultural Land
Environment	SSSI, SAC, SPA, Ancient Woodlands
Human Health	Residential Housing, Critical Services*

***Note**: critical services have been assessed to include the following; health points (including doctor surgeries, clinics, pharmacies, local health clinics), hospitals, fire service, police service, ambulance stations, schools, care-homes, mental homes and utility providers critical infrastructure (Gas, Water and Electric). Motorways, A-roads and Railways have also been considered as "critical infrastructure," when appropriate in this assessment.*

For more information on how past flood events have been classified, refer to Section 4. If a historic flood event was assessed to be "locally significant", the event's impact on Cultural Heritage, Economy, Environment and Human Health was assessed where possible and included in Annex 1.

Some of the collected data sets were more accurate than the data provided by the EA. In such cases, this data was used in preference. The mapping data sets were reviewed, with the assistance of CMBC's GIS team, and the most current data sets were used.

7. Review the "blue square," flood risk areas

1 km^2 squares which were identified as containing sufficient qualifying flood risks were shown as blue squares on a dataset provided by the EA. The purpose of this exercise was to produce a map showing high priority surface water flooding locations to be targeted in more detail in the future.

The PFRA reviews these squares to recommend any changes arising from local knowledge.

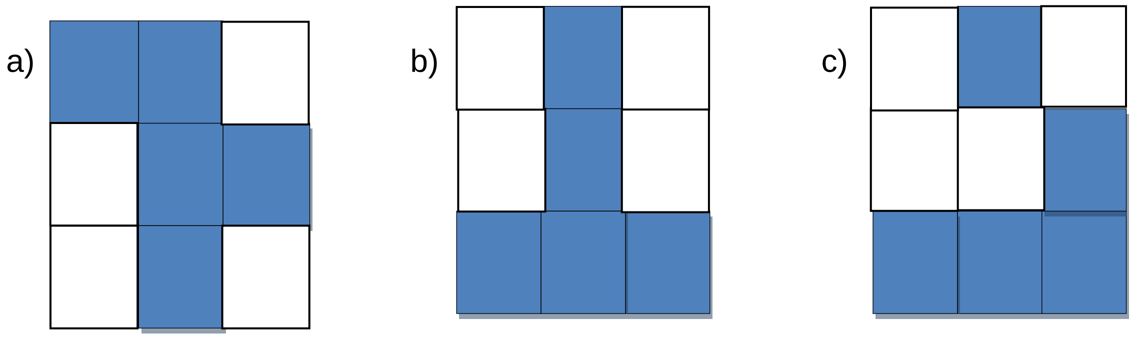
Table 2 shows the criteria for both the blue squares and the qualifying parameters within which an area would be deemed at significant risk by national definition and therefore requiring much more detailed study of hazards, risks and risk management.

Table 2: Criteria for "national significance," and "blue square," flood risk areas

Flood risk area	Area	Residents affected	Non-residential infrastructure affected	Critical infrastructure affected
Significant	5 km^2+	30,000+	3,000+	150+
Blue Squares	1 km^2	200+	20+	2+

If 5 or more, blue squares in a pattern of 9 around a central square each contain sufficient qualifying risks, they are collectively called a "cluster." See Figure 8 and Table 2;

Figure 8: 5 out of 9 touching km^2 grid squares, or more, identified as a "cluster."



From the EA's initial assessment 62 blue squares and 4 clusters were identified within the CMBC area. No nationally significant areas have been identified within the Borough.

A check of the EA's risk areas, after the data collection exercise of local knowledge and asset locations described in chapter 4 has been completed. For the review of the blue squares flood risk areas, refer to chapter 6.

8. Compile the PFRA Report and Annexes 1 & 2 of the PFRA Spreadsheet

The PFRA report was completed with reference to the EA's Final PFRA Guidance.

Locally significant past surface water flood events and their consequences have been included in Annex 1 of the PFRA spreadsheet. Future surface water flood events and their consequences have been included in Annex 2.

9. Locally review the PFRA and submit it to the EA

The PFRA will be reviewed by a CMBC Scrutiny Committee in April 2011. Any necessary changes from the comments made will be incorporated into the final PFRA report and submitted to the EA before the 22nd June 2011 deadline.

3.0 Data Collection

The major part of this PFRA exercise was undertaking data collection from Council Services and key stakeholder organisations of local flooding knowledge and information regarding location of assets, particularly critical infrastructure assets.

3.1 Key Stakeholders Contacted

The following, is a list of all the key stakeholders which were contacted as part of this PFRA study and the data they were able to provide.

