

2011

Kirklees Surface Water Management Plan

An evidenced statement on the surface water flood risk in Kirklees and a delivery plan for reduction of the risk across the district

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Kirklees Council

1/2/2011



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Acknowledgements

This report follows the guidelines set down in the “Surface Water Management Plan Technical Guidance” published March 2010 by Defra.

The Integrated Urban Drainage (IUD) pilot projects carried out to test and inform the guidance document, have been a useful resource in determining a practical approach to produce an effective SWMP for Kirklees. In particular, the plans produced by Richmond and Warrington have suggested processes that have influenced and guided the Kirklees SWMP.

Use of the Information in the Report

As Lead Local Flood Authority (LLFA), Kirklees Council has a duty to develop, maintain, apply and monitor a strategy for local flood risk management. The LLFA must specify objectives to manage flood risk and suggest measures to achieve those objectives. The LLFA has a responsibility to consider the flood risk management functions that it may exercise to reduce risk.

In support of the aim of a general reduction of flood risk across the district, the Council will prioritise investigations and works identified in this Plan to the best of its abilities, based on perceived and evidenced risk and within limited resources.

The indications of flood risk in the report are high level and based on incomplete information. A level of subjectivity has been used in assessing relative flood risk and the results will be used to prioritise future, more robust, investigations and assessments which will, hopefully, lead to reliable measures of risk. Consequently, it is not appropriate to apply the information and recommendations in this report at a local, property level.

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1 Executive Summary

In June 2007, widespread extreme flooding was experienced in the UK. The Government review of the 2007 flooding, chaired by Sir Michael Pitt recommended *“Local Surface Water Management Plans (SWMPs) ... coordinated by local authorities, should provide the basis for managing all local flood risk.”*

The Governments guidance document for SWMPs, “Surface Water Management Plan Technical Guidance”, defines a SWMP as:

- a framework through which key local partners with responsibility for surface water and drainage in their area, work together to understand the causes of surface water flooding and agree the most cost-effective way of managing surface water flood risk
- a tool to facilitate sustainable surface water management decisions that are evidence based, risk based, future proofed and inclusive of stakeholder views and preferences
- a plan for the management of urban water quality through the removal of surface water from “combined” systems and the promotion of SUDS

As a demonstration of its commitment to SWMPs as a structured way forward in managing local flood risk, Defra announced an initiative to provide funding for the highest flood risk authorities to produce SWMPs. Kirklees Council was one such authority, receiving a grant of £100k towards its plan, with a delivery date of April 2011.

Recent legislation, The Flood and Water Management Act 2009 and The Flood Risk Regulations 2010, place new responsibilities on Councils to understand, coordinate and manage local flood risk, creating the new role for Kirklees Council of Lead Local Flood Authority (LLFA).

The legislation, for the first time, creates a clear distinction between responsibility for main-river flooding, managed by the Environment Agency, and flooding from other sources (Surface Water Flooding), managed by the LLFA.

The SWMP process allows discretion to adopt a level of analytical detail appropriate to the quality and quantity of the data available. Consequently, reflecting the scarcity of information available on which to make judgements on risk and priorities for mitigation of the risk, the Kirklees SWMP is strategic and area wide. It has the broad aim of evidencing the general flood risk across the whole district, identifying areas of higher flood risk requiring further, more detailed investigation.

Kirklees is the 11th largest district council out of 348 (Population of around 400,000) and 3rd largest metropolitan council in area (400km²). The main population centres are Huddersfield (125,000), Dewsbury (57,000) and Batley (45,000), with a further 10, or so, small towns (5-20,000). Around 40% of the area is heavily urbanised with 60% rural in character, of which half is in the Pennine hills.

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With respect to water resources, Kirklees has 27 large reservoirs in the Pennines, managed by the local Water and Sewerage Company, Yorkshire Water. There are approximately 100km of enained river, managed by the Environment Agency, and unrecorded, but substantial, lengths of culverted and open minor watercourses. The main rivers in the district are the rivers Colne and Calder flowing to the river Aire, which drains around 85% of the area, and the river Dearne flowing to the river Don, draining the remaining 15%. Average annual rainfall figures for the district range from 1800mm at the Pennine headwaters to 800mm in Huddersfield, compared with an average across England of 950mm.

Surface water flooding is generally more prevalent in the hillier, rural, less developed south side of the district. The settlements along the Dearne, Holme, Colne and Woodsome Valleys are concentrated along the rivers and suffer the consequences of rapid surface water runoff from the uplands and fields on the steep valley sides. Formal drainage systems are sparse, often unrecorded and consequently, poorly maintained. The industrial heritage of the larger settlements as textile centres has left a historical legacy of stone culverts carrying surface water through areas of high residential occupation. Information on the location, condition and connectivity of the culvert systems is piecemeal but is a significant factor in understanding and reducing flood risk in those locations.

The large settlements to the centre and north of the district, Huddersfield, Dewsbury and Batley, have significant networks of public sewers, owned and maintained by Yorkshire Water, with less evidence of smaller culverted watercourses remaining in those areas. It is likely that the traditional means of draining surface water via watercourses has been gradually replaced by the developing public sewer system carrying rainwater in both surface water and combined sewers.

There has been recent significant local summer flooding in the summers of 2002, 2004, 2007 and January 2008

The 2007 floods flooded up to an estimated 500 properties across the district and were described by many residents as the worst in living memory. The flooding was widespread across the district but hotspots occurred around Ravensthorpe, Liversedge, Cleckheaton, Chickenley, Mirfield, Milnsbridge, Brockholes, New Mill, Denby Dale, Scissett and Clayton West.

The 2007 events demonstrated that disruptive and damaging levels of flooding are unpredictable in nature but increasingly likely to occur. Much of the future flood risk is likely to be associated with surface water rather than from rivers and, as such, the mechanisms need to be understood by Local Authorities to allow them to fulfil their roles as LLFA's.

Following the 2007 floods, the Environment Agency produced maps that identified areas susceptible to surface water flooding following severe rainfall. The maps were used in the assessment of relative flood risk to determine the allocation of future funding for local flood risk management and are a useful indication of the scale and relative risk of surface water flooding in Kirklees:

- Kirklees is one of 149 LLFA's in England, ranking 55th in terms of general flood risk

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- Excluding Counties and London Boroughs, Kirklees' ranks 7th behind Hull, Birmingham, Brighton, Doncaster, Leeds and Leicester, in terms of the flood risk to be managed by the LLFA.
- 15,000 properties in the district are at risk from surface water flooding and 12,000 from main river flooding

The Kirklees SWMP provides an evidence base for understanding surface water flood risk across the district. A district-wide, high-level, low-detail assessment of relative surface water flood risk has been carried out to provide a foundation for future, more detailed assessment work, targeted at the areas where the risk is highest. The SWMP includes the following:

- Development of a formal drainage asset recording system for all the surface water systems in the district
- Development of a flood incident recording system to build up an understanding of where flood risk is located
- Representation of the asset and incident information in a graphical format to allow improved visibility and easy cross-referencing of the data
- An assessment of local surface water flood risk using the above data, EA surface water maps, topographic/demographic information and site surveys
- Representation of the relative surface water flood risk across the district in a format that is understandable and accessible by the general public
- A prioritised programme for future detailed investigation of the higher risk areas
- A suite of measures that could be employed to mitigate the risk in the higher risk areas

A partnership approach has been taken to the SWMP, with the Environment Agency and Yorkshire Water engaged as principal partners in the production of the plan. Information on drainage assets, incidents and predictions of the scope and severity of future flooding have been collected through the partnership and represented on the Councils GIS system for ease of understanding, analysis and presentation of flood risk.

An assessment of the risk from surface water flooding has been carried out on a 500m square grid across the district, ranking areas on relative flood risk. Risk factors include critical infrastructure (schools, hospitals, transport routes etc), residential and commercial property density and the presence of historical flood incidents, coincident with the location of predicted flooding.

The results of the assessment highlight around 200 "squares", or areas, where the risk from surface water flooding could be significant and future, more-detailed investigation work could be beneficial. The areas are spread around the district but concentrations occur around Slaithwaite, Ravensthorpe, Dewsbury, Liversedge and the A62 Leeds Road corridor at Deighton.

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The strategic approach to local surface water flood management is in a process of development and the recent European legislation, The Flood Risk Regulations 2010, impose a duty on Lead Local Flood Authorities to follow a structured approach to understanding, publicising and reducing surface water flood risk in their districts. There are clear parallels between the Preliminary Flood Risk Assessment (PFRA), required by the Regulations, and the SWMP process, followed by Kirklees.

The Council's current legal obligations lie mainly with the Flood Risk Regulations and these will direct immediate work. The SWMP provides an evidence base to inform the PFRA required by the Regulations.

The Action Plan for the SWMP includes a programme of further investigations of those areas identified as at high risk from surface water flooding with an indication of the level of Kirklees Council resources required to deliver the actions.

2 Glossary

Annual Exceedance Probability (AEP)	The chance of a flood of a given size happening in any one year eg 1 flood with a 1% AEP will happen, on average, once every 100 years
Catchment	A surface water catchment is the total area that drains into a river or other drainage system
Catchment Flood Management Plan (CFMP)	A strategic planning tool through which the Environment Agency works with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.
Chance of flooding	The chance of flooding is used to describe the frequency of a flood event occurring in any given year, e.g. there is a 1 in 100 chance of flooding in this location in any given year. This can also be described as an annual probability, e.g. a 1% annual probability of flooding in any given year. (See AEP)
Critical infrastructure	Infrastructure which is considered vital or indispensable to society, the economy, public health or the environment, and where the failure or destruction would have large impact. This would include emergency services such as hospitals, schools, communications, electricity sub-stations, Water and Waste Water Treatment Works, transport infrastructure and reservoirs.
Department for Environment, Food and Rural Affairs (Defra)	The UK government department responsible for policy and regulations on the environment, food and rural affairs
Designing for Exceedance	Designing for Exceedance is an engineering philosophy or approach which aims to plan for and manage flows which are larger than the designed capacity of infrastructure during rainfall events. An example of designing for exceedance would be the use of car parks to store water during flood events.
DG5 Register	A Water and Sewerage Company (WaSC) held register of properties which have experienced sewer flooding (either internal or external flooding) due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Environment Agency	The Environment Agency was established under the Environment Act 1995, and is a Non-Departmental Public Body of Defra. The Environment Agency is the leading public body for protecting and improving the environment in England and Wales today and for future generations. The organisation is responsible for wide ranging matters, including the management of all forms of flood risk, water resources, water quality, waste regulation, pollution control, inland fisheries, recreation, conservation and Navigation of inland waterways. It will also have a new strategic overview for all forms of inland flooding
Environment Agency Flood Zones	Flood zones on the maps produced by Environment Agency providing an indication of the probability of flooding (from rivers and the coast) within all areas of England and Wales.
Exceedance flows	Excess flow that appears on the surface once the capacity of the underground drainage system is exceeded

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Flood Hazard map	A map which identifies flood risk areas and shows – a) the likely extent (including water level or depth) of possible floods, b) the likely direction and speed of flow of possible floods, and c) whether the probability of each possible flood occurring is low, medium or high.
Flood Risk Management Plan	A plan for the management of a significant flood risk. The plan must include details of – a) objectives set by the person preparing the plan for the purpose of managing the flood risk, and b) the proposed measures for achieving those objectives
Flood Risk Regulations	Legislation that transposed the European Floods Directive in 2009
Flood Risk map	A map showing in relation to each flood risk (a) the number of people living in the area who are likely to be affected in the event of flooding, (b) the type of economic activity likely to be affected in the event of flooding, (c) any industrial activities in the area that may increase the risk of pollution in the event of flooding, (d) any relevant protected areas that may be affected in the event of flooding, (e) any areas of water subject to specified measures or protection for the purpose of maintaining the water quality that may be affected in the event of flooding, and (f) any other effect on— (i) human health, (ii) economic activity, or (iii) the environment (including cultural heritage).
Flood and Water Management Act	The Flood and Water Management Act clarifies the legislative framework for managing surface water flood risk in England.
Floods Directive	The EU Floods Directive came into force in November 2007 and is designed to help Member States prevent and limit the impact of floods on people, property and the environment. It was transposed into English law in December 2009 by the Flood Risk Regulations.
Fluvial Flooding	Resulting from excess water leaving the channel of a river and flooding adjacent land
Future Water	The Government's water strategy for England; Future Water was published in February 2008. This strategy sets out the Government's long-term vision for water and the framework for water management in England.
Integrated Urban Drainage (IUD) Pilots	The 15 Defra funded studies which ran from January 2007-June 2008 to test new approaches to working in partnership to improve management of urban drainage.
Local Development Framework (LDF)	A non-statutory term used to describe a folder of documents which includes all the local planning authority's Local Development Documents (LDDs). The local development framework will also comprise the statement of community involvement, the local development scheme and the annual monitoring report.
Local Resilience Forums (LRF)	LRFs are multi-agency forums, bringing together all organisations which have a duty to co-operate under the Civil Contingencies Act, and those involved in responding to emergencies. They prepare emergency plans in a co-ordinated manner.

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Main River	Main Rivers are watercourses marked as such on a main river map. Generally main rivers are larger streams or rivers, but can be smaller watercourses.
Making Space for Water	MSfW, launched in 2004, outlines the Government strategy for the next 20 years to implement a more holistic approach to managing flood and coastal erosion risks in England.
Ordinary watercourse	An ordinary watercourse is any other river, stream, ditch, cut, sluice, dyke or non-public sewer which is not a Main River. The local authority has powers for such watercourses.
Pitt Review	An independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England
Planning Policy Statements (PPS)	These set out the Government's national policies on different aspect of planning. The policies in these statements apply throughout England and focus on procedural policy and the process of preparing local development documents. PPS25 sets out policy to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas at risk of flooding and direct development away from areas at highest risk.
Pluvial flooding	'Pluvial' flooding (or surface runoff flooding) is caused by rainfall and is that flooding which occurs due to water ponding on or flowing over the surface before it reaches a drain or watercourse.
Resilience measures	Resilience measures are designed to reduce the impact of water that enters property and businesses, and could include measures such as raising electrical appliances
Resistance measures	Resistance measures are designed to keep flood water out of properties and businesses, and could include flood guards for example.
Riparian owners	A riparian owner is someone who owns land or property adjacent to a watercourse. A riparian owner has a duty to maintain the watercourse and allow flow to pass through his land freely.
Risk	In flood risk management, risk is defined as the probability of a flood occurring x consequence of the flood
Strategic Flood Risk Assessment (SFRA)	A SFRA provides information on areas at risk from all sources of flooding.
Surface water flooding	In this context, surface water flooding describes flooding from sewers, drains, groundwater, and runoff from land, small water courses and ditches that occurs as a result of heavy rainfall.
Sustainable Drainage Systems (SuDS)	A sequence of management practices and control measures designed to mimic natural drainage processes by allowing rainfall to infiltrate and by attenuating and conveying surface water runoff slowly compared to conventional drainage.
UK Climate Impacts Programme (UKCIP)	UKCIP was established to co-ordinate scientific research into the impacts of climate change. In 2002 UKCIP released climate change scenario data, which was updated in 2009
Urban Creep	The change of permeable areas within the urban environment to impermeable areas. Typical types of urban creep are the creation of patios, paving the front gardens to create hard standing parking areas or house extensions.
Water Framework Directive (WFD)	A European Community Directive (2000/60/EC) of the European Parliament and Council designed to integrate the way water bodies are managed across Europe. It requires all inland and coastal waters to reach "good status" by 2015 through a catchment-based system of River Basin Management Plans.

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3 Introduction

3.1 Surface Water Management Plans in Context

The Government's national strategy for flood and coastal erosion risk management, Making Space for Water (MSfW), set out a range of approaches to ensure that flood risk would be managed more effectively in the future by adopting holistic, sustainable and systematic methods. Surface water flood risk in urban areas, arising from inadequacies in drainage systems was a particular concern, with recognition that the physical and institutional complexities of the systems made it difficult to plan improvements to reduce flood risk. MSfW recognised that urban drainage solutions have not always been as cost effective, sustainable, adaptable or robust as they might have been had a more integrated approach been adopted.

In 2007, therefore, Defra instigated a series of 15 pilot studies to examine various aspects of Integrated Urban Drainage (IUD). The pilots assessed the development of partnerships, data sharing, modelling approaches to surface water flood risk assessment, mitigation measures and surface water management in large, new developments. In June 2007, widespread extreme flooding was experienced in the UK, which highlighted that intense rainfall events can occur anywhere and the need for all stakeholders to work in partnership to improve the understanding and management of flood risk. Informed by the IUD Pilots and the summer flooding, Defra, through its Future Water Strategy, set out its intentions to use Surface Water Management Plans (SWMP) as the vehicle to deliver IUD management. The Government review of the 2007 flooding, chaired by Sir Michael Pitt, reiterated this approach. Recommendation 18 of his report states *“Local Surface Water Management Plans, as set out in PPS25 and coordinated by local authorities, should provide the basis for managing all local flood risk.”* (See Section 3.5)

In its response to the Pitt review, the Government confirmed its support for the SWMP approach in high risk areas and outlined the broader intention for local authorities to take a leadership role in local flood risk management.

In October 2008, Defra asked for expressions of interest from local authorities to carry out “first edition” SWMPs to test the emerging guidance on a range of approaches in a range of authorities. 6 SWMPs were carried out and the plans were published in spring 2010.

