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SID 5 Research Project Final Report

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Project identification

1. Defra Project code: ref FD2603 Era-Net Crue File Ref CSA 7277

2. Project title: Risk Assessment and Risk Management for Small Urban Catchments

3. Contractor organisation(s): University o Manchester, School of Environment and Development, Geography

4. Total Defra project costs (agreed fixed price): £ 63,300 excluding VAT

5. Project: start date ..... 01 November 2006

   end date ..... 31 March 2008

6. It is Defra's intention to publish this form.
Please confirm your agreement to do so.....**YES** ☒ **NO** ☐

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Defra recognises that in a small minority of cases there may be information, such as intellectual property or commercially confidential data, used in or generated by the research project, which should not be disclosed. In these cases, such information should be detailed in a separate annex (not to be published) so that the SID 5 can be placed in the public domain. Where it is impossible to complete the Final Report without including references to any sensitive or confidential data, the information should be included and section (b) completed. NB: only in exceptional circumstances will Defra expect contractors to give a "No" answer.

In all cases, reasons for withholding information must be fully in line with exemptions under the Environmental Information Regulations or the Freedom of Information Act 2000.

(b) If you have answered NO, please explain why the Final report should not be released into public domain

Executive Summary

7. The executive summary must not exceed 2 sides in total of A4 and should be understandable to the intelligent non-scientist. It should cover the main objectives, methods and findings of the research, together with any other significant events and options for new work.

Executive Summary

This report covers the work undertaken for Defra by the University of Manchester (UoM) and its subcontractor, the Building Research Establishment (BRE) as part of the wider Era-Net Crue research project. It will also contribute to the final project report for Era-Net Crue which will integrate the findings from this study with those of the other partners in the wider Era-Net Crue project.

The prime objective of the research undertaken by UoM and BRE is to provide an evaluation of the effectiveness of non-structural measures to mitigate flood risk in small urban catchments through a study of the organisation of surface water management, an evaluation of the effectiveness of local land use and development planning in flood risk management, an integrated case study of recent pluvial flood events and an assessment of resilience measures to alleviate the effects of flooding.

The case study covers flood management in Heywood, Greater Manchester where storm-induced pluvial flooding in July 2006 and August 2004 affected 200 homes. There was no previous history of flooding in the area and the most likely causes of these two events are urban infill, an ageing drainage system, two culverted urban streams and high intensity storms. The indicative sensitivity ranges for peak rainfall (storm) are likely to increase in future due to climate change (Defra, 2006) Climate change in the North West will result in increased temperatures, more winter rainfall, higher wind speeds, fewer winter frosts, perhaps more variable weather, higher sea-levels and perhaps more stormy weather and higher wave heights (Shackley et al.,1998). The non-structural aspects of these floods were studied by undertaking 44 personal interviews with homeowners who experienced flooding inside their properties, attending public meetings, and by holding detailed discussions with the Environment Agency (EA) at local and national level, concerned officers within various Local Authorities (LAs) in Greater Manchester, United Utilities, OFWAT, the Association of British Insurers (ABI), and elected local and national government officers. A workshop attended by delegates from the EA, LAs, United Utilities, the insurance industry and environmental consultants discussed and agreed with the findings. These findings have informed the House of Commons Environment, Food and Rural Affairs Select Committee inquiry into flooding chaired by Michael Jack MP.

Institutional barriers: Several agencies are connected with urban flood risk management and there is poor communication between them. Flood risk managers and flood victims indicated the need to readdress current responsibilities and they supported the development of a national policy to determine and co-ordinate more effective working relationships between the EA, LA, utility industry, OFWAT and the

insurance industry. They indicate that a coherent voice and strategic guidance could be provided by an overriding agency or by allocating responsibility to an existing agency. The predominant opinion was that LAs, because of their local knowledge and connections to the public, should be empowered to accept a leading role. Many suggested that a cost-effective solution was that the overriding agency should provide operational guidance to a new dedicated flooding expert within all LA planning departments where there is any risk of urban flooding. The prime function of this person(s) could be to amalgamate data and expertise from the EA, the utility company, LA highways departments, planning departments and emergency services at local or sub-regional level with the objective of working closely with them to provide an integrated flood management service at local level. It was further suggested that because flooding is a national issue finance for this post could be ring-fenced by the Government. However, we recognise that the implication of putting these suggestions into practice is beyond the scope of this project and requires further research.