1. Amey LG

Local knowledge was gained from the Highway Maintenance Contractor, Amey LG. Their contract has been in place with CMBC for the last 9 years and includes maintenance and capital works for road and land drainage problems, which cause surface water flooding.

The contractors were interviewed and a detailed record of the routine sites which they visit across the borough for preventive and regular reactive maintenance works to alleviate highway flooding was made. This information could be built into a flood risk asset management plan following finalisation and acceptance of this report.

2. British Waterways

British Waterways are responsible for the canal network in CMBC which includes the Calder and Hebble Navigation and the Rochdale Canal. As waterways, which could be a source of surface water flooding, these canals are considered within this assessment.

British Waterways provided CMBC with the following data sets in GIS format:- canal centrelines, sluices, flood weirs, locks, aqueducts, culvert locations, historical canal breaches and historical canal overtopping events

A total of 5 historical breaches / overtopping incidents were recorded along the canal network. This information was pooled with all the local knowledge which had been collected.

3. CE Electric

CE Electric is responsible for the electrical infrastructure. The location of CE Electric critical infrastructure was requested but due the sensitivity of this data, this could not be provided.

The best readily available data showing the locations of the electrical sub-stations was provided by the CMBC GIS team. CE Electric did not have any specific local knowledge relating to surface water flooding.

4. CMBC

Council Services were contacted to gain local knowledge of surface water flooding, including Emergency Planning, Highway Maintenance, Environmental Health, Planning and Environment Team. Useful local knowledge was provided regarding surface water flooding incidents. The CMBC database for flooding incidents on the land and highway was also used as a source of information.

The GIS team were able to provide the location of critical infrastructure, number of businesses and resident populations within a locality and the location of other relevant infrastructure.

Information was also provided by the Strategic Planning Section of proposed future residential and business development locations which will help to give an indication of future areas that may be susceptible to surface water flooding.

5. The Coal Authority

The Coal Authority is responsible for maintaining all of the disused coal mines located across the United Kingdom. Coal Mines can collect rain and ground water, and on occasions release large quantities of water they contain, flooding the locality.

The Coal Authority stated however that it did not have any knowledge of surface water flooding from their mines, although 2 sites within the Borough are known to have produced quite dramatic flooding on more than one occasion.

6. Emergency Services

Initial contact has been made with the Emergency Services within Calderdale, including the Police and Fire Service. No local knowledge has currently been received. For flood risk management / strategy purposes, this information will be obtained through the West Yorkshire Resilience Group and its Severe Weather sub-group.

7. English Heritage

English Heritage is responsible for the protection and maintenance of sites of cultural heritage across England, including listed buildings, scheduled ancient monuments, and parklands.

The location of English Heritage's sites of cultural heritage was requested and provided. England Heritage did not have any specific local knowledge of surface water flooding.

8. Environment Agency

The key organisation which was consulted during the development of this PFRA report was the Environment Agency (EA). The EA are the senior organisation responsible for flood risk matters in England and Wales and for superintendence of all of the main rivers.

The information obtained included the following:-

- A list of the surface water flood maps provided by the EA is shown in table 3 below.

  Table 3: The EA's surface water flood maps

Flood Maps	Depth of Flooding Shown
1st Generation Map	Varies
2nd Generation 1 in 30 year Map (Shallow)	0.1 metres or greater
2nd Generation 1 in 30 year Map (Deep)	0.3 metres or greater
2nd Generation 1 in 200 year Map (Shallow)	0.1 metres or greater
2nd Generation 1 in 200 year Map Deep	0.3 metres or greater

  These maps have been used as a reference for any local knowledge gathered, to see where a flooding location is situated in relation to the modelled outlines. The EA's surface water flood maps are discussed in more detail in section 5. The 2nd Generation 1 in 200 year surface water flood map, shallow and deep is shown in Appendix 1, Figure 9.

- The PFRA living draft and final guidance.
- The PFRA spreadsheet, for recording locally significant flood events and their consequences.
- The historic flood maps.
- The flood zone outlines
- Default flood risk locations (blue squares)
- The receptor data base (version 1.1)
- Any relevant studies the EA had within the CMBC area

9. Highways Agency

The Highways Agency is responsible for the maintenance of all motorways and major roads within the United Kingdom and consequently any culverts which pass underneath these roads. The only road which the HA are responsible for within the CMBC area is the M62 Junctions 22 to 25 and any culverts which pass underneath it.

The HA did not have any records of surface water flooding along the M62 carriageway, between these junctions. They have been requested to provide asset information but this has not been forthcoming so far.