Many of the general recommendations within the Pitt Review have been carried through to the Flood and Water Management Act (FWMA) 2010 which received royal assent in April 2010, assigning significant new duties for local authorities as Lead Local Flood Authorities (LLFA). The responsibilities around understanding and communicating local flood risk, coordinating actions amongst partners and determining priorities for action can all be developed through a SWMP.

As a further demonstration of its commitment to SWMPs as a structured way forward in managing local flood risk, Defra announced an initiative, prior to the commencement of the Act, to provide funding for the 77 highest risk authorities to produce SWMPs. Kirklees Council was one such authority, receiving a grant of £100k towards its plan, with a delivery date of April 2011.

3.2 How does the SWMP fit with other policies?

The SWMP fits within the existing national and local policy framework, as follows:

Nationally

- The SWMP can be used to coordinate and strategically plan the drainage provision in all new developments where piecemeal actions are inefficient and do not support consistent ownership and maintenance regimes for sustainable drainage systems (SuDS). In addition the SWMP can also provide a framework for the management of water quality (e.g. the control of discharges from combined sewer overflows, surface water drainage outfalls, sustainable drainage systems and the urban surface generally). Solutions which can address both flood and pollution risk have dual benefits, and can contribute to fulfilling improvements and compliance in ecology, water quality and habitats required under the **Water Framework Directive (WFD)**.
- The SWMP will provide understanding of the mechanisms of surface water flooding and propose mitigation measures, which can provide the evidence base to inform Preliminary Flood Risk Assessments and fulfil the requirement for **Flood Risk Management Plans** under the **Flood Risk Regulations (2009)**
- **The Flood and Water Management Act (2010)** requires Lead Local Flood Authorities to develop strategies for local flood risk management for their areas. The SWMP can make an important contribution to inform the development of this strategy and identifying ways to implement it
- **Planning Policy Statement 25 (PPS25)** sets out how new development should not increase flood risk. The SWMP will inform local planning authorities about the areas at risk from surface water flooding

Locally

- The **Calder Strategic Flood Risk Assessment** was completed in November 2008 and delivers an assessment of general flood risk across the Calder catchment in Kirklees, Calderdale and Wakefield.
 - **Calder SFRA (Section 6.6)** – “Limited modelling of surface water flooding has been carried out in 3 higher-risk locations in Kirklees (Huddersfield, Dewsbury and Mirfield) and flood maps have been produced for 1 in 100 and 1 in 1000 events for these locations. The maps indicate many significant areas vulnerable to surface water flooding outside EA River Flood Zone 3, which require more detailed investigation.”
 - **Calder SFRA (Section 8.3)** – “SWMP concepts are embedded in the Governments new Water Strategy, *Future Water*, setting out a vision for more effective drainage of surface water, in order to deal with the dual pressures of climate change and housing development.
In order to achieve this, SWMPs should:

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- Map and quantify surface flows and drainage with sufficient detail to enable local as well as strategic flooding problems to be tackled;
 - Produce a delivery plan that clarifies responsibilities and then directs resources at tackling surface water, prioritising areas at greatest risk first (See Section 7);
 - Influence local planning policy such that new development occurs primarily in areas of low surface water flood risk or where flood risk can be managed effectively, making use of sustainable drainage solutions where appropriate; and
 - Be periodically reviewed, possibly including independent scrutiny of planning and resource decisions to gauge progress in tackling the most serious problems.”
- The **Calder Catchment Flood Management Plan** was completed in July 2010 and provides a strategic overview of FRM in the catchment. The catchment covers approximately 85% of the Kirklees district.
 - **Calder CFMP – Table 3.1** records flood incidents caused by surface water flooding in Marsden and Huddersfield in June 2000, in Mirfield in October 2000 and across the whole district in June 2007.
 - **Section 3.43** confirms the general lack of understanding of surface water flood risk – “*Further understanding of the spatial distribution of surface water flood risk is needed.*”
 - **Table 6.2** summarises the flood mechanisms in the catchment and the risks associated with them.

Colne, Holme and Fenay Beck	Overtopping of the river and fluvial systems, incapacity of the sewerage, culvert and drainage infrastructure and sheet runoff and rapid runoff.	<ul style="list-style-type: none"> • 2,291 properties; • 3,882 people; • over £1.7 million damages to property; • major road networks; • gas and electricity assets; • 1 CoMAH site; • 1 sewage treatment works; • environmentally designated sites.
Spen	Overtopping of the river and fluvial systems, incapacity of the sewerage, culvert and drainage infrastructure.	<ul style="list-style-type: none"> • 722 properties; • 1,139 people; • significant economic and agricultural damages; • road network; • 15 gas and electricity assets.
Mid Calder	Overtopping of the river and fluvial systems, exceedence of sewer capacity.	<ul style="list-style-type: none"> • 128 properties; • 25 people; • over £1 million damages; • road and rail network • health facilities; • environmentally designated sites.

Table 6.2

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- **Table 7.6** indicates short term actions for surface water management

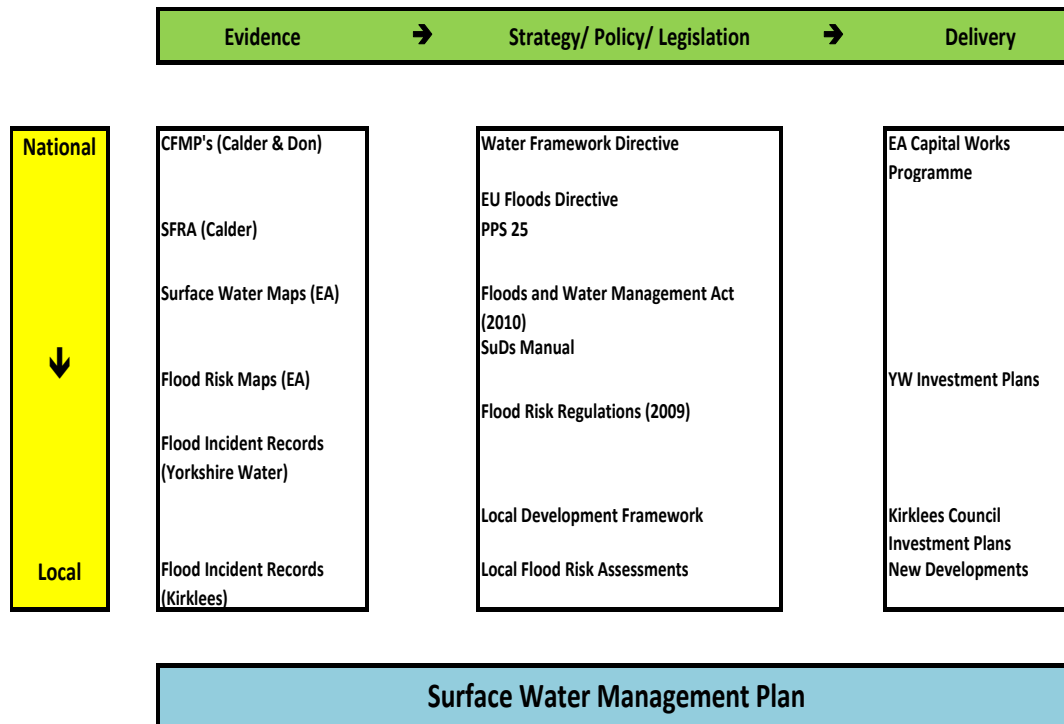
Action	Outcome	Lead organisation	Indicator
Work in partnership with the LLFA to reduce the risk of flooding from surface water. Carry out detailed studies in areas identified as at 'significant risk' in the preliminary flood risk assessment.	Working in partnership to reduce surface water flood risk within the policy unit a long term prioritised plan of action will be developed to reduce the risk of flooding from this source. Further detailed understanding of the risk this source of flooding poses will ensure that future strategic flood risk management plans and development documents take the risk of surface water into account.	Lead Local Flood Authority Kirklees Metropolitan Borough Council.	<ul style="list-style-type: none"> • long term costed programme of works; • prioritised plan of action is developed; • no. of properties flooded by surface water.

Table 7.6

- The **Don Catchment Flood Management Plan** was completed in July 2010 and provides a strategic overview of FRM in the catchment. The catchment covers approximately 15% of the Kirklees district.
 - **Don CFMP – Section 3.4.3** confirms the lack of information available for risk from surface water flooding – *“We have limited information on surface water flooding. Heavy rain can lead to both river and surface water flooding and historically reports have not differentiated between these sources. Estimates suggest that in June 2007, 70% of the properties flooded in the Yorkshire and Humberside regions were as a result of surface water. Locations within the catchment appear to be at higher risk from surface water flooding, especially as a result of development in the floodplain.”*
 - **Don CFMP - Section 6.4.4** - The preferred policy for the Upper Don, including the Upper Dearne valley villages is *“Policy decision has been determined as storage options within the policy unit provide the long term vision and opportunity for the area. This however is based on a large geographical area. Specific flood risk issues, such as those in the villages of Denby Dale, Scissett and Clayton West, will be taken into account in localised studies.”*

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Process chart showing relationships between SWMPs and other plans and policies



3.3 Drivers for a systematic approach to Flood Risk Management (FRM)

National FRM policies are directed to take account of climate change implications and the availability of funding to be able to invest in the provision of sustainable flood risk management. This includes avoidance, substitution and mitigation through land use planning, having regard to flooding from all sources (not just main rivers) and improving and maintaining flood defences where justified. Key policies and initiatives affecting the application of FRM include:

- **Making Space for Water Strategy (2005)** – Confirms the Government’s strategic direction for Flood and Coastal Erosion Risk Management over a 20 year period. The aim of the strategy is to manage sustainability, manage flood risk and ensure the social and economic benefits from growth and development
- **Catchment Flood Management Plans** – Produced by the Environment Agency

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- **Planning policy PPS25** – Development and Flood Risk (2006) – Enabling Planning Authorities to make appropriate and timely decisions that deliver sustainable planning by reducing flood risk to and from new development
- **Learning Lessons from the 2007 Floods** – An independent review by Sir Michael Pitt
- **Climate Change Prediction, Defra (UKCP09)** – Providing information on inevitable climate change to help adaptation to a changing climate

3.4 What is a Surface Water Management Plan?

Surface Water Management Plans (SWMP) are referred to in Planning Policy Statement PPS25 (Development and Flood Risk) as “*a tool to manage surface water flood risk on a local basis by improving and optimising coordination between relevant stakeholders*”. SWMPs build on Strategic Flood Risk Assessments (SFRA) and provide the vehicle for local organisations to develop a shared understanding of local flood risk, including setting out priorities for action, maintenance needs and links into local development frameworks and emergency plans.

The Governments guidance document for SWMPs, “Surface Water Management Plan Technical Guidance”, expands the scope of the plan to include the following:

- A framework through which key local partners with responsibility for surface water and drainage in their area work together to understand the causes of surface water flooding and agree the most cost-effective way of managing surface water flood risk
- To facilitate sustainable surface water management decisions that are evidence based, risk based, future proofed and inclusive of stakeholder views and preferences
- To coordinate and plan the drainage provision in large new developments where piecemeal actions are inefficient, reducing surface water flood risk downstream
- A framework for the management of urban water quality through the removal of surface water from “combined” systems and the promotion of SUDS

3.5 What is Surface Water Flooding?

Surface water flooding describes flooding from surface water sewers, drains, small watercourse and ditches that occurs during heavy rainfall in urban areas. It includes:

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- **Pluvial flooding:** flooding as a result of high intensity rainfall when, water is ponding or flowing overground before it enters the drainage network or watercourse, or cannot enter because the network is full to capacity
- **Groundwater flooding:** where groundwater is defined as water emanating from below the ground
- **Sewer flooding:** flooding which occurs when the capacity of underground sewer systems are exceeded either through lack of hydraulic capacity or restricted outfall, a blockage in the sewer or failure of mechanical/electrical apparatus
- **Flooding from Ordinary watercourses:** flooding which occurs as a result of the capacity of the watercourse being exceeded. (Ordinary watercourses are those managed by the local authority which are not designated as Main River by the Environment Agency)
- **Overland flows:** flooding resulting from surface-water run-off from both developed and undeveloped land

It does not include:

- **Fluvial flooding:** flooding as a result of the capacity of the Main Rivers being exceeded and the excess surface water leaving the channel, flooding adjacent land or property
- **Flooding from the catastrophic failure of reservoirs, ponds and canals**
- **Flooding from foul sewers**

3.6 What are the factors that cause and influence surface water flooding?

The Pitt Review listed several factors that can cause and influence the likelihood of surface water flooding:

- **Intensity of rainfall:** rainwater drains away naturally over long periods of time, but if rain falls in intense bursts the drainage system may be unable to cope. The probability of this type of intense rainfall occurring in the future is likely to increase due to climate change.
- **Location of rainfall:** the direction of travel of surface water is directly influenced by the topography of an area. Small changes in the location of rainfall can have a significant impact on where the water ends up.

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- **Capacity and condition of the sewer and drainage system:** this can affect the rate at which rainwater can drain away.
- **Type of surface material:** the permeability of surface material affects the amount of runoff. Urban areas are more susceptible to surface water flooding than rural areas because they are characterised by a significant quantity of impermeable areas.
- **Saturation of the ground:** if the ground is saturated, or even too dry, any rain that falls will be converted into runoff.

3.7 The Interaction between Surface Water Flooding and Fluvial (River) Flooding

Fluvial (River) flooding is defined as flooding occurring as a result of water leaving a river channel as a result of lack of capacity in the channel, either through overtopping of the river bank/flood bank or as a result of breaching of the flood bank.

Responsible Authority - The Environment agency is responsible for managing flooding from main rivers ie those significant rivers designated by the Agency as “main” river.

Surface Water Flooding has been defined previously in Section 3.5.

Responsible Authority - The recent Floods and Water Management Act 2010 created a new duty for Local Authorities, in their capacity as LLFA, to investigate all significant flooding incidents and allocate responsibility for action as appropriate. Responsibility for action is shared between Local Authorities, Water Companies and landowners.

The floods of 2007 demonstrated the gaps and overlaps in understanding the interaction of drainage networks and relevant responsibilities, and the mechanisms of failure. Recommendations for improving understanding formed much of the substance of the subsequent Pitt report.

Whilst the public and media perception was that the majority of flooding was as a result of rivers bursting their banks, the post-flood review carried out by the EA attributed 70% of property flooding in Yorkshire and Humber to surface water flooding ie flooding as a result of overland surface water run-off being unable to enter drainage systems or rivers that were full to capacity.

In Kirklees, there were isolated incidents of fluvial flooding where rivers overtopped, eg the River Spen at Liversedge and the River Dearne at Clayton West and Scissett, but the majority of property flooding was caused by either surcharging surface water systems or the

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inability of those systems to discharge freely into main rivers because of high river levels and submerged outfalls.

During extreme rainfall events, it will often be the case that both fluvial **and** surface water flooding occur during the same event. It is extremely difficult to quantify the individual effect of each type of flooding but this is largely irrelevant to those people suffering flooding, who are interested in the impact rather than the cause.

The LLFA has a responsibility to investigate **all** flooding incidents (as defined in Section 3.5) and allocate responsibility for further action as appropriate. Close and clear working relationships with partners and stakeholders will be essential to achieve efficient resolution of problems.

Key Points : Introduction

- *SWMPs provide a structured way forward to manage local flood risk*
- *The SWMP will provide the evidence base for the Kirklees PFRA*
- *The SWMP will facilitate surface water management decisions that are evidence-based, risk-based, future-proofed and inclusive of stakeholder views and preferences*

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4 The Study Area for the SWMP

4.1 Definition of the scope of the Plan

Anecdotal evidence from several significant flood events in the last decade (2002, 2004, 2007 and 2008) has illustrated that surface water flood risk in the district is widespread and varied. The mechanisms of flooding are often complex and the Council's historic limited investment in Flood Risk Management (FRM) has resulted in poor drainage asset and flood incident records, making decisions on further action difficult.

The SWMP process allows discretion to adopt a level of analytical detail appropriate to the quality and quantity of the data available. Consequently, reflecting the scarcity of information available on which to make judgements on risk and priorities for mitigation of the risk, the decision has been made to carry out an area-wide SWMP. The SWMP has the broad aim of evidencing the general flood risk across the whole district, identifying areas of flood risk requiring further, more detailed investigation.

4.2 Characteristics of the Area

Kirklees is a unitary council in West Yorkshire bounded by Calderdale, Bradford, Leeds, Wakefield, Barnsley, Derbyshire and Oldham. In terms of size, it is the 11th largest district council out of 348 (Population of around 400,000) and 3rd largest metropolitan council in area (400km²). The main population centres are Huddersfield (125,000), Dewsbury (57,000) and Batley (45,000), with a further 10, or so, small towns (5-20,000). Around 40% of the area is heavily urbanised with 60% rural in character, of which half is in the Pennine hills.¹

With respect to water resources, Kirklees has 27 large reservoirs in the Pennines, managed by the local Water and Sewerage Company, Yorkshire Water. There are approximately 100km of enmained river, managed by the Environment Agency, and unrecorded, but substantial, lengths of culverted and open minor watercourses. The main rivers in the district are the rivers Colne and Calder flowing to the river Aire, which drains around 85% of the area, and the river Dearne flowing to the river Don, draining the remaining 15%. Average annual rainfall figures for the district range from 1800mm at the Pennine headwaters to 800mm in Huddersfield, compared with an average across England of 950mm.²

4.3 General Flooding Characteristics and Issues

4.3.1 Pluvial Flooding/ Smaller Watercourse Flooding

Kirklees is dominated by 2 main river systems, the River Calder to the North of the district and the River Dearne to the South, both rivers having their headwaters in the Pennines and both ultimately flowing to the Humber estuary.