Better planning: Although significant advances have been made increasing the linkages between planning and flood risk management in recent years, there is evidence that all the relevant information is not yet influencing actual land use decisions. There is a tendency for flood risk to be assessed and mitigated on a site by site basis thus inhibiting the potential for strategic mitigation solutions and involvement by the local community and key stakeholders. Furthermore, planners have difficulty balancing socioeconomic priorities against flood risk (White et al., 2007). Many planning departments no longer have drainage engineers and have to rely on the EA and the utility company for information. Better data needs to be made available to planners and utility companies, who are not statutory consultees on individual development applications, should be more closely involved in the planning process. Research focused on facilitating the effective translation of national planning policy aims into local level planning decisions is needed.

Informing the public: The public are confused about who is responsible for urban flood risk management and are ill-informed about how best to protect their properties. Most would like a single contact covering all issues relating to flooding, including resilience measures. Based on the findings of this research, this could come under the auspices of the proposed new flood expert within LAs who could also initiate practical issues, such as instigating localised urban flood risk mitigation schemes (such as SUDS and drainage routes).

The obtaining, recording, and availability of data: The lack of robust data adversely affects flood risk management. Much data on past flood events is in the hands of private companies (utilities and insurance) and there is no compulsion for them to make this data available to the EA or LAs. The research indicated that sharing data should be a statutory requirement and it is suggested that the EA National Flood and Coastal Defence Data Base could become the repository of all flooding data, including urban sewer flooding. The research indicates that Home Information Packs (HIPS) could provide more accurate data on flood risk as at present HIPS rely solely on data from the EA web site and inclusion on the DG 5 Register (see below).

Insurance: Inter-company competition constrains the insurance industry from providing a unified response to flood damage claims. Non-betterment clauses constrain them from instigating resilience and mitigation methods. Victims of urban pluvial flooding in areas without a history of flooding who are now being penalised through no apparent negligence of their own tend to look to the insurance industry for their financial security. This research suggests that where private insurance cannot be obtained by people not living on flood plains, or in areas without a long history of flooding, further research should be undertaken to test the hypothesis that the Government should consider becoming the insurer of last resort to prevent property blight. Further, re-instatement claims should include flood resilience measures- even when this could be perceived to include betterment.

The poor DG5 register: The register is limited by the severe weather clause and also by home owner's reluctance to report events because of the risk of property blight. The research demonstrates that an option could be to change the register to defining properties at risk of flooding, as opposed to those that have already flooded.

Improving SFRAs: SFRAs will inform local development decisions. The EA is developing quality protocols but the effectiveness of SFRAs is constrained by data availability, issues such as upstream storage and available finance. To be more effective, SFRAs must include pluvial flood risk and address strategic storage issues and options.

Building resilience: The extent of damage to buildings in floods at Heywood has been highly variable, with depths of flood water reaching from a few centimetres to almost one metre. However, all buildings where floodwater entered were polluted by contaminated material or sewage. This results in significant clean up requirements as well as health risks. For small urban catchments the research has shown that dry proofing measures represent the preferred option. This would attempt to keep water out of the property

thus avoiding damage and contamination. However, the approach to resilience and resilient repair should in the first instance follow the guidance provided by Communities and Local Government (CLG) (2007) and Garvin et al. (2005).

Building regulations do not currently consider flood resilience as a requirement for new buildings. The research has demonstrated that there may be difficulties in demonstrating the need for resilience in small urban catchments based upon traditional flood risk assessment. However, building regulations may require resilience where the risk is determined as greater than 1 in 75 years for new buildings. For existing buildings building regulations may require resilient measures based on undertaking a risk assessment of the need and nature of the repair required.

Sustainable Urban Drainage Systems (SUDS): SUDS are an effective mechanism to control local surface water problems, but are only rarely used because of a variety of issues such as their installation and on-going maintenance (e.g see White and Howe, 2005). SUDS should be promoted in public open spaces, along roads or in parking areas. This research indicates that SUDS can help alleviate surface water floding and where appropriate should be installed by the LA, with the LA taking the lead for ongoing maintenance. However, further research aimed at 'Securing SUDS' is use required as the planning policy framework for SUDS has been in place since 2000, Building Regulations (Part H) have been amended, yet they are still not being utilised.