10. Kingston Communication (K-com)

K-com installs fibre optic cables. K-com stated that their fibre optic cables are not adversely affected by flood water and they do not hold any local knowledge of surface water flooding.

11. McNicholas Contractors

McNicholas Contractors are employed to install telecommunications.

McNicholas stated that the equipment they install is not adversely affected by flood water and they did not have any specific local knowledge relating to surface water flooding.

12. Natural England

Natural England is responsible for the protection and maintenance of environmentally sensitive sites across England.

The location of Natural England's environmentally sensitive sites located within CMBC were requested and provided.

Natural England stated however that they did not have any specific local knowledge relating to surface water flooding.

One of the tools which may help to reduce flood risk in Pennine Districts is better management of upland areas, particularly moorland which has been drained by the practice known as gripping (ditches). Also deterioration of the catch-waters serving abandoned reservoirs causes a similar problem.

Unfortunately these areas tend to be designated for protected species of flora or fauna and this creates serious conflict with the aims of species protection. Protocols may need to be established to enable land management to proceed in a more flood friendly way.

13. Network Rail

Network Rail is responsible for the maintenance of the railway track across the United Kingdom and the maintenance of any culverts which pass under their railway.

The location of Network Rail's assets was requested and provided. Network Rail also had some local knowledge related to surface water floodingand

provided some locations of culverts passing under the railway and maintenance regimes.

14. Northern Gas

Northern Gas is responsible for the supply of gas to residents and businesses in the Borough.

The location of Northern Gas most critical infrastructure located within CMBC was requested and provided. Northern Gas did not hold any specific local flooding knowledge which they were able to readily provide.

15. Parish and Town Councils

All of the Parish Councils within CMBC were contacted in order to give them the opportunity to contribute to this study. Parish Councils represent the community in that locality and can have some influence with the political representative for the CMBC area. The nine Parish and Town Councils are as follows;

a) Blackshaw Parish Council

b) Clifton Neighbourhood Council

c) Erringden Parish Council

d) Hebden Royd Town Council

e) Heptonstall Parish Council

f) Ripponden Parish Council

g) Sowerby Bridge Parish Council

h) Todmorden Town Council

i) Wadsworth Parish Council

Any useful local knowledge which the various Town and Parish Councils were able to provide was incorporated into this study.

16. Yorkshire Water

In the development of the PFRA study a data sharing protocol was setup in December 2010 between Calderdale MBC and Yorkshire Water (YW). The following information was provided:-

- Manhole Locations
- Foul, clean and combined systems
- Pumping Stations
- Storm Overflows
- Flow Controls
- Hydro brakes
- Rising Mains
- Siphons
- Air Valves

- Detention Tanks
- Treatment Works

A request was also made for the DG5 (flooded properties) register for the area. This register identifies 14 individual properties known to flood from the sewer system, which is within the scope of this study. Information from this register was pooled with the local knowledge collected from the other stakeholders.

The location of YW's sewer networks and their capacities was also requested. YW has provided some of this information in their Drainage Area Plans (DAPs). Although this information gives an indication of the potential weaknesses in the sewer system it was only provided towards the end of the PFRA process and the information is not recent.

Consequently there is insufficient time available in this exercise to carry out a full analysis which would make comparisons with other data and highlight areas for more detailed study. However, YW has embarked upon a 4 year programme to update all its DAP's which means that improved data will be available for further study prior to the 6 year review of the PFRA.

3.2 Historic Flood Maps

The EA provided the historic flood maps which give an indication of past flooding which has occurred from all sources. Due however to the fact that this study should only include flooding from surface water, ground water and ordinary watercourses, the historical flood maps will be of limited use. The historic flood maps are shown in Figure 10 included in Appendix 1.

3.3 Strategic Flood Risk Assessment (SFRA)

This document was produced on behalf of Calderdale MBC, Kirklees Council and Wakefield Council by JBA Consultants in November 2008. A combined SFRA was undertaken for these three councils because the districts are all located within the River Calder catchment and so combined consideration of flood risk issues for all these areas is a sensible approach.

The SFRA is primarily a reference document for planners and developers. It is to help them to balance development drivers with the need to steer developments away from areas at the highest risk of flooding. The SFRA looks at all sources of flooding.

Effective flood risk management is achieved partly by avoidance of inappropriate development in high risk zones. This should take priority over substitution of lower vulnerability infrastructure where avoidance is not possible. Where avoidance or substitution is not possible the mitigation of the risks through a variety of techniques should be undertaken.