In the upper reaches of the **Calder's** tributaries, valleys are generally narrow and steep-sided and consequently, flood zones are narrow. Existing development is mostly housing,

¹ Kirklees Council, *Factsheets 2010*,
<http://www.kirklees.gov.uk/community/statistics/factsheets/factsheets.shtml>

² Environment Agency, *Calder Catchment Flood Management Plan July 2010*, page 54

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commercial or small areas of light industry. Flood defences are typically discontinuous with flood walls in a mixed condition, offering low standards of flood protection.

In the downstream catchment between Huddersfield and Dewsbury, the floodplain broadens and land-use includes large areas of heavy industry and housing within high flood risk zone. Flood defences generally offer a higher level of protection.

The upper reaches of the **Dearne** above Clayton West are fairly steep and respond quickly to rainfall. The industrial textile heritage of the area, resulting in recent residential conversions of riverside mills, and the general high density of residential development in the valley bottom leave a sizeable part of the local community at risk of flooding. There is little historical evidence of river flooding from breached defences or overtopping but the main issue appears to be flooding resulting from submerged outfalls to the river.

Surface water flooding is generally more prevalent in the hillier, rural, less developed south side of the district. The settlements along the Dearne, Holme, Colne and Woodsome Valleys are concentrated along the rivers and suffer the consequences of rapid surface water runoff from the uplands and fields on the steep valley sides. Formal drainage systems are sparse, often unrecorded and consequently, poorly maintained. The industrial heritage of the larger settlements as textile centres has left a historical legacy of stone culverts carrying surface water through areas of high residential occupation. Information on the location, condition and connectivity of the culvert systems is piecemeal but is a significant factor in understanding and reducing flood risk in those locations.

The large settlements to the centre and north of the district, Huddersfield, Dewsbury and Batley, have significant networks of public sewers, owned and maintained by Yorkshire Water, with less evidence of smaller culverted watercourses remaining in those areas. It is likely that the traditional means of draining surface water via watercourses has been gradually replaced by the developing public sewer system carrying rainwater in both surface water and combined sewers.

The Ravensthorpe community, south west of Dewsbury, suffers an unusual form of surface water flooding. Whilst the majority of the area lies in the highest fluvial flood risk zone, there are no recent records of flooding from the rivers Calder and Spen, which have their confluence in Ravensthorpe. However, there have been several recent episodes, most notably in 2007, when high river levels restrict the free discharge of watercourses and public sewers, causing the drainage systems to “back-up”, flooding the basements of the many hundreds of Victorian terrace properties characteristic of the area. Social pressures in the community are such that the majority of basements are now used as living space, with the related consequence of damage and disruption to the inhabited rooms.

4.3.2 Pluvial Flooding/ Sewer Flooding

Yorkshire Water owns much of the combined and surface water sewers in the region. Sewer systems are currently designed not to flood in a 1:30 year return period design storm. This does not include accommodating flows from exceptional and high magnitude rainfall events. During extremely wet weather, the rainfall may exceed current design criteria. Such events can result in exceedance of the hydraulic capacity of the sewer thus increasing the risk of

flooding. One of the most recent occurrences of this type of event was the flooding experienced in June 2007.

There are some known sewer related flooding issues within the Kirklees catchment. However, overall sewer performance is satisfactory. Yorkshire Water is working with Kirklees Council, the Environment Agency and other parties to better understand the interaction of the networks and provide improvements that will help further reduce the risk of flooding.

4.4 Recent Flood History

The evidence base for this SWMP plan is gathered from the last 10 years, utilising the available council recorded flood incidents and recently gathered drainage asset information. It seems appropriate to consider the consequences of severe flood events during that same period when carrying out the risk assessment

- There has been recent significant local summer flooding in the summers of 2002, 2004, 2007 and January 2008
- The 2007 floods flooded up to an estimated 500 properties across the district and were described by many residents as the worst in living memory. The flooding was widespread across the district but hotspots occurred around Ravensthorpe, Liversedge, Cleckheaton, Chickenley, Mirfield, Milnsbridge, Brockholes, New Mill, Denby Dale, Scissett and Clayton West.

2007 Floods

Two significant rainfall events occurred on Friday 15 June and Monday 25 June 2007, exacerbated by previous, generally high, May and June rainfall. In Kirklees, a wet May was followed by the wettest June on record – May rainfall was 30% above average and total June rainfall was 325% above average (nearly 300mm falling at Emley Moor during the month). The River Don was recorded running at 650% above the monthly average flow and also recorded the highest peak flow on record.³

A fifth of Hull's average yearly rainfall fell in a single day.

Yorkshire received more than 3 times the monthly average rainfall – a third of the average annual rainfall fell in the 3 week period preceding 25 June.⁴

The effect of the above was unprecedented rainfall run-off from saturated fields onto undrained rural roads and very high river and watercourse levels. Few watercourses in Kirklees breached their banks but many surface water outfalls were submerged. Restricted, or the inability to have a free, discharge, resulted in surcharge of highway drains, YW surface water sewers and culverted watercourses causing much of the surface flooding in

³ Environment Agency (December 2007) *Review of 2007 Summer Floods*, page 8

⁴ Centre for Ecology and Hydrology (March 2008) *The Summer 2007 Floods in England and Wales – a hydrological appraisal*, page 10

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the area. The design capacity of YW combined sewers was exceeded which exacerbated the problem with Combined Sewer Overflows (CSO's) operating and sewage mixing with floodwater.

The post-analysis of the flooding by the Environment Agency identified that approximately 70% of the flooding in the region was due to surface water rather than fluvial flooding ie rain water unable to enter drainage systems due to design capacity being exceeded, rather than rivers breaking their banks or over-topping flood defences. The rainfall event was estimated to have a return period of around 1 in 200 ie a 0.5% chance of occurring annually.

The 2007 events demonstrated that disruptive and damaging levels of flooding are unpredictable in nature but increasingly likely to occur. Much of the future flood risk is likely to be associated with surface water rather than from rivers and, as such, the mechanisms need to be understood by Local Authorities to allow them to fulfil their roles as Lead Local Flood Authorities (LLFA's) under the Floods and Water Management Act 2010.

4.5 Predicted Future Flooding

Following the 2007 floods, the Environment Agency produced maps that identified areas susceptible to surface water flooding following severe rainfall. The maps were used in the assessment of relative flood risk to determine the allocation of funding for the current programme of Surface Water Management Plans. The maps predict the extent of flooding from a severe rainfall event with a 1 in 200 return period (0.5% AEP). The number of properties in Kirklees estimated to flood is detailed below:⁵

Area	No of Properties affected
Huddersfield	5500
Dewsbury	1900
Holmfirth/Honley	1600
Cleckheaton/Liversedge	1400
Batley	1100
Marsden	450
Skelmanthorpe/Clayton West	420
Mirfield	320
Kirkburton	170
Meltham	160
Denby Dale	150
Heckmondwike	90
Shepley/Shelley	90
Flockton	10
Total No in Kirklees	13360

⁵ Defra August 2009, *National Rank Order of Settlements Susceptible to Surface Water Flooding*
<http://www.defra.gov.uk/environment/flooding/documents/manage/surfacewater/sw-settlement-order.pdf>

4.6 Relative Flood Risk between Kirklees and other Local Authority Areas

The Environment Agency's recent work on identifying areas susceptible to surface water flooding has provided information that shows the scale and relative risk of flooding in Kirklees.

- Kirklees is one of 149 LLFA's in England, ranking 55th in terms of general flood risk
- Excluding Counties and London Boroughs, Kirklees' ranks 7th behind Hull, Birmingham, Brighton, Doncaster, Leeds and Leicester, in terms of the flood risk to be managed by the LLFA.
- A list of selected LLFA's, the number of properties predicted to flood in an extreme rainfall event and their relative rankings, are shown below:

LLFA	Surface Water Flooding	Fluvial Flooding	Ranking
Lincolnshire	35,000	151,000	1/149
Hull	9,000	77,000	9/149
North Yorkshire	16,000	40,000	19/149
Doncaster	7,000	14,000	49/149
Leeds	16,000	5,000	50/149
Kirklees	15,000	12,000	55/149
Calderdale	14,000	11,000	64/149
Wakefield	10,000	21,000	79/149
Bradford	8,000	3,000	93/149

(Numbers rounded for clarity)

It is likely that the above analysis of flood risk will form the basis for the distribution of additional government funding for the new duties in the Floods and Water Management Act.⁶

4.7 The Effect of Climate Change on Future Flooding

Over the last 10 years, Defra and other agencies have developed a body of evidence supporting the inevitability of climate change. The outputs from the UK Climate Change Projections programme are informing a variety of national analyses of future flood risk, including PPS25 and flood modelling work by the Environment Agency. In general terms, the main implications are:

- More frequent and intense rainfall events causing flash flooding to low-lying areas
- More and faster surface water runoff and overland flows causing sewers, drains and rivers to overflow
- Rising groundwater levels causing increased spring source activity and higher spring flows

⁶ Defra, August 2009, *Distribution of £9.7m early action funding*

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Local application of PPS25, agreed and applied jointly across the West Yorkshire Councils, requires the developers of new sites to include an allowance for a 30% increase in peak surface water discharge rates due to future climate change.

It is clear that the ability of existing drainage systems to carry future floodwater will be severely compromised as a result of development pressure and climate change.

Key Points: The SWMP study area

- *Kirklees suffered significant flooding in 2002, 2004, 2007 and 2008*
- *Kirklees is at significant risk from future surface water flooding (55th out of 149 LLFA's and 7th out of 76 district or city council LLFA's)*
- *15,000 properties in Kirklees are at risk from surface water flooding from a severe rainfall event (1 in 200 year return period)*
- *The high flood risk areas are spread across the district and the mechanisms are varied and complex*

5 Objectives of the Plan

5.1 Key Objectives

- To collect all available information on drainage assets and historical flood incidents and present it in a format that is accessible, maintainable and relevant to understanding the location and mechanisms of local surface water flooding
- To provide an evidenced position statement as to where the Council stands in relation to its understanding of flood risk across the district
- To provide an information tool that will benefit
 - The Council's FRM officers in offering constructive advice to developers and the planning department, with respect to the application of PPS25
 - The Council's operational drainage teams in determining priorities for the allocation of maintenance and revenue budgets
 - Local communities in understanding more clearly the size and nature of the flood risk in their areas
 - Residents and businesses in understanding more clearly the size and nature of the flood risk to their land and property and to give them the tools and knowledge to mitigate the risk
 - The Council's Strategic Drainage Team in determining priorities for further detailed investigation of areas of higher flood risk
 - The Council's Strategic Drainage team in developing the evidence base required for agreement of Flood Risk Areas required for the Preliminary Flood Risk Assessment detailed in the Flood Risk Regulations 2009
 - The Council's Partners in planning future work programmes and priorities

5.2 The Approach to the Plan

The lack of available information on drainage infrastructure and flooding mechanisms has already been mentioned earlier in the report. The previous lack of legal responsibilities for the Council has resulted in a historic lack of investment in flood management with only a reactive approach to post-flood incident investigation and advice being carried out.

An increasing risk of local flooding as a result of climate change and development pressure, coupled with new legal obligations under the Flood Regulations (2009) and the Flood and Water Management Act (2010), has resulted in the Council committing to a more proactive and planned approach to reducing flood risk across the district.

The funding provided by Defra to produce a Surface Water Management Plan for Kirklees is being used as the catalyst to provide an evidence base for understanding surface water flood risk across the district. The intention is to carry out a district-wide, high-level, low-detail assessment of relative surface water flood risk to provide a foundation for future, more

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detailed assessment work targeted at the areas where the risk is highest. The SWMP will include the following:

- Development of a formal drainage asset recording system for all the surface water systems in the district
- Development of a flood incident recording system to build up an understanding of where flood risk is located
- Representation of the asset and incident information in a graphical format to allow improved visibility and easy cross-referencing of the data
- An assessment of local surface water flood risk using the above data, EA surface water maps, topographic/demographic information and site surveys
- Representation of the relative surface water flood risk across the district in a format that is understandable and accessible by the general public
- A prioritised programme for future detailed investigation of the higher risk areas
- A suite of measures that could be employed to mitigate the risk in the higher risk areas

5.3 Structure of the Report

The report follows the methodology for producing a SWMP published by Defra, "Surface Water Management Plan Technical Guidance March 2010"

The SWMP guidance is structured into four key phases; **preparation, risk assessment, options and implementation and review**. The four phases of the guidance provide the framework for undertaking the Kirklees SWMP, although local needs and circumstances have been considered in producing a document that is both appropriate and proportionate to the resources available.



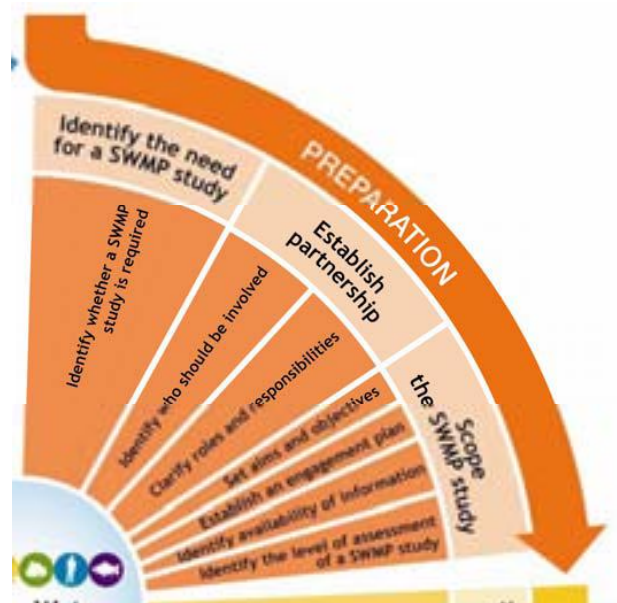
Key Points: SWMP Objectives

The plan will provide

- *An evidenced record of surface water flood risk across the district*
- *The catalyst for the provision of a graphical information system for drainage assets, flood incidents and flood risks*
- *A prioritised programme of future investigation work*

6 Preparation Stage

- Do we need a SWMP study?
- Who are the Council's partners and how will the partnership work?
- What are the main aims of the SWMP?
- How do we engage with stakeholders?
- What information/ evidence do we use?



6.1 Identifying the Need for a SWMP Study

An area-wide SWMP is considered desirable because –

- The Level 1 Calder SFRA recommended that SWMPs be produced for a number of defined areas (The centres of Huddersfield, Mirfield and Dewsbury were subsequently chosen and surface water modelling has been carried out for these areas)
- Defra's recent appraisal of surface water flood risk has highlighted the Kirklees district as high risk
- A Kirklees SWMP offers the opportunity to produce, for the first time, an evidenced record of existing and future surface water flood risk
- The Flood Risk Regulations (2009) require the production of a PFRA by June 2011. A suitably drafted SWMP will provide much of the evidence required for the PFRA.

6.2 Establishing the Partnership

Work commenced on the SWMP in January 2010 with a broad action to collect “flood data” from as many sources as possible. The diagnostic use of the data was not determined at the time but a rationale developed as the quantity and quality of the data became apparent. Formal partnering arrangements were not deemed to be a priority early in the study and were felt to be more valuable when agreeing the process of data analysis, assessment of risk and identification of options. Consequently, the first formal partnering meeting was held on 23 September 2010 with the core group of Kirklees Council (LLFA), Environment Agency and Yorkshire Water present.

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The Kirklees SWMP will be a high-level information resource with actions geared towards further, localised, more-detailed analysis of flood risk. The partnership reflects this by involving a low number of strategic partners. It is anticipated that stakeholders and other minor partners will be involved when the more detailed actions are progressed.

The following definitions have been used

Partner – A person or organisation with responsibility for the decision or actions that need to be taken

Stakeholder – Anyone affected by, or interested in, the problem or solution

- **The SWMP Partnership** is therefore –
 - Kirklees Council – Strategic Drainage Team within the Investment and Regeneration Service, taking lead as LLFA
 - Environment Agency
 - Water and Sewerage Company (Yorkshire Water)

- **Minor partners and stakeholders** will include –
 - Partners**
 - Kirklees Council – Highways
 - Kirklees Council – Emergency Planning
 - Highways Agency
 - Network Rail
 - Stakeholders**
 - The general public
 - Riparian owners
 - Developers
 - Local businesses
 - Association of British Insurers (ABI)

- **Roles and Responsibilities** within the Partnership
 - **Roles of Partners** – Kirklees, as LLFA, will write, maintain and review the SWMP, and chair the Partnership meetings. The Environment Agency and Yorkshire Water will be active partners in ensuring their respective views and aspirations are included within the SWMP.
 - **Sharing Information** – Systems have been established to facilitate the sharing of relevant data between partners. The Environment Agency has a well established system for the sharing of relevant data now formalised through the website, <http://www.geostore.com/environment-agency>. A data sharing protocol is also in place between Kirklees Council and Yorkshire Water to manage the data flow between the two organisations.
 - **Engagement with Others** – It is not anticipated that other partners and stakeholders will be consulted on the content of the SWMP. The Plan is essentially an information tool to allow further investigation of high-risk areas and it is these investigations which will require close involvement of all partners and affected stakeholders. Further details are included in Section 6.3.2.
 - **Partner Resources** – Partnership working has been limited to three formal meetings to minimise the time commitment required from Partners. The award of the Defra grant to fund the SWMP has allowed Kirklees to allocate dedicated resources to collect flood incident and drainage asset data to form the evidence base for the plan. Partners may have to commit further resources to implement the action plan for the SWMP in investigating high risk areas in more detail. An indication as to the level of future (Kirklees Council) resources required to complete detailed investigations are shown in the Action Plan in Section 9.3.
 - **Skilled Resources** – In recognition of the limited knowledge, experience and expertise within Kirklees as LLFA, the SWMP is high-level and non-technical. Implementing all recommendations in the Action Plan may require specific skills, not currently available within the LLFA.
 - **Implementation and Monitoring** – Kirklees will take responsibility for implementing actions and monitoring progress on the SWMP. It is possible that much of the Action Plan and identified longer-term work will be absorbed within the PFRA and associated Flood Management plans, required under the Flood Risk Regulations. In addition, local, formal flood management liaison meetings will be set up to address the Flood and Water Management Act requirements for agencies to work better with stakeholders, and each other. SWMP actions will be discussed and monitored at these meetings.