Project Report to Defra

8. As a guide this report should be no longer than 20 sides of A4. This report is to provide Defra with details of the outputs of the research project for internal purposes; to meet the terms of the contract; and to allow Defra to publish details of the outputs to meet Environmental Information Regulation or Freedom of Information obligations. This short report to Defra does not preclude contractors from also seeking to publish a full, formal scientific report/paper in an appropriate scientific or other journal/publication. Indeed, Defra actively encourages such publications as part of the contract terms. The report to Defra should include:
   - the scientific objectives as set out in the contract;
   - the extent to which the objectives set out in the contract have been met;
   - details of methods used and the results obtained, including statistical analysis (if appropriate);
   - a discussion of the results and their reliability;
   - the main implications of the findings;
   - possible future work; and
   - any action resulting from the research (e.g. IP, Knowledge Transfer).

Nota Bene
This report covers the work undertaken for the Department of the Environment Food and Rural Affairs (Defra) by the University of Manchester (UoM) and its subcontractor, the Building Research Establishment (BRE) as part of the wider Era-net Crue research project on Small Urban Catchments Flooding. The research is being addressed through a number of case studies in England, Scotland, France and Germany. This report will contribute to the final project report. The research reported here is integral towards fulfilment of the objectives as set out in the contract but it does not, on its own, seek to meet all of these objectives.

Objectives

The scientific objectives for the project are as follows:

A. Relevance and requisites of the societal environment for non-structural flood measures

1. To identify dependencies between the societal structure, the cultural conditions and the stakeholders' "risk culture".
2. To correlate the level of flood risk awareness and response to the socio-economic situation, the applied information policy and the administrative regulations.
3. To identify the efficiency of various methods of flood information in raising stakeholders' risk awareness and readiness for appropriate response.
4. To use Interactive Learning Groups to demonstrate stakeholders' learning capabilities and to identify which stakeholders, including policy makers and civil society organisations, would support increased multi-purpose use of small urban streams to gain flood risk mitigation benefits.

B. Structure and efficiency of non-structural measures in small urban catchments

1. To explore the opportunities and limitations of non-structural measures for flood mitigation in small urban catchments.
2. To assess the effectiveness of physical and ecological modifications to drainage systems from green roofs to channel changes.
3. To assess the social, economic and environmental effectiveness of non structural measures.

Methodology

In the first instance the regulatory framework under which flood risk management operated was established. A desk study was undertaken of the organisation of surface water management and its relationship to flood risk and spatial planning in the four countries participating in the project: England, Scotland, Germany and France. Also undertaken was a desk study of the effectiveness of the English land use and development planning system in delivering flood risk management in England. The principal research comprised a comprehensive study of the causes, the management, the impact and the consequences of flood events in a small urban catchment through a detailed case study of pluvial flooding in Heywood, Rochdale, Greater Manchester on 2 July 2006 and 3 August 2004.

In an effort to contact every householder affected by one or both of the two flood events, 44 householders were visited and gave responses to a questionnaire, and supplemented them by detailed discussions. Researchers attended local community meetings as participant observes in the aftermath of the 2006 flood. Several informal discussion meetings were held during the research period with local government, utility company, and EA. The team became closely involved in efforts to encourage dialogue locally between residents, local government and utility company. Feedback on the research was given regularly to local stakeholders and trust was effectively built-up. The team analysed records of four recording pluviographs, one daily read rain gauge within 8 km of Heywood and two water level recorders in the River Roch catchment to establish significance of the two flood events. The detailed analysis to identify areas subject to pluvial flooding is continuing. A detailed GIS of the sewer system and land use/land cover of Heywood enabled potential hotspots for sewer overflows to be identified and changes in impermeable surfaces to be mapped. In September 2007 when preliminary results were available, an interactive workshop was held with 35 stakeholders from local government, the utility company, the EA and other professions.