Whilst the SFRA does provide modelled flood extent maps, it does not contain any detailed local knowledge which can be extracted and used in this PFRA study.

3.4 Catchment Flood Management Plan (CFMP)

This document was produced by the EA, however it has not been finalised and could still be subject to alterations. The CFMP encompasses all of the Calder Catchment which covers an area of 945.5 km^2 and includes the Rivers Calder, Colne, Hebble, Ryburn and Holme.

This is another strategic planning document for managing flood risk specifically for this Calder Catchment Area over the next 50 – 100 years and is one of 76 CFMPs which cover all of England and Wales.

The CFMP not only assesses how flood risk affects development issues but also social, economic and environmental aspects of the Calder Catchment.

The CFMP provides a detailed study of the Calder Catchment and makes recommendations for future flood risk management which need to be taken into account by the future Calderdale Local Flood Risk Management Strategy. However the recommendations are based at sub-catchment level and although they inform the PFRA process they are not truly comparable to the local scale of flooding hot spots.

4.0 Past Flood Risk

4.1 Analysis of local knowledge gathered

The best local knowledge information of past flooding incidents has been collected and pooled from all the sources described in Section 3. A total of 2177 separate flood related events have been collected. Table 4 below indicates the source of this information.

Table 4: Total recorded flood related incidents and the source of this data

Source of data	Number of data entries
Amey LG	187
British Waterways	5
CMBC land drainage database	1893
CMBC proposed capital schemes	49
CMBC completed capital schemes	2
CMBC general internal knowledge – Known historical extreme local events	9
Network Rail	7*
Town and Parish Councils	2*
Yorkshire Water (DG5 Register)	14
Total	**2177**

***Note:** *Although local knowledge was provided by Network Rail and the Town Parish Councils, this data could not be mapped, due to locations given not being specific enough. These data entries were not given a classification or included in table 5.*

The EA's 1 in 200 year shallow surface water flood map shows the most extensive second generation surface water flood outline and has been used as a reference surface water flood outline for the local knowledge collected.

In Figure 11, the locations of past surface water flooding incidents have been mapped. Each incident is shown in green or red depending on its proximity to the flood outline. This cross references each incident with the modelled flood outline, indicating which is located inside (green) or outside (red) the expected flood outline. The local knowledge gathered has generally been shown to verify the accuracy of the surface water flood maps. It should be recognised, that some local knowledge highlights isolated flooding which could not have been predicted in the surface water flood maps, e.g. a property cellar flood, a culvert which regularly blocks and causes highway flooding.

4.2 Locally significant flooding

Once all of the readily available information had been collected incidents and risks which are considered locally significant were identiifed.

Determining a definitive and quantifiable criterion for local significance was difficult. This was due to the following reasons;

- There is no nationally agreed set of criteria by which to establish this and so judgements on a case-by- case have been made.
- Limited information was available for each incident recorded and determining exactly what had been affected in the locality by a past event was not possible and certainly not to the required timescale.
- A more sophisticated means of data recording is needed together with robust protocols for ensuring sufficient feedback is obtained.
- A flood event may cause little damage to infrastructure directly, but it still may be seen as locally significant e.g. a deep pond of surface water on the highway or severe icing in winter may occur frequently and could cause a serious road traffic accident.

For these reasons each incident was taken on a case by case basis and a classification of significant (S), less significant (L), not significant (N) and other (O) was assigned. The meaning of each classification is as follows;

Significant (S) – This is a location with potential for repeat flooding / icing with no remedial measures in place at this present time. Local disruption to people or infrastructure has been caused at this location and this may reoccur. Refer to Figure 12, in Appendix 1 for the location of each incident identified as significant.

Less Significant (L) – This location has been known to flood or be subject to icing in the past and now has some remedial measures put in place. Some local disruption to people or infrastructure has been caused at this location and this might reoccur.

Not Significant (N) – This location has been known to flood / ice but is unlikely to be a cause of future problems. Remedial works have been put in place at this location which has solved the root cause.

Other (O) – This location has been a source of reported problems, however not enough information was immediately available about this particular location in order to give it a classification and more investigation is required.

Table 5: The number of incidents within each classification

Classification	Number of incidents
Significant	392
Less Significant	803
Not Significant	875
Other	98

Any locally significant incidents identified have been included in Annex 1 of the PFRA spreadsheet, along with their consequence to cultural heritage, the environment, human health and the economy, where it has been possible to make this assessment.