6.3 Scope of the Study

6.3.1 Aims and Objectives

As a general principle, the objectives for the SWMP will be specific, measurable, achievable, realistic and timebound (SMART)

As a Partnership,

- we will map current and potential surface water flood risk areas, irrespective of source, and engage the community and all stakeholders to share this knowledge
- we will determine the consequences of surface water flooding, now and in the future, so that we can establish our priorities and understand and compare the merits of different mitigation strategies
- we will identify effective, affordable, achievable and, cost-beneficial measures to mitigate surface water flood risk which achieve multiple benefits, where possible
- we will develop the evidence base to inform strategic planning of drainage provision in large new developments
- we will periodically review the plan and monitor the effectiveness of chosen solutions.

6.3.2 Stakeholder Engagement

A limited stakeholder consultation exercise was carried out to assess the value of initiating a wider process and the results were disappointing. Although knowledge of both historic flooding incidents and drainage infrastructure is clearly held by residents and landowners, extracting the information without using significant resources is very difficult. The scale of the task appears to be challenging for consultees and it is more appropriate to involve stakeholders in the local issues identified through the risk assessment process. Consequently, local stakeholder engagement will be a key part of developing solutions for the higher-risk areas identified in the SWMP.

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6.3.3 Sources of Information

Data Type	Source	Why is it required?
Highway drainage records	Kirklees Highways Dept	To understand mechanisms of highway flooding and provide solutions for flooding problems
Ordinary watercourses	Kirklees Drainage Dept	Capacity and condition data is essential for efficient urban drainage, esp. culverted watercourses
Maintenance regimes and records	All partners	Need to target maintenance at areas of greatest flood risk
River models and asset data	Environment Agency	To understand the interaction between river and surface water flooding
Public sewer records	Yorkshire Water	To understand interaction between combined/ surface water sewers and watercourses etc
Combined / surface water models	Yorkshire Water	Information on public sewer capacity/ hotspots
Location of critical infrastructure	Kirklees Emergency Planning	To be considered when assessing the overall flood risk
OS mapping data	LLFA	Sets the base for graphical presentation of risk and historic maps provide evidence of old drainage systems
Surface level data	All partners	Consideration of flood flow paths and depths
Historic flood incidents	All partners	Will influence both current and future risk
Anecdotal evidence	Local press, councillors, members of the public	Useful for verifying records and adding to the assets and flood incidents databases
Calder Strategic Flood Risk Assessment	Kirklees Planning Authority	Essential source of background info, but weak on surface water risk
Calder and Don Catchment Flood Management Plans	Environment Agency	Useful background info, but little on surface water risk

6.3.4 The Level of the SWMP Assessment

The SWMP Technical Guidance suggests that a **Strategic Level** assessment would be appropriate, which would produce the following outputs

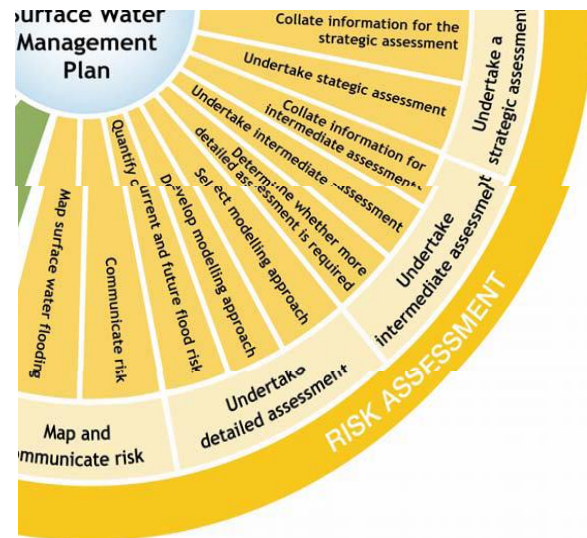
- A prioritised list of locations requiring further assessment. This is done through an assessment of the locations which are considered more vulnerable to surface water flooding, using available data.
- Information gathered as part of the strategic assessment will be used to fulfil the requirements of Part 2 of the Flood Risk Regulations (2009), where lead local authorities are required to prepare preliminary assessment maps and reports
- Identification of achievable mitigation measures; in particular, immediate or quick win measures which can be implemented to reduce surface water flooding

Key Points: Partnership and Scope

- *The partnership is between Kirklees Council, Environment Agency and Yorkshire Water*
- *The SWMP will be a Strategic Level assessment with an area-wide, high-level approach*
- *Outputs will provide:*
 - *a prioritised list of locations requiring further assessment*
 - *an evidence base to verify the PFRA*
 - *achievable mitigation measures for the reduction of flood risk*

7 Risk Assessment Stage

- How do we collect and organise the data?
- How do we assess the flood risk?
- How do we present the risk?
- How do we communicate that risk to stakeholders and partners?



A **Strategic Assessment** has been carried out based on known historical flooding, known drainage infrastructure location and condition and predicted future flooding. The strategic assessment has identified 'local' hotspots (i.e. parts of a settlement) which are likely to be at greater risk of surface water flooding and require more detailed assessment. The approach has been flexible and some elements of an Intermediate Assessment approach have been included, providing an additional level of detail in places.

7.1 Collating Information

There are five principal sources of data and information which are considered to be important for the strategic assessment

- **Historic flood incident data** – Data is available from a number of sources
 - **Kirklees Council** – The only records available are those logged on the Councils Customer Service Request database which date back to 1999. Significant work has been carried out to manually sift through drainage/flooding related requests to determine their relevance to FRM. Approximately 2500 flooding records have been extracted from the database and are now logged as “flood incidents” on the Councils GIS system
 - **General Public/ Local Councillors** – Whilst it is accepted that there must be extensive knowledge of flood incidents within local communities, the task of extracting the information easily and accurately is difficult and beyond the scope of this study. Limited liaison with “interested” individuals and local councillors has taken place but little additional information has come from the process.

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- **Environment Agency** – The Agency has limited information available on surface water flooding in comparison to the wealth of information on fluvial flooding but reference has been made in the SWMP to the summer 2007 flooding map and aerial photographs from the 2007 floods.
- **Yorkshire Water** – The DG5 database, recording flood incidents associated with the public sewer system, will be used in the detailed risk assessment of areas highlighted in the SWMP as being at higher risk of surface water flooding
- **Environment Agency surface water flood maps** – These maps provide an indication of areas which are more susceptible to flood first, flood deepest and flood more frequently.
- **Ground model data** – The GIS-based method of recording and presenting the information gives access to Ordnance Survey data, such as historic maps and contours as well as other Council datasets such as environmental, land contamination and land ownership information.
- **SFRA/ CFMP** – These sources of evidence provide further information on historical flood incidents and information on other sources of flooding which have been taken into account in the SWMP. Previous policy recommendations in relation to FRM have also been considered within the SWMP.
- **Drainage Asset Records** – A considerable amount of work has been carried out, as part of this SWMP, to determine the location and capacity of the surface water drainage system across the district. Much of the culverted watercourse and highway drainage network is unrecorded but its location, condition and capacity is critical to any meaningful understanding of flooding mechanisms and potential solutions. A better understanding of the interaction of main rivers, ordinary watercourses, highway drains and public sewers is required and will facilitate reductions in surface water flood risk across the district.

A note on the collection of asset data – A structured investigation of drainage assets was considered to be an important stage in developing achievable options for reducing flood risk.

Historical records of culverted watercourses and highway drains, held by a succession of authorities responsible for land drainage, are sparse. Where these are available, they have formed the basis for the current asset record.

Every significant populated area in the district has been examined for possible drainage assets, by reference to old Ordnance Survey plans for evidence of old infrastructure eg troughs, wells, mill culverts, streams etc. Asset information from recent flood incident investigations has been transferred into the GIS system and a systematic new process for transferring knowledge held by council drainage officers onto the system has also been carried out. A limited number of site surveys at prioritised locations have been undertaken to try and “fill in the gaps” in the

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information.

The value of recording the drainage asset will become apparent as detailed investigations of areas provisionally identified as high flood risk, are investigated in more detail and options for mitigating flood risk are developed.

The drainage asset is incomplete, resources are not available to proactively survey and record assets, and it is unlikely that we will ever be able to record the whole asset. However, accurate analysis of surface water risk, and the development of solutions, will only be possible if we work towards a comprehensive record of the various systems.

Recognition of the current incompleteness of the drainage asset record is useful in understanding the potential inaccuracies in determining causes and solutions. A summary of the recorded drainage asset is shown below, together with an estimate of the length of unrecorded asset.

Drainage Asset	Recorded Length (km)	Estimated Total Length (km)	% Unrecorded
Highway Drain	50	600	92
Culverted Watercourse	40	400	90
Open Ordinary watercourse (Significant)	-	600	-
YW Public Sewers	5000	5000	0

7.2 Undertaking the Strategic Assessment

The Guidance encourages a flexible approach to the use and interpretation of the data and resources available to the LLFA in carrying out the assessment of surface water flood risk.

7.2.1 Method of Assessment

The following rationale has been used to record, assess and quantify surface water flood risk in this SWMP –

- The Councils corporate GIS system, “**Planweb**”, has been used to record and display the data collected for, and relevant to, the SWMP.

Planweb,

- is Mapinfo based and offers compatibility with the Councils chosen method for asset recording and flood incident logging
 - offers compatibility with data available from partners
 - allows access via “layers” to other Council and national datasets eg EA flood maps, current planning applications, environmental data etc
 - is familiar to staff, intuitive and corporately maintained
- The quality and quantity of data is improving with time and this initial Strategic - level SWMP is based on incomplete data. The analysis carried out will be “of the moment”

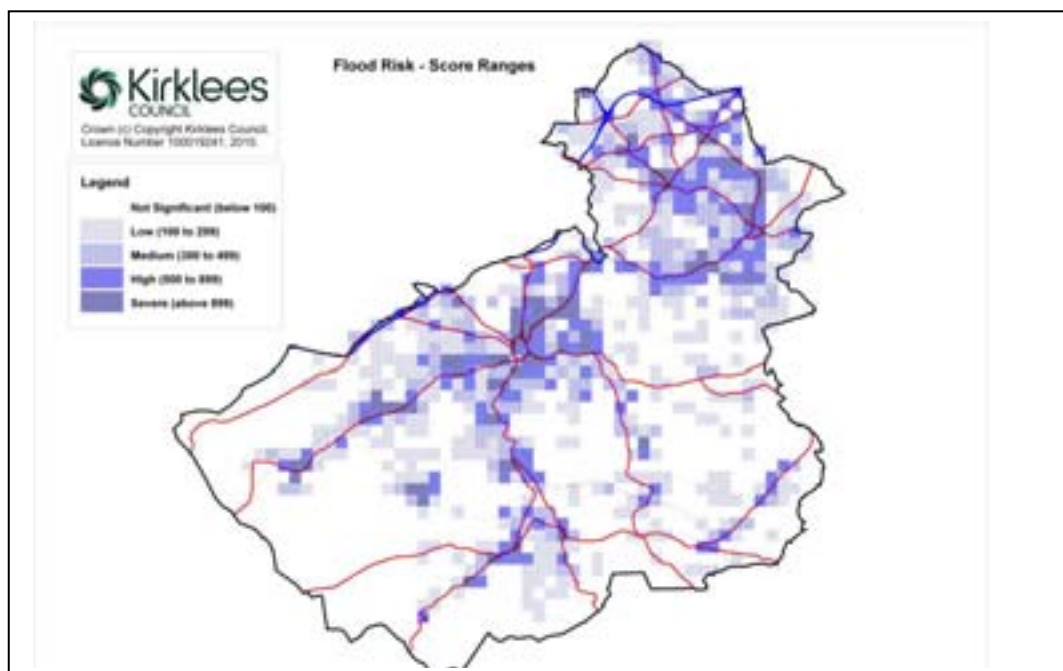
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providing a base document on which further refinements can be made as more supporting data becomes available

- The only **quantitative** assessment of analytical risk made, is that associated with the indicative 1 in 200 year flood outlines on the Surface Water Flood Maps supplied by the EA.
- The majority of the assessment of flood risk is made **subjectively** using a combination of weighted, scored parameters from other data. The risk assessment methodology is detailed in Appendix 1.
- The method developed to quantify relative flood risk is similar to the method for the risk assessments carried out to produce the “default” maps for Preliminary Flood Risk Assessments. However, it has been developed independently, reflecting a local judgement on the weighting and relevance of data. The intention is to produce a body of evidence in a format that will allow easy verification of the nationally developed default maps with an independent approach.

7.2.2 Results of Assessment

- The area of the study has been divided into approximately 1600, 500x500m squares and each square has been “scored” in accordance with the matrix in Appendix 1. The results are summarised in the table in Appendix 1.
- All squares have been coloured, reflecting their total risk score, with highest flood risk areas heavily shaded and lowest risk lightly shaded. A larger scale version of the map is included in Appendix 2.



- Appendix 2 also shows further maps indicating the 50, 150 and 300 highest flood risk areas across the district

7.3 Mapping and Communicating the Risk

7.3.1 Mapping

The processes around determining flood risk are complex, abstract and imprecise. They are generally subjective assessments of risk based on a limited amount of fact and a large amount of circumstantial evidence. The challenge is to present the overall assessment of flood risk in a manner that is clear and accessible to all and allows access to the supporting data when required.

Digital mapping of the data and the results of the assessment process, provides a readily understandable media that is consistent with other Council and Partner formats.

Digital mapping will allow subsequent reanalysis of the data as and when new information is available, providing a tool which can be regularly updated and refined.

Digital mapping will help to determine

- the number of people living in the area who are likely to be affected in the event of flooding
- the type of economic activity likely to be affected in the event of flooding
- industrial activities in the area that may increase the risk of pollution in the event of flooding
- relevant protected areas that may be affected in the event of flooding

7.3.2 Communicating

The main purpose of flood mapping is to provide an evidence base for partners and stakeholders to understand flood risk. This will include:

- helping to engage stakeholders in understanding surface water flood risk
- informing the spatial planning process by improving the evidence base in the Local Development Framework and directing the Development Control Process towards sustainable surface water solutions for sites of high flood risk
- informing emergency planning functions carried out by Local Resilience Forums
- identifying whether critical infrastructure is at risk from surface water flooding and where appropriate, communicating this risk to the responsible stakeholders

General Stakeholders

The general public should be engaged in the development and implementation of the SWMP, in accordance with the engagement plan specified in the preparation stage of the SWMP study (Section 6.3.2). Under the Flood Risk Regulations (2009) there is a requirement to publish the preliminary assessment reports and maps (Part 2), and the flood risk and flood hazard maps (Part 3) in areas of significant risk.

Therefore, flood maps produced as part of the SWMP study will be shared with, and communicated to, the public. The presentation of information is discussed further in Section 9.4.

Planning Authority

Kirklees Planning Department will be encouraged to use the map outputs from the SWMP to augment the Calder SFRA, where surface water flooding has not been addressed in detail. Planning policies and site allocations may be influenced by the SWMP, if the SWMP study highlights significant risks which were previously not taken into account.

Outputs from the SWMP study will be used in the Sustainability Appraisal of the Core Strategy to provide evidence, sustainability objectives and indicators.

The SWMP will provide Planning Development Control with the first available evidence base for surface water flood risk, to complement existing information on fluvial (river) flood risk. It is anticipated that new developments in identified high surface water flood risk areas will be rigorously assessed for suitability.

The high flood risk allocated to certain locations will help to highlight the measures that may need to be taken in the planning process to manage the incremental increase of flood risk as a result of urban creep.

Emergency Planning

Surface water flooding has very short lead times and is hard to predict in real time because local topography and drainage infrastructure affects the direction or runoff and location of flooding. However, the initial assessment carried out as part of this SWMP will provide the basis for future identification of the likely flow pathways and locations of ponding of surface water in those areas of highest flood risk.

The results of this future analysis will be fed to the Councils Emergency Planning team to improve the Councils response to surface water flooding events.

Critical Infrastructure

Where the flood risk assessment process highlights critical infrastructure that may be vulnerable to flooding, the evidence will be presented to the responsible authority or owner with a recommendation to consider further investigations to determine the necessity for mitigation measures.