The research received the full collaboration of the staff and elected members of the Local Authority, the sewage undertaker United Utilities, officers of the EA, and in particular the local residents who experienced the flooding. We held detailed separate discussions with the following stakeholders:

- Rochdale MBC Development Services and Development Control
- Rochdale MBC Planning Department
- Rochdale MBC Technical Services
- Rochdale MBC Highways Department
- Rochdale MBC Risk and Resilience Co-ordinator
- Retired Drainage Engineer for Rochdale MBC
- The Chairman of Heywood Township Council
- The Member of Parliament for Middleton and Heywood
- Local officers and the Policy Advisor on Urban Flood Risk Management for the EA
- Local and regional officers and the Policy/Strategy Manager for United Utilities
- Staff of OFWAT
- Scott Wilson, the author of the Greater Manchester SFRA.
- The commissioning officer for stage II of the Greater Manchester SFRA.
- Manchester City Council Emergency Planning Manager and the Civil Contingencies Strategy Manager
- Salford City Council Emergency Services Manager
- Salford City Council Spatial Planning and Environmental Services
- The ABI

- The RTPI
- The TCPA

The situation in England

The legislative framework under which a plethora of agencies in England involved in urban flood risk management operates is complex. Separate pieces of legislation govern the activities of the EA, sewage undertakers, planners and the construction industry responsible for resilience measures. The legislature and the organisational framework covering flood management in England, Scotland, France and Germany have been systematically reviewed for this project (Appendix 1).

Development control and planning policy is fundamental to flood risk management and the Government has sought to strengthen planning guidance on flood risk in Planning Policy Statement 25 (PPS25) and its accompanying good practice guide. PPS25 promotes a strategic approach, ensuring that flood risk is considered at all stages of the planning process and strengthening the importance of flood risk assessments in supporting that analysis. The effectiveness of local land use and development planning in flood risk management in England has also been broadly reviewed for this project (Appendix 2).

Flooding has a high priority on the UK Government's agenda. Historically, flood risk management in the UK has mainly concentrated on river and coastal flooding, however it is pluvial flooding which mainly affects urban areas such as the case study area. Pluvial flooding is primarily the result of run-off exceeding the drainage capacity during short, intense periods of heavy rainfall- typically summer thunderstorms. Estimates suggest that around 40% of flood damage, and associated economic losses, are attributable to pluvial flooding (*Defra/Environment Agency Flood and Coastal Erosion Risk Management R&D Programme. Incident Management and Community Engagement (IMC)- Theme Work Plan, 2005-2010, June 2007)*.

There are a number of agencies and stakeholders connected with urban flood risk management in England and the Greater Manchester case study has highlighted where problems may arise. The next sections consider the specific role of different organisations in the Heywood area.

Environment Agency

The EA is only responsible for riverine flooding in designated main rivers and critical ordinary watercourses, i.e. rivers and high density streams. Urban pluvial flooding is thus only indirectly within the Agency's sphere of influence. The Agency is also responsible for providing warning of flood risk yet pluvial urban flooding is, at present outside the remit of the EA. Pluvial flood risk does not as yet appear on the EA's web based flood risk maps because of lack of information at national level on pluvial flooding. The strategy for these maps is only reviewed every 5 years.

The EA now considers Strategic Flood Risk Assessments (SFRAs) to be the fundamental document guiding regional and local urban flood risk management and it is the duty of Local Authorities to undertake an SFRA. Although the EA is developing quality protocols for the delivery of SFRAs, there are still issues constraining their effectiveness, such as the availability of robust data for pluvial flooding. The EA is aware that the availability of data is a problem which needs to be addressed and that whilst main river and sea flood risk is well mapped there is little information on flood risk from groundwater, urban drainage and overland flow. Not withstanding the availability of robust data the EA also feels that the impact of climate change should be considered in SFRAs and they should not necessarily rely on the application of +10%/+20% in local areas. Furthermore, if SFRAs are limited to the geography of a LA, issues such as upstream storage and other strategic mitigation measures as well as downstream effects will need to be taken into account by consultants undertaking these assessments for the local authority.

Local Authority

The LA is responsible for surface water (runoff) and for the maintenance of highways and road drains and ordinary water courses, i.e. brooks and small watercourses. The LA is also the sole agency responsible for granting planning permission for all new developments and is answerable to the local community. However, flooding is a low priority for many urban LAs faced with social deprivation. Most LAs no longer have flood risk management expertise amongst their staff and have to employ outside consultants to undertake SFRAs.