The locations within CMBC of locally sensitive locations of cultural heritage, the environment, human health and the economy along with the locations of locally significant flood locations are shown in Figures 13 – 21, in Appendix 1.

4.3 Causes of surface water flooding

A feature of the CMBC area is steep topography which is an underlying reason for the dispersed nature of flooding areas, except in the valley bottoms. Therefore surface water flood events across CMBC tend to be numerous but generally tend not to have a serious or lasting impact on people or infrastructure. This however is not always the case, and in a small proportion of instances, there have been serious impacts to both people and infrastructure.

Other main contributing factors to surface water flooding across the area have been identified below.

- <u>Blocked ditches, road gullies and culverts</u> - The cause of a lot of the surface water flooding incidents is blocked ditches or road gullies, causing flooding to the surrounding area. Much of the surface water flooding is made worse in the autumn, when leaf fall is high, causing culverts and road gullies to block.

  Surface water flooding also occurs when ordinary water courses are culverted underneath road embankments, railways and canals, but become blocked due to a lack of regular maintenance.

  A programme of regular checking and maintenance of some principle culvert crossings is undertaken by CMBC. This helps to reduce surface water flooding.

  There are thousands of culverts across CMBC. If the policy of regular maintenance was expanded this would contribute further to flood risk management in the Borough.

- <u>Poor Land Management</u> - Due to the topography of Calderdale, large amounts of surface water runs off directly from the surrounding land and fields. If drainage systems have not been designed to carry large run-off flows or are not well maintained, the flooding of highways and surrounding properties will result. Surface water run-off from the land can be reduced by proper management of the higher moorland areas and farmland.

Various land management techniques have been identified to attenuate and reduce surface water flooding from the land. This includes replanting in certain areas, grip-blockers which attenuate runoff from moorland, the direction fields are ploughed and adequate land drainage. All such techniques can be effective in reducing the intensity of surface water run-off from land but these are sometimes frustrated by environmental considerations (see Section 2 on Natural England).

- Ground water flooding – From the data collection exercise undertaken, ground water was not a significant contributor to the surface water flooding within the CMBC owing to the geology of the area.
- Sewer Flooding – The DG5 register of flooded properties was obtained from Yorkshire Water. This included 14 addresses in Calderdale. All DG5 properties are reviewed on a regular basis and the cost benefit of providing solutions is examined. This helps to prioritise a programme of solutions overseen by OFWAT.

  Other areas of repeated non-property flooding are known to exist and these will be discussed with Yorkshire Water in due course. Sewer flooding was not considered a major source of surface water flooding within the CMBC area.

  Flood risk from sewers will be assessed in a later stage using hydraulic model output as a base measure. Most of the current models available, held by Yorkshire Water have not been updated in a number of years. Over the next 4 years all or most of the models covering Calderdale will be updated and re-run. This should provide the opportunity to gauge the risks as accurately as possible.
- New Developments – Considerable work is on-going between the Planning Services and the Enviroment Team which provides flooding and surface water disposal consultation and performs the Council's duties as LLFA. It is important to increase awareness of flood risk and sustainable development throughout the planning and building control processes.

  Sustainable drainage is an issue which will affect all providers of drainage facilities in England and Wales.

  Much remains to be done both internally and with contributing architects, developers and consultants to raise standards to the level envisaged by PPS 25, the Pitt Review and the Flood and Water Management Act. Action to try and resolve significant procedural and administrative issues is ongoing.

  New development should be protected from flood risk and should not increase surface water run-off to sewers or to watercourses. Greenfield run-off rates should be preserved after development.

- Surface water and main river interaction - When main rivers levels are high, it can prevent surface water from being discharged into the main river system. The surface water could then back up and cause flooding to the locality.

  This is a significant and complex issue in Calderdale owing to the topography and characteristics of local development. This matter should be the subject of detailed study in conjunction with the EA to understand the risks more fully.

- Mine Water - Disused mines can contain large amounts of ground and rain water and when full will discharge the collected water to the locality. This has only been identified as the cause of flooding in a few locations.

- Canals - A number of canal locations within CMBC have been identified as having caused or have the potential to cause flooding from breaching or overtopping.