Key Points: The Assessment of Risk

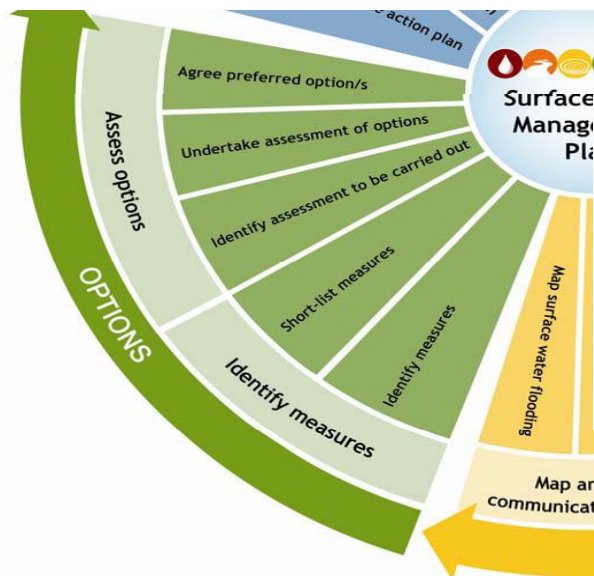
- *Historic flood incidents from the last 10 years are now mapped on GIS*
- *Systems are set up to auto-record future flood incidents on GIS*
- *Local area flood risk is determined from a combination of recorded incidents/ EA flood maps/ land sensitivity*
- *A record of relative flood risk from surface water has been produced, highlighting high priority locations*
- *Communication of flood risk to partners and stakeholders is key to the success of the SWMP*

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8 Options Stage

- **What measures can we take to reduce local flood risk?**
- **Agree a hierarchy of achievable measures.**
- **Which areas do we assess first?**
- **How do we carry out the assessment?**



8.1 Identifying Measures

A range of measures are available to manage surface water flood risk. Consideration of the measures to be used will not, at this stage, be constrained by cost or viability but will seek to maximise the opportunity to resolve any other related flooding issues at the same time, delivering multiple benefits. These additional benefits include water quality, biodiversity and public amenity.

The Source-Pathway-Receptor model used in many FRM policies and technical notes can be used to categorise the measures available:

Source (Controlling the surface water at its place of origin)

- Measures –
- Green Roof
 - Soakaways
 - Swales
 - Permeable Paving
 - Rainwater Harvesting
 - Detention Basins
 - Ponds and Wetlands

Pathways (The routes that both overland and underground flows of water follow)

- Measures -
- Increasing capacity in drainage systems
 - Separation of foul and surface water sewers
 - Improved maintenance regimes

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Managing/ redirecting overland flows

Land management practices

Receptors (The people, property and environment affected by flooding)

Improved weather warnings

Using planning policies to influence development

Using temporary or demountable flood barriers

Social change, education and awareness, encouraging self-help

Improved resilience and resistance measures

8.2 Priorities for Assessment

The risk assessment process carried out on a local, square by square basis, has highlighted those areas where flood risk is highest and where further investigation is required to determine the flood mechanism and options for reducing the risk. The scoring process will establish a programme of further investigation work spread across the whole district. (See Section 9)

8.3 Method of Assessment

Detailed assessments of priority flood risk areas need to be methodical, consistent, robust and as simple as is practicable. A standard approach will be taken to assess each high priority area and a draft template has been developed to provide a structured assessment report that could form the basis for future dialogue with partners and stakeholders.

The report template includes the following:

- A description of the topography and demography of the area
- A record of previous flood incidents (Map)
- An assessment of future surface water flood risk indicating depth severity and extent (Map)
- A schedule of affected properties and land, including number of people and assessment of potential damage and/or disruption
- A statement on the presence and condition of drainage systems in the area, including watercourses, public sewers, private systems and bodies of water
- Land-use planning proposals in the area
- An assessment of the vulnerability of properties and infrastructure in the area to flooding, sensitivity (use) of the building/land, threshold (floor) levels, resilience and recovery standard, escape routes.

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- An indication of flood flow paths (modelled and/or estimated)
- A list of possible measures to reduce flood risk, with an indication of practicality/ cost, based on the general hierarchy shown in Section 8.1

A completed example of the assessment template is included in Appendix 3

A completed example of the priority measures template, developed from the assessment template, is included in Appendix 4

Key Points: Options

- *A standard suite of mitigation measures has been formulated*
- *A standard assessment process and report template has been developed for the assessment of all identified high flood risk areas*

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9 Implementation and Review

- **Develop a programme of further detailed investigations**
- **Develop a broad Action Plan**
- **How do we present the findings/ next steps to the Public?**
- **How and when do we review the plan?**



9.1 The Extent and Severity of Surface Water Flood Risk

The risk assessment process in Section 7 has been used to assess the level of flood risk across the district and the results are detailed in Appendix 1. The following table summarises the results:

Level of Flood Risk	Number of Areas (500m x 500m squares)
Severe	72
High	143
Medium	157
Low	232
Not Significant	1032
Total	1636

It is possible to refine the above analysis to prioritise individual areas within each risk category, which will produce a programme of future investigation and detailed risk assessment work leading to a suite of mitigation measures for each identified area. A programme for further work, based on the highest priority squares, has been produced and is listed in Section 9.2.

The strategic approach to local surface water flood management is in a process of development and the recent European legislation, The Flood Risk Regulations 2009, impose a duty on Lead Local Flood Authorities to follow a structured approach to understanding, publicising and reducing surface water flood risk in their districts. There are clear parallels between the Preliminary Flood Risk Assessment (PFRA), required by the Regulations, and the SWMP process, followed by Kirklees. It is appropriate, where areas identified in the SWMP as severe/high risk are recorded as key local Flood Risk Areas through the PFRA process, that they are further assessed through the Councils obligations under the Regulations. Other areas of local surface water flooding detailed in this SWMP but not

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identified in the PFRA, will be investigated by the Council separately, when resources and other priorities permit.

The Council's current legal obligations lie mainly with the Flood Risk Regulations and these will direct our immediate work. The Action Plan for the SWMP will be a programme of further investigations of those areas identified as at high risk from surface water flooding. It is likely that many of these areas will be included within the wider high risk areas that will be identified through the assessment process required by the Flood Risk Regulations.

9.2 Immediate Priorities

The 50 highest priority areas (Squares) for surface water flood risk, forming the initial programme of further investigation and detailed assessment, are as follows:

Priority	Ordnance Survey Reference	Centre of Square	Area
1	SE1408SW	Holmfirth Bus Station	Holmfirth
1	SE2220SW	Huddersfield Rd gyratory	Ravensthorpe
3	SE1516SW	Lidl, Wakefield Road	Aspley
4	SE1316SW	The Triangle	Paddock
4	SE1416NW	Westgate	Huddersfield TC
4	SE1417NE	Hillhouse Lane	Fartown
4	SE2023NE	The Swan PH, Leeds Road	Liversedge
8	SE0814SW	Colne Valley Leisure Centre	Slaithwaite
8	SE1517NW	Town Estate, Leeds Road	Huddersfield
8	SE2421NE	Town Hall	Dewsbury
8	SE2423NE	Rouse Mill Lane	Batley
12	SE0411NE	Station Road	Marsden
12	SE1417SW	John William Street	Huddersfield TC
12	SE1417SE	Gt Northern Street gyratory	Huddersfield TC
15	SE1716NW	Green Lea Mills	Dalton
16	SE1618SW	Syngenta Works, Leeds Road	Huddersfield
17	SE1717SW	Kirkwood Hospice	Dalton
17	SE1825SE	Westgate	Cleckheaton
19	SE1315SE	Lockwood Road	Lockwood
19	SE1311NE	Honley Ambulance Station	Honley
19	SE1415NW	Queens Mill Lane	Lockwood
19	SE1418NE	Dewhurst Road	Fartown Green
19	SE1518SW	Textile centre, Leeds Road	Huddersfield
19	SE1925NW	Victoria Mills, Bradford Road	Cleckheaton
25	SE0910NE	Station Street	Meltham
25	SE1118NE	Briar Court hotel, Halifax Road	Birchencliffe
25	SE1116SE	Armitage Road	Milnsbridge
25	SE1115NE	Market Street	Milnsbridge
25	SE1417NW	St Johns Road	Huddersfield
25	SE1418SW	Norman Park	Birkby
25	SE1618NE	Ashgrove Road	Deighton
25	SE2024SW	Knowler Hill	Liversedge
25	SE2220NW	Broomer Street	Ravensthorpe
25	SE2225NE	Bradford Road	Birstall
25	SE2422NW	Mill Road	Batley
36	SE0713NE	Manchester Road	Slaithwaite
36	SE2422SW	Dewsbury College	Dewsbury
38	SE2419NW	Brewery Lane	Thornhill Lees
38	SE2423SE	Bradford Road	Batley
40	SE1720SW	Station Road	Bradley

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41	SE0814SE	Grosvenor Chemicals	Linthwaite
41	SE2024SE	Listing Lane	Liversedge
41	SE1116SW	Royd Street	Milnsbridge
41	SE1416SE	Queen Street Sth	Huddersfield
41	SE1518SE	Arch Chemicals, Leeds Road	Huddersfield
41	SE1616NW	Grosvenor Road	Dalton
41	SE1618NW	Playing Fields, Leeds Road	Huddersfield
41	SE2220SE	Huddersfield Road	Ravensthorpe
41	SE2324NW	Carlinghow Lane	Batley
41	SE2424SE	The Mill, Bradford Road	Batley

Table 9.2

9.2.1 Verification of the Prioritisation Process

The significant flooding from the summer 2007 rainfall event presents us with an opportunity to verify, to some extent, the validity of the risk assessment process used in the SWMP. The Environment Agency's report, following the flooding, suggested that 70% of local flooding across the Yorkshire region was caused by surface water (pluvial), rather than river (fluvial) mechanisms.

The Council has limited information available on the areas that suffered flooding and they are summarised in table 9.2.1 below, together with their SWMP priority ranking from the table in 9.2.

Summer 2007 Flooding Locations	Cause?	Ordnance Survey Reference	SWMP Ranking
Broomer Street, Ravensthorpe	SW	SE2220NW	Severe (25 th)
St Peg Lane, Cleckheaton	?	SE1925SW	High (>50 th)
Radulf Gardens, Liversedge	River	SE2024SW	Severe (25 th)
Gawthorpe Lane, Kirkheaton	SW	SE1916NW	Low (>50 th)
Huddersfield Road, New Mill	SW	SE1608NW	High (>50 th)
Riverside, Clayton West	River/SW	SE2511SW	High (>50 th)
Water Street, Fleet St, Dearne St, Dearne Terrace, Barnsley Rd, Scissett	River	SE2410SE	High (>50 th)
Ings Crescent, Liversedge	River	SE2023NE	Severe (4 th)
Broadoaks Close, Chickenley	River	SE2621SW	Medium (>50 th)
Barnsley Road, Flockton	SW	SE2314NW	Low (>50 th)
Steannard Lane, Mirfield	SW	SE2019SE	Medium (>50 th)
Low Town, Kirkburton	?	SE1912NE	High (>50 th)
Parkgate, Skelmanthorpe	River	SE2311SW	Low (>50 th)
Leeds Road Playing Fields, Huddersfield	SW	SE1618NW	Severe (41 st)
Langley Lane, Scissett	River	SE2511SW	High (>50 th)
Gynn Lane, Honley	SW	SE1411NW	High (>50 th)
Summerfield Grove, Lepton	SW (Soakaway)	SE1814NE	Low (>50 th)
Kenyon Bank, Denby Dale	SW (Blocked Grille)	SE2208SE	High (>50 th)
Abbey Road, Shepley	SW	SE1910SE	Medium (>50 th)
Moor Lane, Gomersal	SW	SE2126NW	High (>50 th)

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Huddersfield Road, Liversedge	SW	SE2023NE	Severe (4 th)
Balme Road, Cleckheaton	SW	SE1825NE	Low (>50 th)
Westgate, Cleckheaton	SW	SE1825SE	Severe (17 th)
Thorntonville, Cleckheaton	SW	SE1924NE	High (>50 th)
Manor Road, Clayton West	SW	SE2611NW	Medium (>50 th)
Valley Road, Liversedge	SW	SE2024SW	Severe (25 th)
Church Green, Kirkburton	SW (Blocked Grille)	SE1912NE	High (>50 th)

Table 9.2.1

The correlation between the actual 2007 flooding locations and the predicted locations from the SWMP risk assessment process is good, with the majority of flooding locations identified as high or severe flood risk in the SWMP.

9.3 The SWMP Action Plan

Further, detailed analysis of the areas identified as high flood risk will form the core of the Action Plan. A further tranche of work, developing the most effective ways of applying the evidence in the SWMP to improve our FRM processes will form the rest of the Plan.

Reference	Action	Proposed Outcomes	Timescale
SWMP1	Prepare and implement a programme of further detailed investigations for the 50 highest risk areas identified in Section 9.2, producing Flood Risk Assessment Reports and Priority Measures Summary for each area	<ul style="list-style-type: none"> An initial summary of the flood risk issues in the defined area A suite of measures that can be implemented to reduce flood risk Further evidence to support the agreement of PFRA Flood Risk areas 	Programme with timescales to be produced by Jan 2011.
SWMP2	Develop an operational relationship with SWMP partners to investigate and explore causes of and solutions for flooding in the priority areas	<ul style="list-style-type: none"> Data sharing Skill/ knowledge sharing Matching improvement and maintenance priorities with identified flood risk 	Trial the first Flood Risk Assessment Report in February 2011
SWMP3	Produce a communications strategy for the dissemination of information from the completed Flood Risk Assessment reports for each priority area	<ul style="list-style-type: none"> Evidence and suggested mitigation measures to be discussed with landowners, partners and other responsible agencies 	Strategy to be completed by March 2011
SWMP4	Integrate the evidence from the SWMP into the Planning Development Control assessment process	<ul style="list-style-type: none"> Improving the quantity, quality and relevance of FRM advice through the planning consultation process 	Information to be imported to Council's GIS system by March 2011
SWMP 5	Use the SWMP as the local evidence base to challenge or confirm the default Flood Risk Areas issued by the EA for the PFRA	<ul style="list-style-type: none"> Agreement of PFRA Flood Risk Areas by June 2010 	Completed and presented to Scrutiny for approval by April 2011

9.4 Presentation and Publication of Results

The Kirklees SWMP will be made available to the general public and promoted by the Council as an evidence base to carry out further work into prioritised areas of high surface water flood risk. The information in the report is sensitive and care needs to be taken to ensure that it is not taken out of context, is as clear and unambiguous as it can be, is discussed with individuals when requested and, ultimately, leads to a properly evidenced assessment of surface water flood risk in each identified area.

The SWMP will be published on the Council's website and awareness will be raised with local councillors, local media and the minor partners identified in Section 6.2 of the SWMP.

9.5 Reviewing the Action Plan

Although much of the future assessment work will be carried out as part of the Council's legal responsibilities under the Flood Risk Regulations 2009, it is appropriate that an annual audit be carried out on progress against the action plan identified in Section 9.3.