- Large “one off,” rainfall events - Widespread surface water flooding can occur in some locations only when a very high intensity rainfall event takes place. A number of such “one off,” events have been recorded which have caused widespread flooding and risk to life. It is difficult to prepare and protect a locality against such high intensity rainfall events. Examples of such events are;

a) The 1982 flood at Cornholme produced damage to the locality which was very extensive. Main river culverts were unable to transmit the generated flows and major flooding occurred with significant damage to properties and infrastructure being sustained. This generated a major capital scheme.

b) The 1989 flood over Luddenden and Wainstalls was estimated to be greater than a 1 in 1000 year rainfall event. Roads, houses and industrial premises in the locality were severely damaged. Lives were put at risk from the deluge. The recovery lasted almost 6 months even though the main effects were confined to only a small area of the borough. Effects were also observed in Halifax and Brighouse.

c) The 2000 flooding caused widespread damage nationally. Calderdale was also affected.

d) Various other events occurred in the 1980’s including those at Norland (Sowerby Bridge) and Cragg Road (Mytholmroyd).

e) Regular events affect the A646 particularly in the centre of Mytholmroyd and between Hebden Bridge and Todmorden.

5.0 Future Flood Risk

Most future surface water flooding has been assessed using national data sets (i.e. not locally collected knowledge) provided by the EA.

Data was also obtained from the Council's Strategic Planning Section regarding future development, giving some indication of areas where increased attention to surface water management will be required if and when development proceeds.

5.1 Surface water flood maps

The first generation surface water flood maps were produced in 2008 by the EA following the recommendations stated in Sir Michael Pitt's Report.

The second generation surface water runoff maps are a revision of the first generation maps and in some locations are considered to be a better representation of surface water flooding. This was due to more realistic modelling parameters used in the second generation maps. A comparison of the main differences in modelling parameters used, in the first and second generation maps are shown in table 6 below.

Table 6: A comparison of the first and second generation surface water flood maps

Modelling parameter	First generation maps	Second generation maps
Ground Data Used	DTM data	Recently surveyed DTM
Buildings Accounted for	No	Yes
Rainfall Profile	Summer Profile	Summer Profile
Storm Duration	6.25 hour storm	1.1 hour storm
Roughness	Generic	Better Representation
Sewers	Not accounted for	12 mm / hr
Rainfall Events	1 in 200 year	1 in 30 and 1 in 200 year
Surface water runoff	100% Runoff	70% urban, 39% rural
Model grid resolution	5 metres	5 metres

The first and second generation map outlines were compared to determine which best represented surface water flooding in the CMBC area. From this comparison, local knowledge of flooding and the modelling parameters used, it was agreed that the second generation flood maps were considered to be the better representation of the surface water flooding in CMBC and were used in this study.

The numbers of residential and non-residential properties assessed to be at risk of surface water flooding, from the 1 in 200 year rainfall event, have been included in Annex 2 of this report.

5.2 EA flood outlines

The EA provided flood outlines of flood zones 2 and 3 in a GIS format for all watercourses.

- Flood zone 2 shows the fluvial flood outline for up to the 1 in 1000 year flood event.

- Flood zone 3 shows the fluvial flood outline for up to the 1 in 100 year flood event.

Figure 22 included in Appendix 1, shows ordinary watercourse flood zones distinct from the main river flood zones. This gives an indication of future surface water flood risk locations.

5.3 Locations of future development

Areas of future development were obtained from the CMBC Planning Services. This gives an indication of where surface water flooding may increase due to the increase in impermeable area and potential development in or close to flood risk areas.

Future development plans show areas where residential and business developments are to be located over the next twenty years. This information is shown in Figures 23 and 24 in Appendix 1.

Future development however, should not increase surface water runoff due to the requirements of PPS-25 which stipulates that surface water runoff from a site must not increase post development. Therefore, if surface water runoff from these sites is properly managed, flood risk from surface water runoff should not increase.

5.4 Climate Change

- **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 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 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 14%

- **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).

6.0 Flood Risk Areas

6.1 Methodology for identifying flood risk areas

It should be noted, that in total 62 “blue squares,” 4 “clusters,” and no areas of “nationally significant,” flood risk have been identified within CMBC, according to the EA’s initial assessment. Figure 25 shows the EA’s assessment of “blue square,” areas. The EA used the National Receptor Database (NRD) to produce this assessment. These data sets provided locations of most of the infrastructure within CMBC, including residential housing, businesses, critical infrastructure etc.

This assessment of the “blue square,” flood risk areas which the EA have identified was reviewed using the best available data. Generally it was noted that where local data sets were available, these would be a more reliable source of data than the NRD. The source of the data which has been used in the re-assessment of the blue squares is shown in table 7 below.