Key Points: Implementation and Review

- *The spread of surface water flood risk across Kirklees has been determined*
- *An Action Plan highlighting the priority areas for further investigation and proposed uses for the FRM evidence has been produced*
- *A commitment to publicise and regularly review the plan*

Appendix 1

Risk Assessment Scoring Methodology

Surface Water Flooding Risk Scoring Matrix

Risk	Factor	Factor Weighting (a)	Description of Factor (Risk Score) (b)				Score (a) x (b)
Likelihood	Recorded flood incident		0	1 to 5	6 to 10	10+	
		4	1	3	4	5	
	Surface water map areas		None	Low	Medium	High	
		6	0	2	4	5	
	Recorded drainage assets		None	Limited	Full		
		2	1	2	3		
Total Likelihood Score (X)							
Consequences	Land use		Open	Rural	Urban Fringe	Central Urban	
		3	1	3	4	5	
	Critical infrastructure		None	Low density	High density		
		5	0	2	4		
Total Consequences Score (Y)							
Overall Risk Score (X) x (Y)							

Overall Risk Score (XxY)	<100	101 to 300	301 to 500	501 to 900	>900
Overall Risk Rating	Not Significant	Low	Medium	High	Severe

Recorded flood incident – those incidents recorded by Kirklees Council as flood incidents

SW map areas – A general indication of flood risk using the EA surface water maps

Recorded drainage assets – a measure of the density/completeness of the drainage infrastructure

Land use – reflecting the density of residential/industrial/retail units

Critical infrastructure – reflecting the density and criticality of sensitive buildings/transport links

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Risk Assessment Scores

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
1	Holmfirth	SE1408SW	1550
2	Ravensthorpe	SE2220SW	1550
3	Huddersfield	SE1516SW	1488
4	Marsh	SE1316SW	1426
5	Huddersfield	SE1416NW	1426
6	Huddersfield	SE1417NE	1426
7	Liversedge	SE2023NE	1426
8	Slaithwaite	SE0814SW	1364
9	Huddersfield	SE1517NW	1364
10	Liversedge	SE2023NE	1364
11	Dewsbury	SE2421NE	1364
12	Batley	SE2423NE	1364
13	Marsden	SE0411NE	1344
14	Huddersfield	SE1417SW	1240
15	Huddersfield	SE1417SE	1240
16	Dalton	SE1716NW	1240
17	Huddersfield	SE1618SW	1178
18	Dalton	SE1717SW	1120
19	Cleckheaton	SE1825SE	1120
20	Lockwood	SE1315SE	1058
21	Honley	SE1311NE	1058
22	Huddersfield	SE1415NW	1058
23	Fartown	SE1418NE	1058
24	Huddersfield	SE1518SW	1058
25	Mirfield	SE1925NW	1058
26	Meltham	SE0910NE	1012
27	Lindley	SE1118NE	1012
28	Crosland	SE1116SE	1012
29	Crosland	SE1115NE	1012
30	Fartown	SE1417NW	1012
31	Fartown	SE1418SW	1012
32	Deighton	SE1618NE	1012
33	Liversedge	SE2024SW	1012
34	Batley	SE2225NE	1012
35	Batley	SE2422NW	1012
36	Ravensthorpe	SE2220NW	1000
37	Slaithwaite	SE0713NE	966
38	Dewsbury	SE2422SW	966
39	Thornhill Lees	SE2419NW	966
40	Batley	SE2423SE	966
41	Slaithwaite	SE0814SE	920
42	Milnsbridge	SE1116SW	920
43	Huddersfield	SE1416SE	920
44	Huddersfield	SE1518SE	920
45	Huddersfield	SE1616NW	920

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
46	Huddersfield	SE1618NW	920
47	Liversedge	SE2024SE	920
48	Ravensthorpe	SE2220SE	920
49	Batley	SE2324NE	920
50	Batley	SE2424SE	920
51	Bradley	SE1720SW	896
52	Marsden	SE0411SE	880
53	Marsden	SE0511NW	880
54	Slaithwaite	SE0814NW	880
55	Linthwaite	SE0914SE	880
56	Holme	SE1010SW	880
57	Holme	SE1010NW	880
58	Holmbridge	SE1206NW	880
59	Netherton	SE1307NW	880
60	Armitage Bridge	SE1313NW	880
61	Honley	SE1411NW	880
62	New Mill	SE1608NW	880
63	Oakenshaw	SE1727NW	880
64	Ravensthorpe	SE2120SE	880
65	Ravensthorpe	SE2319NW	880
66	Lockwood	SE1315SW	874
67	Hudds	SE1316SE	874
68	Huddersfield	SE1518NW	874
69	Batley	SE2324NW	868
70	Linthwaite	SE0914SW	840
71	Kirkburton	SE1912NE	840
72	Birstall	SE2225NW	840
73	Dalton	SE1618SE	828
74	Linthwaite	SE0914NE	800
75	Meltham	SE1011SE	800
76	Meltham	SE1010NE	800
77	Honley	SE1313NE	800
78	Honley	SE1412SW	800
79	Brockholes	SE1411NE	800
80	Brockholes	SE1411SE	800
81	Newsome	SE1510NW	800
82	Almondbury	SE1714NW	800
83	Denby Dale	SE2208SE	800
84	Mirfield	SE2019NE	800
85	Liversedge	SE1924NE	800
86	Heckmondwike	SE2122NE	800
87	Birstall	SE2126SE	800
88	Ravensthorpe	SE2219NW	800
89	Batley	SE2425SE	800
90	Dewsbury	SE2322NW	784

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
91	Heckmondwike	SE2124SW	782
92	Heckmondwike	SE2123NE	782
93	Batley	SE2324SE	782
94	Milnsbridge	SE1115NW	760
95	Holmfirth	SE1307NE	760
96	Holmfirth	SE1408NW	760
97	Honley	SE1412SE	760
98	Newsome	SE1511SW	760
99	Bradley	SE1720NE	760
100	Cleckheaton	SE1826NW	760
101	Scisset	SE2510NW	760
102	Upper Hopton	SE1912SE	760
103	Batley	SE2325SW	760
104	Honley	SE1215NW	736
105	Huddersfield	SE1416NE	736
106	Deighton	SE1619NE	736
107	Mirfield	SE1925SW	736
108	Holmfirth	SE1409NE	714
109	Lockwood	SE1314NE	690
110	Huddersfield	SE1415NE	690
111	Dalton	SE1617NE	690
112	Almondbury	SE1616NE	690
113	Heckmondwike	SE2123SE	690
114	Birstall	SE2226SW	690
115	Dewsbury	SE2320NE	690
116	Batley	SE2424SW	690
117	Thornhill Lees	SE2419NE	690
118	Marsden	SE0411NW	680
119	Mirfield	SE1820SE	680
120	Savile Town	SE2420NE	660
121	Savile Town	SE2421SE	660
122	Dalton	SE1717NW	646
123	Shelley	SE2010NW	646
124	Clayton West	SE2511NE	646
125	Clayton West	SE2511SW	646
126	Slaithwaite	SE0714SE	644
127	Longwood	SE1016SW	644
128	Lindley	SE1017NE	644
129	Lindley	SE1119SW	644
130	Honley	SE1216SW	644
131	Huddersfield	SE1516SE	644
132	Almondbury	SE1715NW	644
133	Liversedge	SE2023NW	644
134	Heckmondwike	SE2123NW	644
135	Heckmondwike	SE2224SW	644

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
136	Heckmondwike	SE2223NW	644
137	Birstall	SE2226SE	644
138	Birstall	SE2226NE	644
139	Birstall	SE2326NE	644
140	Dewsbury	SE2322NE	644
141	Birstall	SE2327NE	644
142	Slaithwaite	SE0813NW	640
143	Birkenshaw	SE2027NW	640
144	Gomersal	SE2025NE	640
145	Mirfield	SE2119NE	640
146	Thornhill Lees	SE2420SW	640
147	Deighton	SE1619SE	620
148	Lindley	SE1018NW	600
149	Denby Dale	SE2308NW	600
150	Heckmondwike	SE2123SW	600
151	Birstall	SE2326NE	600
152	Netherton	SE1217SW	598
153	Hinchcliffe Mill	SE1216SE	598
154	Huddersfield	SE1414NW	598
155	Fartown	SE1418SE	598
156	Bradley	SE1519NW	598
157	Mirfield	SE1924NW	598
158	Dewsbury Moor	SE2221NE	598
159	Birstall	SE2327SW	598
160	Batley	SE2326SW	598
161	Dewsbury Moor	SE2320NW	598
162	Dewsbury	SE2321SE	598
163	Dewsbury	SE2421NW	598
164	Huddersfield	SE1516NW	570
165	Huddersfield	SE1617SW	570
166	Marsden	SE0512SW	560
167	Hinchcliffe Mill	SE1214SE	560
168	Netherthong	SE1311SE	560
169	Holmfirth	SE1407NW	560
170	Huddersfield	SE1515NW	560
171	Almondbury	SE1515SE	560
172	Cleckheaton	SE1725SE	560
173	Waterloo	SE1716NE	560
174	Mirfield	SE1920SW	560
175	East Bierley	SE2029SW	560
176	Birkenshaw	SE2028NW	560
177	Gomersal	SE2027SW	560
178	Liversedge	SE2023SW	560
179	Mifield	SE2020SW	560
180	Gomersal	SE2027SE	560

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
181	Gomersal	SE2127SW	560
182	Gomersal	SE2126NW	560
183	Gomersal	SE2124NE	560
184	Mirfield	SE2119NW	560
185	Batley	SE2224NE	560
186	Batley	SE2325NE	560
187	Dewsbury	SE2422SE	560
188	Batley	SE2422NE	560
189	Netherthong	SE1309NE	544
190	Huddersfield	SE1517SW	540
191	Crosland	SE1115SW	528
192	Lower Hopton	SE2019SW	528
193	Mirfield	SE2019NW	528
194	Honley	SE1215SW	520
195	Upperthong	SE1213NE	520
196	Holmfirth	SE1308SE	520
197	Bradley	SE1520SW	520
198	Kirkheaton	SE1717SE	520
199	Lepton	SE1914NW	520
200	Denby Dale	SE2208SW	520
201	Birkenshaw	SE1927NE	520
202	Batley	SE2224NW	520
203	Batley	SE2324SW	520
204	Savile Town	SE2420NW	520
205	Chickenley	SE2621NW	520
206	Marsden	SE0612NE	510
207	Holme	SE1005SW	510
208	Brockholes	SE1510SW	510
209	New Mill	SE1609SW	510
210	Lepton	SE1814SE	510
211	Scisset	SE2410SE	510
212	Holmfirth	SE1407NE	504
213	Heckmondwike	SE2122NW	504
214	Thornhill Lees	SE2319NE	504
215	Marsden	SE0410NW	480
216	Marsden	SE0410NE	480
217	Outlane	SE0817NE	480
218	Meltham	SE0910SE	480
219	Honley	SE1312NE	480
220	Dalton	SE1617SE	480
221	Mirfield	SE1926SW	480
222	Cleckheaton	SE1826SE	480
223	Mirfield	SE1920SE	480
224	Netherton	SE1206NE	476
225	New Mill	SE1607NW	476

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
226	Bradley	SE1720SE	476
227	Shepley	SE1910SE	476
228	Cleckheaton	SE1925SE	476
229	Fartown	SE1419NE	460
230	Brockholes	SE1509SW	460
231	Deighton	SE1620SE	460
232	Batley	SE2223SE	460
233	Lindley	SE1018SW	456
234	Scisset	SE2510SW	456
235	Huddersfield	SE1516NE	450
236	Cleckheaton	SE1824NE	450
237	Batley	SE2323SW	450
238	Dewsbury	SE2321NE	450
239	Slaithwaite	SE0713NW	442
240	Slaithwaite	SE0717SE	442
241	Linthwaite	SE0915SE	442
242	Meltham	SE1014SW	442
243	Honley	SE1207SE	442
244	New Mill	SE1607SW	442
245	Kirkburton	SE2013SW	442
246	Grange Moor	SE2215NE	442
247	Lockwood	SE1314NW	432
248	Longwood	SE1016SE	420
249	Honley	SE1216NW	420
250	Netherton	SE1218SW	420
251	Crosland	SE1216NE	420
252	Fartown	SE1418NW	420
253	Huddersfield	SE1415SE	420
254	Almondbury	SE1615NW	420
255	Huddersfield	SE1619SW	420
256	Huddersfield	SE1619NW	420
257	Deighton	SE1620NE	420
258	Almondbury	SE1616SE	420
259	Batley	SE2223NE	420
260	Batley	SE2423NW	420
261	Savile Town	SE2420SE	420
262	Batley	SE2523NW	420
263	Earlsheaton	SE2521NE	420
264	Huddersfield	SE1416SW	414
265	Fartown	SE1419SE	414
266	Dewsbury Moor	SE2222NE	414
267	Ravensthorpe	SE2220NE	408
268	Holmfirth	SE1409SW	400
269	Honley	SE1412NW	400
270	Westgate Hill	SE1929NE	400

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
271	Gomersal	SE2026SE	400
272	Lower Hopton	SE2019SE	396
273	Netherton	SE1217NW	390
274	Crosland	SE1217SE	390
275	Marsh	SE1315NW	390
276	Hudds	SE1315NE	390
277	Lockwood	SE1314SE	390
278	Honley	SE1312SE	390
279	Waterloo	SE1716SE	390
280	Mirfield	SE2020NW	390
281	Dewsbury Moor	SE2222SE	390
282	Dewsbury	SE2322SE	390
283	Batley	SE2423SW	390
284	Dewsbury	SE2421SW	390
285	Thornhill	SE2518NW	390
286	Slaithwaite	SE0714SW	384
287	Meltham	SE0910NW	384
288	Linthwaite	SE0913NW	384
289	Netherton	SE1311NW	384
290	Huddersfield	SE1515SW	384
291	Mirfield	SE1820NE	384
292	Mirfield	SE1821SW	384
293	Cleckheaton	SE1825NW	384
294	Clayton West	SE2611NW	384
295	Mirfield	SE2020NE	384
296	Mirfield	SE2021SW	384
297	Mirfield	SE2020SE	384
298	Mirfield	SE2021SE	384
299	Golcar	SE0918SW	360
300	Meltham	SE1015SW	360
301	Armitage Bridge	SE1314SW	360
302	Holmfirth	SE1409SE	360
303	Brockholes	SE1509NW	360
304	Huddersfield	SE1518NE	360
305	New Mill	SE1509NE	360
306	New Mill	SE1509SE	360
307	Flockton	SE2414NW	360
308	Liversedge	SE1923NE	360
309	Birkenshaw	SE2028SW	360
310	Mirfield	SE2120SW	360
311	Heckmondwike	SE2222SW	360
312	Birstall	SE2227NE	360
313	Birstall	SE2327NW	360
314	Dewsbury Moor	SE2321SW	360
315	Ravensthorpe	SE2320SW	360

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
316	Thornhill Lees	SE2319SE	360
317	Batley	SE2325SE	360
318	Marsden	SE0312SE	342
319	New Mill	SE1508NE	342
320	Jackson Bridge	SE1607SE	342
321	Birds Edge	SE2010SW	342
322	Oakenshaw	SE1726NE	340
323	Outlane	SE0817NW	336
324	Longwood	SE1016NE	336
325	Lindley	SE1118NW	336
326	Netherton	SE1218NW	336
327	Honley	SE1207NE	336
328	Honley	SE1313SE	336
329	Scholes	SE1626SW	336
330	Almondbury	SE1715SW	336
331	Fenay Bridge	SE1715NE	336
332	Stocksmoor	SE1810NW	336
333	Lepton	SE1815SW	336
334	Highburton	SE1813NE	336
335	Highburton	SE1913SW	336
336	Cleckheaton	SE1825SW	336
337	Hunsworth	SE1826SE	336
338	Mirfield	SE1921NE	336
339	East Bierley	SE1929SE	336
340	Norristhorpe	SE2022NW	336
341	Roberttown	SE2021NW	336
342	Liversedge	SE2023SE	336
343	Gomersal	SE2025SE	336
344	Gomersal	SE2026NE	336
345	Birkenshaw	SE2027NE	336
346	Birkenshaw	SE2028SE	336
347	Birkenshaw	SE2127NE	336
348	Northorpe	SE2121SW	336
349	Mirfield	SE2119SW	336
350	Heckmondwike	SE2124SE	336
351	Heckmondwike	SE2124NE	336
352	Heckmondwike	SE2222NW	336
353	Batley	SE2324NW	336
354	Overthorpe	SE2318SE	336
355	Thornhill	SE2519SW	336
356	Earlsheaton	SE2521SE	336
357	Chidswell	SE2622NW	336
358	Chickenley	SE2621SW	336
359	Chickenley	SE2621SE	336
360	Upperthong	SE1213SE	322

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
361	Hudds	SE1317SE	322
362	Longwood	SE1015NE	312
363	Crosland	SE1114NE	312
364	Honley	SE1214NW	312
365	Honley	SE1212NE	312
366	Armitage Bridge	SE1313SW	312
367	Birkby	SE1318NW	312
368	Honley	SE1414SW	312
369	Huddersfield	SE1415SW	312
370	Almondbury	SE1614NE	312
371	New Mill	SE1608NE	312
372	Cleckheaton	SE1724NE	312
373	Kirkheaton	SE1717NE	312
374	Lepton	SE1815SE	312
375	Kirkburton	SE1813SE	312
376	Liversedge	SE1924SE	312
377	Gomersal	SE2025NW	312
378	Mirfield	SE2120NE	312
379	Birstall	SE2226NW	312
380	Grange Moor	SE2215NW	312
381	Denby Dale	SE2208NE	312
382	Denby Dale	SE2309SE	312
383	Dewsbury Moor	SE2221SE	312
384	Birstall	SE2326SE	312
385	Batley	SE2325SW	312
386	Thornhill Lees	SE2419SW	312
387	Thornhill Edge	SE2418SW	312
388	Thornhill	SE2418NE	312
389	Batley	SE2524SW	312
390	Hanging Heaton	SE2523NE	312
391	Slaithwaite	SE0717SW	306
392	Brockholes	SE1510NW	306
393	Oakenshaw	SE1727SE	306
394	Oakenshaw	SE1726SE	306
395	Bradley	SE1721SW	306
396	Scisset	SE2409SW	306
397	Mirfield	SE2218NW	306
398	Lindley	SE1117NE	300
399	Almondbury	SE1615SE	300
400	Batley	SE2323NE	300
401	New Mill	SE1608SW	288
402	Golcar	SE0918SE	270
403	Holme	SE1009NW	270
404	Hinchcliffe Mill	SE1215SE	270
405	Marsh	SE1316NW	270

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
406	Hudds	SE1316NE	270
407	Huddersfield	SE1517NE	270
408	Lepton	SE1814NE	264
409	Linthwaite	SE0913NE	252
410	Holmbridge	SE1109NE	252
411	Holmfirth	SE1406SE	252
412	Holmfirth	SE1508SW	252
413	New Mill	SE1508SE	252
414	Scholes	SE1507NE	252
415	New Mill	SE1606NW	252
416	Almondbury	SE1614SW	252
417	Lepton	SE1916NW	252
418	Mirfield	SE1926NW	252
419	Flockton	SE2414SW	252
420	Cleakheaton	SE1925NE	252
421	Mirfield	SE2021NE	252
422	Upper Hopton	SE1918NE	252
423	Birds Edge	SE2007NW	252
424	Gomersal	SE2024NE	252
425	Meltham	SE0911SW	240
426	Golcar	SE0916SW	240
427	Linthwaite	SE0915NE	240
428	Meltham	SE0911SE	240
429	Milnsbridge	SE1117SW	240
430	Milnsbridge	SE1117NW	240
431	Lindley	SE1119SE	240
432	Lindley	SE1117SE	240
433	Milnsbridge	SE1116NE	240
434	Crosland	SE1115SE	240
435	Marsh	SE1317SW	240
436	Fartown	SE1419SW	240
437	Fartown	SE1420NE	240
438	Huddersfield	SE1515NE	240
439	Scholes	SE1625NE	240
440	Hartshead Moor	SE1724NW	240
441	Lepton	SE1815NW	240
442	Mirfield	SE1824NW	240
443	Skelmanthorpe	SE2310NW	240
444	Scisset	SE2410NE	240
445	Birstall	SE2126NE	240
446	Batley	SE2225SW	240
447	Batley	SE2323NW	240
448	Hanging Heaton	SE2521NW	240
449	Earlsheaton	SE2523SE	240
450	Marsden	SE0312SW	234