Table 7: The best available data used in the re-assessment of “blue square,” areas

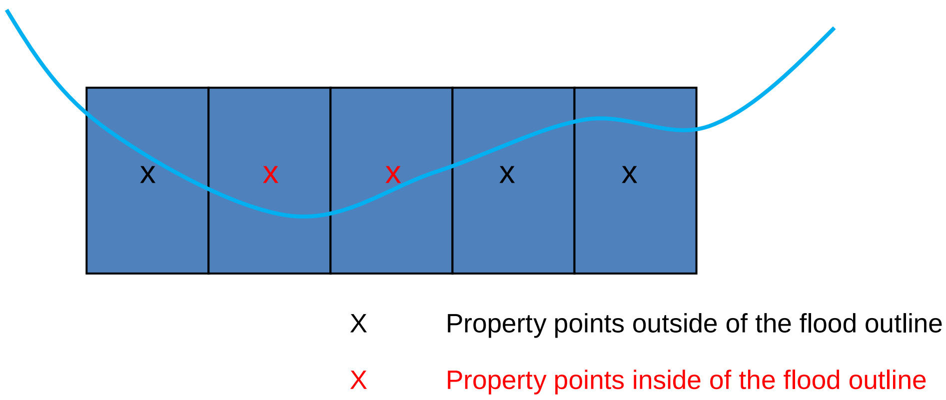
Data	Data source
Residential Properties	CMBC data sets
Non-Residential Properties*	NRD from the EA
Ambulance Stations	CMBC data sets
Care / Nursing Homes	CMBC data sets
Fire Stations	CMBC data sets
Health Points	CMBC data sets
Hospitals	CMBC data sets
Mental Homes	CMBC data sets
M62	CMBC data sets
Police Stations	CMBC data sets
Railways	CMBC data sets
Roads (Main A-Roads)	CMBC data sets
Schools	CMBC data sets
Gas	Northern Gas
Electrical	CMBC data sets
Water	Yorkshire Water

***Note**: The NRD data was used for non-residential properties, in preference to other data sets as the EA were very specific about what was and was not to be classified as a non-residential property. CMBC did not have a data set which matched this specific criteria, so the EA’s NRD had to be used.*

A “blue square,” is identified when a 1km^2 area has more than 200 residential properties or 20 non-residential properties or more than 2 critical infrastructures affected by surface water flooding.

This assessment has been done by the EA using the 1 in 200 year deep (greater than 0.3 metres) second generation surface water flooding map. Property outlines were used in this assessment, as opposed to a property point. This gave a more accurate assessment of properties affected by surface water flooding, as demonstrated in Figure 26 below.

Figure 26: Property count methodology



Some properties would be assessed as being outside the surface water flood map if the property was represented by simply a point. However, if the whole property outline is taken into account in the assessment, all property polygon outlines which intersect the flood outline would be included in the property count.

Where surface water flooding, identified from local knowledge, was shown to be outside of the default flood risk areas and could produce a new “blue square,” risk area, the surface water flooding outline at this location was investigated in more detail. This ensured that any local knowledge collected, was also accounted for in the “blue square,” assessment.

6.2 Identification of “blue square,” flood risk areas

With reference to Figure 27 in Appendix A, all of the new flood risk areas have been checked against the criteria, with the aid of all the local knowledge collected and the best available GIS data.

The default “blue squares,” identified by the EA has each been numbered. Any “blue square,” areas assessed as not meeting the criteria shown in green have been shown along with any new “blue squares,” shown in red.

In total 4 of the 62 blue squares originally identified have been assessed to not meet the criteria. A comparison of the EA’s assessment and this assessment is shown in table 8 below.

Table 8: Flood risk areas assessed not meet the "blue square," criteria shown in Figure 27

Square number	Residential		Non-residential		Critical Infrastructure	
	EA	Mouchel	EA	Mouchel	EA	Mouchel
23	46.8	45.5	15	6	2	1
34	65.5	72.5	23	19	0	1
44	93.6	98.3	10	10	2	1
59	234	133.4	21	17	1	0

In addition to the default blue squares, 10 new "blue squares" were assessed. The reason for identifying these areas as new "blue square," is shown in table 9 below.

Table 9: New "blue square," risk areas identified, shown in Figure 27

Square number	Residential	Non-residential	Critical Infrastructure
12	22	4	2
13	15	7	2
14	71	12	2
15	36	12	2
27	19	17	2
30	79	15	2
61	11	16	2
63	25	3	3
68	21	1	2
72	0	5	2

All of these new "blue square," areas qualify by virtue of an identified two or more critical infrastructure sites.