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
451	Marsden	SE0512NE	234
452	Marsden	SE0612NW	234
453	Marsden	SE0613SE	234
454	Slaithwaite	SE0716SW	234
455	Slaithwaite	SE0810NE	234
456	Golcar	SE0915NW	234
457	Linthwaite	SE0913SE	234
458	Holmbridge	SE1207SW	234
459	Honley	SE1212SE	234
460	Brockholes	SE1410SE	234
461	New Mill	SE1606SW	234
462	Almondbury	SE1614SE	234
463	Oakenshaw	SE1727NE	234
464	Stocksmoor	SE1809NE	234
465	Thunderbridge	SE1811SE	234
466	Kirkburton	SE1911SW	234
467	Shelley	SE2010NE	234
468	Skelmanthorpe	SE2311SW	234
469	Clayton West	SE2510SE	234
470	Cleckheaton	SE1926SE	234
471	Shelley	SE1910NE	234
472	Lepton	SE2015SE	234
473	Whitley	SE2117SE	234
474	Mirfield	SE2121SE	234
475	Whitley Lower	SE2217NW	234
476	Clayton West	SE2211SE	234
477	Skelmanthorpe	SE2210NE	234
478	Briestfield	SE2317SE	234
479	Chickenley	SE2620NW	234
480	Longwood	SE1016NW	216
481	Meltham	SE1010SE	216
482	Honley	SE1214SW	216
483	Armitage Bridge	SE1312NW	216
484	Huddersfield	SE1519NE	216
485	Bradley	SE1720NW	216
486	Shepley	SE1909NW	216
487	Cleckheaton	SE1825NE	216
488	Highburton	SE1913SE	216
489	Gomersal	SE2026SW	216
490	Birkenshaw	SE2128NW	216
491	Northorpe	SE2120NW	216
492	Heckmondwike	SE2223SW	216
493	Denby Dale	SE2308NE	216
494	Denby Dale	SE2309SW	216
495	Batley	SE2225SE	216

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
496	Dewsbury	SE2321NW	216
497	Thornhill Lees	SE2320SE	216
498	Batley	SE2424NE	216
499	Batley	SE2524NW	216
500	Hanging Heaton	SE2521SW	216
501	Earlsheaton	SE2520SW	216
502	Earlsheaton	SE2519NW	216
503	Chidswell	SE2622SW	216
504	Chidswell	SE2623SE	216
505	Lindley	SE1118SW	210
506	Lindley	SE1118SE	210
507	Hinchcliffe Mill	SE1215NE	210
508	Hinchcliffe Mill	SE1214NE	210
509	Birkby	SE1319SE	210
510	Huddersfield	SE1519SW	210
511	Huddersfield	SE1517SE	210
512	Almondbury	SE1616SW	210
513	Almondbury	SE1615NE	210
514	Almondbury	SE1716SW	210
515	Hightown	SE1724SE	210
516	Dewsbury	SE2322SW	210
517	Batley	SE2323SE	210
518	Thornhill	SE2518SW	210
519	Outlane	SE0816SE	192
520	Linthwaite	SE0916SE	192
521	Longwood	SE1015NW	192
522	Milnsbridge	SE1116NW	192
523	Honley	SE1208SE	192
524	Netherton	SE1308SW	192
525	Netherton	SE1311SW	192
526	Holmfirth	SE1408NE	192
527	Holmfirth	SE1407SE	192
528	Scholes	SE1626SE	192
529	Scholes	SE1624NE	192
530	Cleckheaton	SE1725NE	192
531	Kirkheaton	SE1718SE	192
532	Mirfield	SE1821SE	192
533	Cleckheaton	SE1827SW	192
534	Roberttown	SE1922SE	192
535	Roberttown	SE1922NE	192
536	Roberttown	SE2022SW	192
537	Gomersal	SE2125NW	192
538	Batley	SE2224SE	192
539	Chidswell	SE2623SW	192
540	Holme	SE1011SW	180

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
541	Holmfirth	SE1409NW	180
542	Holmfirth	SE1405NE	180
543	Holmfirth	SE1508NW	180
544	Scholes	SE1726SW	180
545	East Bierley	SE1928NE	180
546	Lower Hopton	SE1919SE	180
547	Whitley	SE2119SE	180
548	Thornhill Lees	SE2319SW	180
549	Briestfield	SE2318SW	180
550	Chickenley	SE2620NE	180
551	Marsden	SE0511NE	168
552	Slaithwaite	SE0813NE	168
553	Lindley	SE1017SW	168
554	Lindley	SE1017NW	168
555	Lindley	SE1017SE	168
556	Meltham	SE1015SE	168
557	Crosland	SE1212NW	168
558	Crosland	SE1213SW	168
559	Fixby	SE1420SW	168
560	Honley	SE1414NE	168
561	Holmfirth	SE1406NE	168
562	Huddersfield	SE1620NW	168
563	Scholes	SE1625SW	168
564	Hightown	SE1723NE	168
565	Kirkheaton	SE1718NE	168
566	Lepton	SE1816SW	168
567	Mirfield	SE1824SW	168
568	Cleckheaton	SE1824NE	168
569	Highburton	SE1913NW	168
570	Clayton West	SE2510NE	168
571	Mirfield	SE1921SE	168
572	Westgate Hill	SE2029NW	168
573	Norristhorpe	SE2022NE	168
574	Shelley	SE1911SE	168
575	Birds Edge	SE2011SW	168
576	Birkenshaw	SE2028NE	168
577	Grange Moor	SE2216SW	168
578	Skelmanthorpe	SE2310SW	168
579	Skelmanthorpe	SE2310SE	168
580	Thornhill	SE2418SE	168
581	Thornhill Lees	SE2419SE	168
582	Thornhill	SE2518SE	168
583	Earlsheaton	SE2522SE	168
584	Earlsheaton	SE2522NE	168
585	Hanging Heaton	SE2524SE	168

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
586	Chickenley	SE2621NE	168
587	Marsden	SE0211NE	162
588	Marsden	SE0510NW	162
589	Marsden	SE0613SW	162
590	Slaithwaite	SE0716NW	162
591	Holmbridge	SE1106SE	162
592	Holmbridge	SE1106NE	162
593	Holmbridge	SE1112SE	162
594	Crosland	SE1212SW	162
595	Armitage Bridge	SE1312SW	162
596	Honley	SE1414SE	162
597	Holmfirth	SE1505SW	162
598	Holmfirth	SE1505NW	162
599	Huddersfield	SE1514SW	162
600	Mirfield	SE1823NW	162
601	Shepley	SE1909NE	162
602	Shelley	SE2011SE	162
603	Mirfield	SE2022SE	162
604	Lower Hopton	SE2018NE	162
605	Woodbottom	SE2118NW	162
606	Woodbottom	SE2118SW	162
607	Whitley Lower	SE2217SW	162
608	Overthorpe	SE2318NE	162
609	Thornhill Edge	SE2417SE	162
610	Thornhill Edge	SE2417NE	162
611	Thornhill	SE2518NE	162
612	Thornhill	SE2520SE	162
613	Marsden	SE0614NW	144
614	Slaithwaite	SE0715NE	144
615	Slaithwaite	SE0815NW	144
616	Outlane	SE0816SW	144
617	Meltham	SE1013SW	144
618	Meltham	SE1008SE	144
619	Holme	SE1005NE	144
620	Holmfirth	SE1309SE	144
621	Honley	SE1412NE	144
622	Holmfirth	SE1507SW	144
623	Scholes	SE1507SE	144
624	Thurstonland	SE1610NE	144
625	Hepworth	SE1606NE	144
626	Shepley	SE1908NW	144
627	Lepton	SE1916SW	144
628	Upper Hopton	SE1918NW	144
629	Mirfield	SE1922NW	144
630	Mirfield	SE1822NE	144

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
631	Cleckheaton	SE1826SW	144
632	East Bierley	SE1929SW	144
633	Shelley	SE2008NE	144
634	Lepton	SE2015SW	144
635	Lepton	SE2015NW	144
636	Lwr Cumberworth	SE2209SW	144
637	Skelmanthorpe	SE2210SE	144
638	Flockton	SE2314NW	144
639	Flockton	SE2314NE	144
640	Gomersal	SE2026NW	144
641	Upper Hopton	SE1918SE	144
642	Lepton	SE2114SE	144
643	Grange Moor	SE2214NE	144
644	Denby Dale	SE2207SE	144
645	Lower Hopton	SE1919NE	138
646	Marsden	SE0412SW	126
647	Marsden	SE0412SE	126
648	Marsden	SE0515SW	126
649	Marsden	SE0516SE	126
650	Marsden	SE0515SE	126
651	Marsden	SE0513SE	126
652	Marsden	SE0512SE	126
653	Marsden	SE0612SW	126
654	Marsden	SE0615SW	126
655	Marsden	SE0613NE	126
656	Marsden	SE0612SE	126
657	Slaithwaite	SE0713SW	126
658	Slaithwaite	SE0714NE	126
659	Slaithwaite	SE0713SE	126
660	Slaithwaite	SE0812NW	126
661	Slaithwaite	SE0815SW	126
662	Outlane	SE0816NW	126
663	Outlane	SE0817SW	126
664	Outlane	SE0816NE	126
665	Slaithwaite	SE0815SE	126
666	Slaithwaite	SE0813SE	126
667	Slaithwaite	SE0812NE	126
668	Slaithwaite	SE0811NE	126
669	Meltham	SE0912SW	126
670	Golcar	SE0917NE	126
671	Meltham	SE0912SE	126
672	Meltham	SE0911NE	126
673	Holme	SE1005NW	126
674	Holme	SE1007NW	126
675	Holme	SE1008SW	126

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
676	Holme	SE1012SW	126
677	Meltham	SE1013NW	126
678	Meltham	SE1014NW	126
679	Lindley	SE1018NE	126
680	Meltham	SE1014NE	126
681	Meltham	SE1012SE	126
682	Holme	SE1006SE	126
683	Holmbridge	SE1107NE	126
684	Crosland	SE1112NE	126
685	Holmfirth	SE1411SW	126
686	Holmfirth	SE1506NW	126
687	Holmfirth	SE1507NW	126
688	Scholes	SE1506SE	126
689	Almondbury	SE1612NW	126
690	Almondbury	SE1613NE	126
691	Farnley Tyas	SE1612NE	126
692	Thurstonland	SE1610SE	126
693	New Mill	SE1608SE	126
694	Jackson Bridge	SE1707SE	126
695	Jackson Bridge	SE1707NE	126
696	Stocksmoor	SE1710NE	126
697	Dalton	SE1718SW	126
698	Scholes	SE1725NW	126
699	Hightown	SE1723SE	126
700	Lepton	SE1816NE	126
701	Lepton	SE1817NE	126
702	Mirfield	SE1822SE	126
703	Kirkburton	SE1912SW	126
704	Shepley	SE1910SW	126
705	Flockton	SE2415SW	126
706	Flockton	SE2415SE	126
707	Emley	SE2413SW	126
708	Emley	SE2412SW	126
709	Denby Dale	SE2508NW	126
710	Clayton West	SE2511SE	126
711	Clayton West	SE2610NW	126
712	Drub	SE1926NE	126
713	Shelley	SE1908NE	126
714	Upper Hopton	SE1917NE	126
715	Birds Edge	SE2008NW	126
716	Birds Edge	SE2009SW	126
717	Kirkburton	SE2012SW	126
718	Lepton	SE2014NW	126
719	Birds Edge	SE2107SE	126
720	Lepton	SE2114SW	126

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
721	Lepton	SE2116SE	126
722	Woodbottom	SE2117SW	126
723	Emley	SE2213NW	126
724	Emley	SE2213NE	126
725	Skelmanthorpe	SE2210NW	126
726	Denby Dale	SE2207SW	126
727	Denby Dale	SE2307NE	126
728	Emley	SE2313SW	126
729	Denby	SE2316SE	126
730	Thornhill	SE2517NW	126
731	Thornhill	SE2519NE	126
732	Drighlington	SE2128SE	120
733	Drighlington	SE2227NW	120
734	Birkenshaw	SE2128SW	102
735	Heckmondwike	SE2122SE	102
736	Birkby	SE1320SE	96
737	Fixby	SE1419NW	96
738	Almondbury	SE1614NW	96
739	Scholes	SE1625NW	96
740	Scholes	SE1625SE	96
741	Mirfield	SE1921NW	96
742	Lindley	SE1018SE	90
743	Huddersfield	SE1617NW	90
744	Batley	SE2523SW	90
745	Batley	SE2522NW	90
746	Marsden	SE0511SW	72
747	Marsden	SE0614NW	72
748	Slaithwaite	SE0815NE	72
749	Meltham	SE0910SW	72
750	Linthwaite	SE0916NE	72
751	Birkby	SE1319NE	72
752	Fartown	SE1420SE	72
753	Bradley	SE1520NE	72
754	Bradley	SE1520SE	72
755	Huddersfield	SE1519SE	72
756	Almondbury	SE1514NE	72
757	Almondbury	SE1615SW	72
758	Thurstonland	SE1609SE	72
759	Farnley Tyas	SE1712NW	72
760	Roberttown	SE1923SE	72
761	Gomersal	SE2025SW	72
762	Marsden	SE0213SE	54
763	Marsden	SE0212NE	54
764	Marsden	SE0212SE	54
765	Marsden	SE0311NW	54

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
766	Marsden	SE0311NE	54
767	Marsden	SE0410SW	54
768	Marsden	SE0414NW	54
769	Marsden	SE0415SW	54
770	Marsden	SE0415NW	54
771	Marsden	SE0416SW	54
772	Marsden	SE0416NW	54
773	Marsden	SE0416NE	54
774	Marsden	SE0416SE	54
775	Marsden	SE0415NE	54
776	Marsden	SE0415SE	54
777	Marsden	SE0414NE	54
778	Marsden	SE0412NE	54
779	Marsden	SE0510SW	54
780	Marsden	SE0512NW	54
781	Marsden	SE0513SW	54
782	Marsden	SE0513NW	54
783	Marsden	SE0514SW	54
784	Marsden	SE0514NW	54
785	Marsden	SE0515NW	54
786	Marsden	SE0516SW	54
787	Marsden	SE0516NW	54
788	Marsden	SE0516NE	54
789	Marsden	SE0515NE	54
790	Marsden	SE0514NE	54
791	Marsden	SE0514SE	54
792	Marsden	SE0513NE	54
793	Marsden	SE0511SE	54
794	Marsden	SE0613NW	54
795	Marsden	SE0614SW	54
796	Marsden	SE0615NW	54
797	Marsden	SE0616SW	54
798	Marsden	SE0616NW	54
799	Marsden	SE0615NE	54
800	Marsden	SE0615SE	54
801	Marsden	SE0614SE	54
802	Marsden	SE0611NE	54
803	Marsden	SE0611SE	54
804	Slaithwaite	SE0712SW	54
805	Slaithwaite	SE0714NW	54
806	Slaithwaite	SE0715SW	54
807	Slaithwaite	SE0715NW	54
808	Slaithwaite	SE0716NE	54
809	Slaithwaite	SE0716SE	54
810	Slaithwaite	SE0715SE	54

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Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
811	Slaithwaite	SE0712NE	54
812	Slaithwaite	SE0712SE	54
813	Slaithwaite	SE0711NE	54
814	Slaithwaite	SE0811SW	54
815	Slaithwaite	SE0811NW	54
816	Slaithwaite	SE0812SW	54
817	Slaithwaite	SE0813SW	54
818	Outlane	SE0817SE	54
819	Slaithwaite	SE0814NE	54
820	Slaithwaite	SE0811SE	54
821	Meltham	SE0911NW	54
822	Meltham	SE0912NW	54
823	Linthwaite	SE0913SW	54
824	Linthwaite	SE0914NW	54
825	Linthwaite	SE0915SW	54
826	Golcar	SE0916NW	54
827	Golcar	SE0917SW	54
828	Golcar	SE0917NW	54
829	Golcar	SE0917SE	54
830	Meltham	SE0912NE	54
831	Holme	SE1009SW	54
832	Holme	SE1011NW	54
833	Meltham	SE1012NW	54
834	Meltham	SE1014SE	54
835	Meltham	SE1013NE	54
836	Meltham	SE1013SE	54
837	Meltham	SE1012NE	54
838	Meltham	SE1011NE	54
839	Meltham	SE1009NE	54
840	Meltham	SE1009SE	54
841	Meltham	SE1008NE	54
842	Holmbridge	SE1107SE	54
843	Holmbridge	SE1108SE	54
844	Holmbridge	SE1108NE	54
845	Holmbridge	SE1109SE	54
846	Holmbridge	SE1110SE	54
847	Holmbridge	SE1110NE	54
848	Holmbridge	SE1111SE	54
849	Holmbridge	SE1111NE	54
850	Crosland	SE1113SE	54
851	Crosland	SE1113NE	54
852	Crosland	SE1114SE	54
853	Crosland	SE1219SW	54
854	Holmfirth	SE1308NE	54
855	Honley	SE1413NE	54

Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
856	Honley	SE1413SE	54
857	Brockholes	SE1410NE	54
858	Holmfirth	SE1408SE	54
859	Holmfirth	SE1405SE	54
860	Holmfirth	SE1506SW	54
861	Newsome	SE1511NW	54
862	Huddersfield	SE1514NW	54
863	Almondbury	SE1514SE	54
864	Brockholes	SE1511SE	54
865	Brockholes	SE1510SW	54
866	Scholes	SE1506NE	54
867	Scholes	SE1505NE	54
868	Scholes	SE1505SE	54
869	Thurstonland	SE1609NW	54
870	Thurstonland	SE1610SW	54
871	Thurstonland	SE1610NW	54
872	Farnley Tyas	SE1611SW	54
873	Scholes	SE1725SW	54
874	Drub	SE1927SE	54
875	Mirfield	SE2219SW	54
876	Slaithwaite	SE0712NW	42
877	Marsden	SE0213SW	18
878	Marsden	SE0213NW	18
879	Marsden	SE0213NE	18
880	Marsden	SE0211SE	18
881	Marsden	SE0311SW	18
882	Marsden	SE0312NW	18
883	Marsden	SE0313SW	18
884	Marsden	SE0313NW	18
885	Marsden	SE0313NE	18
886	Marsden	SE0313SE	18
887	Marsden	SE0312NE	18
888	Marsden	SE0311SE	18
889	Marsden	SE0411SW	18
890	Marsden	SE0412NW	18
891	Marsden	SE0413SW	18
892	Marsden	SE0413NW	18
893	Marsden	SE0414SW	18
894	Marsden	SE0414SE	18
895	Marsden	SE0413NE	18
896	Marsden	SE0413SE	18
897	Marsden	SE0410SE	18
898	Marsden	SE0510NE	18
899	Marsden	SE0510SE	18
900	Marsden	SE0611SW	18

Kirklees Surface Water Management Plan

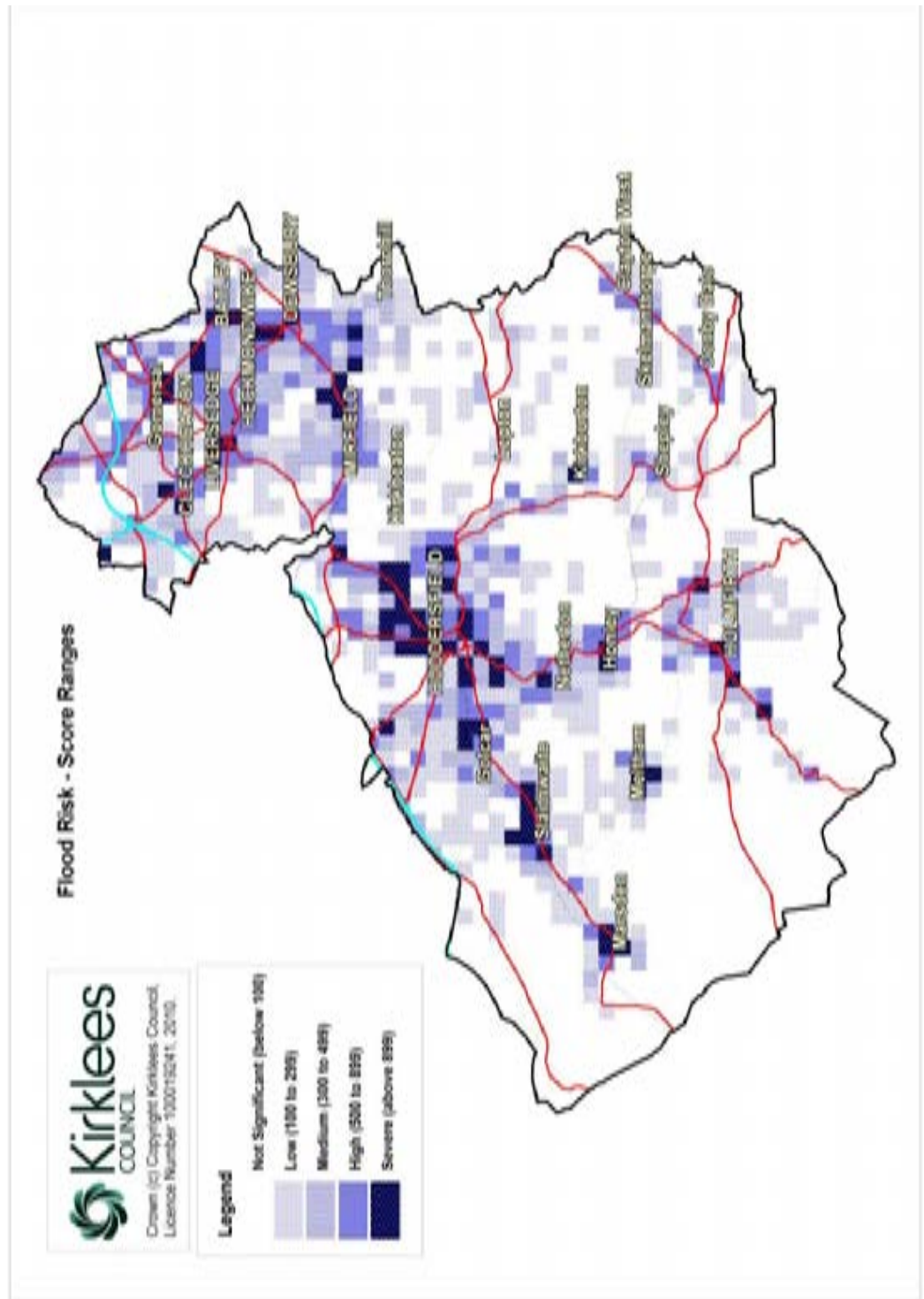
Rank	General Area	Ordnance Survey Ref	Total Flood Risk Score
901	Marsden	SE0611NW	18
902	Slaithwaite	SE0711SW	18
903	Slaithwaite	SE0711NW	18
904	Slaithwaite	SE0711SE	18
905	Slaithwaite	SE0809SW	18
906	Slaithwaite	SE0809NW	18
907	Slaithwaite	SE0810SW	18
908	Slaithwaite	SE0810NW	18
909	Slaithwaite	SE0812SE	18
910	Slaithwaite	SE0810SE	18
911	Slaithwaite	SE0809NE	18
912	Slaithwaite	SE0809SE	18
913	Holme	SE1006SW	18
914	Holme	SE1006NW	18
915	Holme	SE1007SW	18
916	Holme	SE1008NW	18
917	Meltham	SE1007NE	18
918	Holme	SE1007SE	18
919	Holme	SE1006NE	18
920	Huddersfield	SE1620SW	18

The remaining 700+ "OS Squares" are unscored but have a score of less than 100, assessing them as having insignificant flood risk.

Appendix 2

The Spread of Surface Water Flood Risk across Kirklees

All Areas

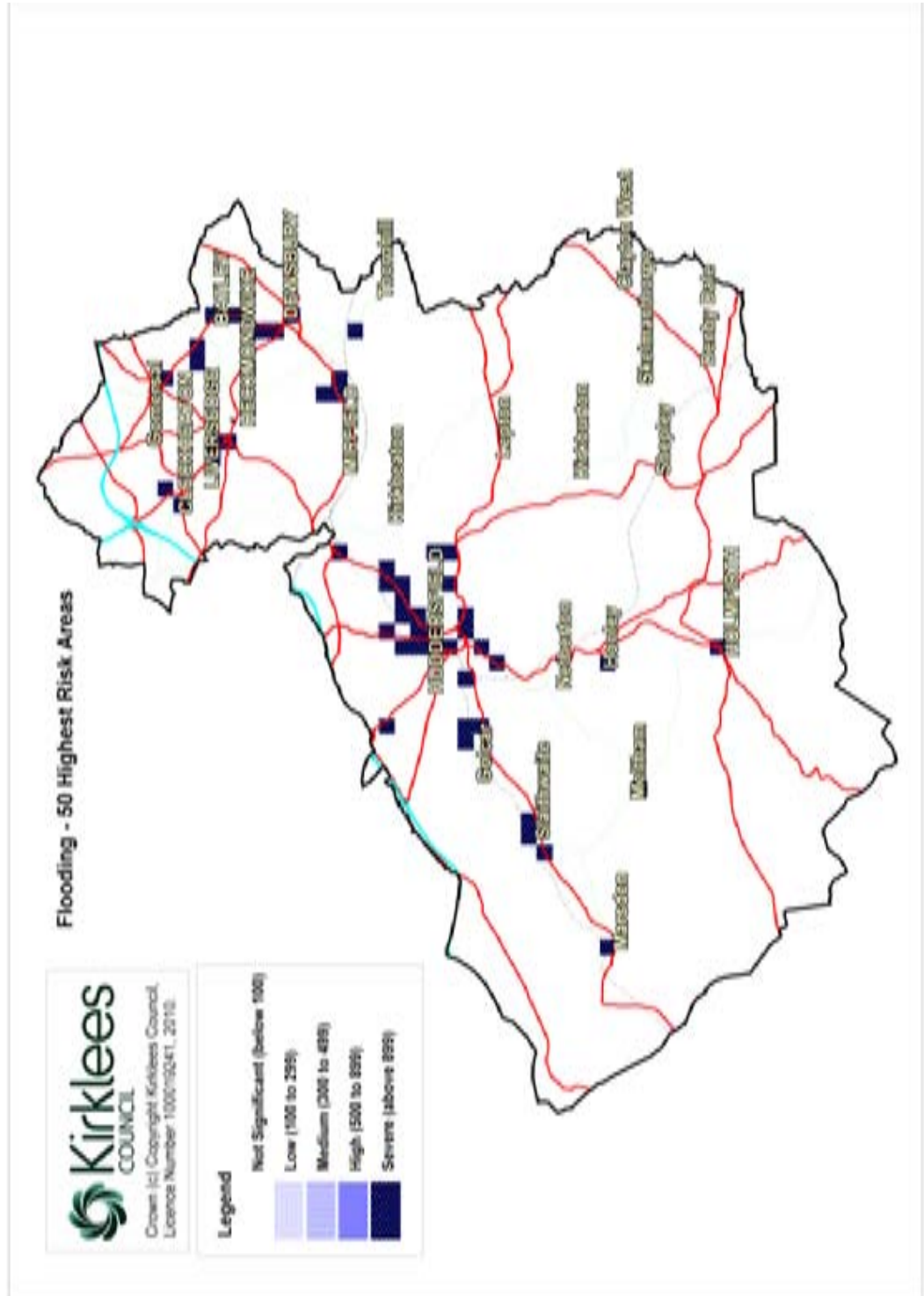


Kirklees Surface Water Management Plan

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The Spread of Surface Water Flood Risk across Kirklees

50 Highest Risk Areas

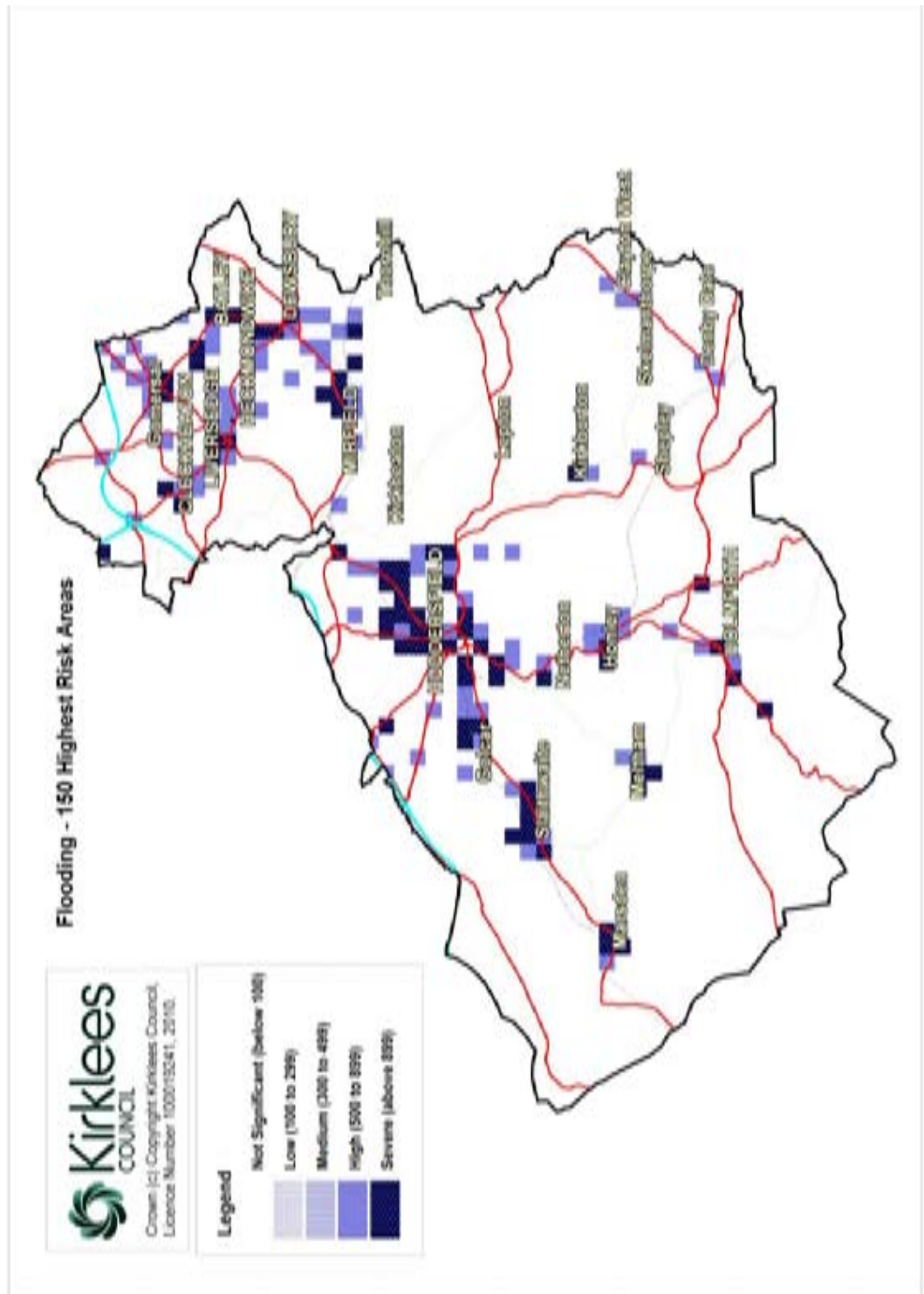


Kirklees Surface Water Management Plan

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The Spread of Surface Water Flood Risk across Kirklees

150 Highest Risk Areas



The Spread of Surface Water Flood Risk across Kirklees

Kirklees Surface Water Management Plan

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Kirklees Surface Water Management Plan

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Appendix 4 (Worked Example)

Priority Measures Template

OS Square Ref:	SE1417SE
Location:	Gt. Northern St Gyratory, Huddersfield TC
Assessment Date:	19 November 2010
Assessment By:	Tom Ghee

Ref.	Priority	Measure	Details
A	1	Flood Warning	Carry out desktop and site survey to highlight vulnerable properties eg low thresholds, on predicted flow paths, low-spots around building doors with risk of blocked drainage. Standard letter to highlight that their property may be in a predicted surface water flood zone. Bespoke letters to offer additional advice around threshold protection (ref F), private drainage maintenance (ref J).
B	1	Development Control	Large commercial sites to be monitored through planning process. Potential for future SUDS approach and higher floor levels. Seems to be little opportunity to explore combined sewer separation. Real opportunities for storage and discharge control above the area of predicted flooding around the gyratory.
C	1	Resilience/ Resistance (New)	Use planning opportunities to encourage resilience measures to vulnerable properties, particularly basements in terraced housing on Lwr Fitzwilliam St and William St
D	4	Brownfield Development Opp.	Take opportunities through the Tesco redevelopment to improve capacity in existing drainage systems. Ex Grahams development in low spot is very vulnerable to flooding, consider raised floors in any future redevelopment proposals. Similarly, car park off Gasworks Street is vulnerable to flooding if redeveloped, unless connection to the canal is permitted.
E	4	Permeable Paving	Retrofit not feasible but opportunities through redevelopment to encourage permeable paving to retail park car parks.
F	6	Threshold Raising	Not feasible unless redevelopment occurs
G	6	Green Roofs	Possibilities if retail parks developed but would require a change in design philosophy on lightweight roofs
H	8	Flow Paths	Site inspection shows predicted flow route towards Perrys is probably inaccurate, more likely to flow down Lwr Fitzwilliam St. May be an opportunity to negotiate an overflow route into the canal.
I	9	Further Modelling	Depth and velocity details would be useful. Inconsistency between EA Surface Water maps and SFRA Surface Water maps. Modelling required (possibly at developers expense) if we want to specify floor levels.
J	9	Improve Maintenance	Private drainage maintenance addressed in Ref A. Gyratory vulnerable to flooding – consider increased maintenance of gullies and Beany Blocks. Need to investigate any reoccurring YW issues.
K	9	Resilience/ Resistance (Existing)	Need to highlight to terraced housing the risks of using basements for habitable accommodation and measures that can be taken to recover quickly from flooding.

Kirklees Surface Water Management Plan