7.0 Conclusions and Recommendations

7.1 Conclusions

Calderdale has no significant surface water flood risk assessed according to the national definition. Consequently the later stages of Flood Risk Management Planning for the borough are condensed into the formation of a Local Flood Risk Management Strategy (FRM Strategy) which is required to follow a national format yet to be announced.

Surface Water flood risk to Calderdale MBC falls into four main categories.

- Flooding caused by inhibition of surface water outfalls to river during high main river flows
- Overloading and/or blockage of minor watercourses and other surface water infrastructure outside the influence of main rivers
- Surface water run-off from steeply sloping land or man-made surfaces.
- New development

The first of these categories is not clearly understood and there needs to be more work done jointly with the EA before any specific conclusions and recommendations can be formed.

The second is relatively easy to plan for provided that sufficient funds are available to commit to a programme of routine inspection and maintenance. The FRM Strategy should clearly indicate how maintenance of ordinary watercourses will be procured and funded.

Detailed inspection of Yorkshire Water's hydraulic models is required as and when these are updated to identify areas which may give rise to additional local flood risk especially as the effects of climate change become more apparent. If these studies generate Yorkshire Water future investment, this needs to be taken account of in the overall flood risk management plan.

Data collection has identified flooding incidents at 2,177 locations in the borough. Although detail is not consistently available it is considered that a high proportion of these are caused by breakdown of field drainage and other infrastructure. The effects are varied but during winter the smaller the flow of water the greater the problem in terms of icing on highways and footpaths.

Approximately 20% of the total incidents have been assessed to be of local significance. However, when compared to surface water flooding at a national scale the vast majority of incidents recorded within CMBC are relatively minor.

A small number of more serious incidents have been recorded, caused by impeded discharge to or within rivers during extreme rainfall. There is little that can be done to prevent these rarer events. Response will centre around general preparedness and effective recovery.

Although new development has contributed greatly to flood risk in the past by its presence in previously at risk areas and by increasing discharge to the local sewer and watercourse infrastructure the task of the LLFA and the Planning Authority is to reduce this to an absolute minimum. National and local guidance is in place and the Council's new duties under the Flood and Water Management Act 2010 reinforce these provisions.

7.2 Recommendations

The following measures are recommended:-

- Through the recently formed Calderdale Flood Risk Management Group a study group should be formed to investigate the interface between main river and other surface water infrastructure in order to gain an understanding of how, when and where they interact to cause surface water flooding. Initial approaches have already been made to the EA.

- The recently acquired watercourse and surface water data collection and analysis system known as DAMS should be developed alongside other corporate systems as an asset management tool. Assets and features on those assets should be recorded and condition graded in a consistent manner to enable judgements to be made on future inspection requirements and routine and ad- hoc maintenance. DAMS is configured to facilitate transfer of data to a national database which is under development by the EA.

- Incidents should also be recorded in a consistent manner in the DAMS system with sufficient detail to allow prioritisation of action which can be judged against available finance to progress a programme of remedial measures. Incoming reports are currently logged in the Council's Insight database and cross-referenced to DAMS. Incident investigation is required under the Flood and Water Management Act 2010

- Planning Services and Highways and Engineering should continue to build an effective and efficient protocol which serves the needs of both Planning and Flooding legislation. Guidance for developers continues to be improved as new duties and responsibilities are announced by Government. Consideration of the mitigation of surface water runoff should be included for new and in some instances, existing developments, e.g. SUDS.

- Continued co-operation between Flood Risk stakeholders. This should be achieved by continuing and developing the Calderdale Flood Risk Management Group. Formed initially by representatives from the Council, the EA and Yorkshire Water other stakeholders will be engaged as appropriate.

- A better rapport needs to be built between the Council and Natural England in relation to the potential use of land management techniques in upland areas to reduce future flood risk.

- The Local Flood Risk Management Strategy, which is a statutory requirement of the Flood and Water Management Act 2010, will be prepared and brought forward to the Scrutiny Committee.

- The cost of implementing these recommendations is not yet known but it is likely be significant. Continued effort should be made to identify sources for funding flood risk management.

8.0 References:

1. *The Preliminary Flood Risk Assessment Final Guidance, Main Report (EA publication, December 2010)*

2. *The Preliminary Flood Risk Assessment Final Guidance, Annexes (EA publication, December 2010)*

3. *The Flood Risk Regulations 2009*

4. *Selecting and reviewing Flood Risk Areas for local sources of flooding, Guidance to Lead Local Flood Authorities (DEFRA publication 2010)*

5. *Property Count Methodology, Technical Note (EA publication, December 2010)*

6. *The Flood and Water Management Act 2010*