Utility company

The utility company is responsible for the sewage system and, whilst they input into strategic guidance such as Local Development Frameworks (LDFs) and Regional Spatial Strategies (RSSs), they are not a statutory consultee for individual planning applications that affect the details of local drainage. However, it is questionable whether or not the industry would in fact welcome having to provide the necessary human resources if it were consulted on all planning proposals and PPS25 only advises planning departments to seek advice from utility companies. Also, capital investment in drainage capacity by utility companies is invariably constrained by the regulator, OFWAT, who has a duty to the customer to monitor charges levied by the utility. OFWAT therefore operate an At Risk Register to flooding, the DG 5 Register, and will only sanction capital investment, and thus

increased charges by the utility company, where the risk of flooding is greater than 1:20 years and is not due to an exceptional event. There is considerable room for debate on where, and over what time, an event is assessed as exceptional. Homeowners are encouraged to report flooding to the utility company so that they can be included on the register but are often reluctant to do so because a property known to be at risk to flooding is likely to depreciate in value. The now 20 year old Register is flawed because it is not a register of properties at risk but is simply a register of properties where flooding has been reported.

Sustainable drainage systems (SUDS) are underused because of institutional and financial problems relating to their installation and their on-going maintenance. The utility industry does not consider SUDS as part of the drainage system.

Insurance industry

The insurance industry is responsible for covering insured home owners against loss. Flood risk insurance is not compulsory in the UK but most insurance companies provide cover as a part of a bundle with other perils in a household policy.

The insurance of private homes in the UK is entirely private and has been guaranteed by the industry for everyone until recently. An agreement was in place between the industry and government in order to protect houses that were at risk. However, this guarantee is no longer in place and the insurance industry policy is now to provide cover when the risk is less than 1 in 75 years, or in other words greater than an annual probability of 1.3%. Where the level of risk is greater, i.e. a greater probability, then insurers will need to determine that improvements to flood defences are in place. The insurance industry in the UK has had in place a statement of principles, which is currently being revised. The statement of principles includes for the following:

- Improve information on flood risk from all sources.
- Develop a long term strategy and target to reduce risk.
- Prevent new building that would increase risk.

Insurance companies generally rely on the EA for data, although some companies have their own flood risk models. Flood risk cover will invariably be refused in areas which are considered to be at risk of frequent flooding by the EA and exceptions to a refusal to insure are only possible where the home owner is able to demonstrate the installation of robust flood resilience measures. Also, repeated claims invariably result in increased premiums, increased excesses and even refusal to insure. The industry is constrained by inter-company competition in providing a standard charge for flood risk insurance and in taking a unified response to the victims of urban floods. Insurers will look favourably at home owners who have themselves installed resilience methods by reducing the excess, but they will not provide loans for their installation. The ABI feel that flood resilience measures will be difficult to implement on a voluntary basis and that they should be incorporated into building regulations in high risk areas. The Insurance industry is also unable to finance post flood resilience measures because these could be construed to be in breach of non-betterment clauses. In principle, the insurance industry looks to the Government, the LAs and the utility industry to manage the risk of flood damage occurring. The insurance industry has set out three main recommendations in a 25 year strategy, which are summarised as follows:

- The EA should become the main organisation for flood reduction (in England & Wales).
- There is a need to better understand flood risk and associated input data. There is also a need as part of this understanding to better comprehend the impact of drainage and surface water flooding, and to understand all sources of flooding.
- To have a planning policy that is fit for purpose; avoids flood plain development if possible and if it is done to carry it out correctly.

The insurance industry has recently stated its unhappiness at the level of flood defence investment by the government and considers that it should at least double. The insurers have the potential to resort to the withdrawal of cover for certain buildings or even areas. Although, the ABI's Statement of Principles (January 2006) does commit insurers to continuing to insure buildings in flood risk areas. Any decision to withdraw cover is therefore unlikely to be a multilateral decision by the whole industry, however, individual insurers may well undertake to withdraw cover from individuals or even whole areas based on their knowledge of the risk and level of investment in flood defences. Climate change is a major issue for the insurance industry with the cost of inland and coastal floods likely to more than double over this century. Insurers need to see either a reduction in risk through protection by more defences or they will react to protect their business and withdraw cover.

Within these recommendations there is a realisation that floods in small urban catchments need to be addressed, i.e. the impact of drainage and surface water flooding. However, with the insurers moving away from high risk areas for flood insurance there is a risk that previously flooded buildings in small urban catchments may become uninsurable or attract a higher than average premium. Unlike a development in a recognised river flood plain or coastal risk area small urban catchments are unlikely to appear in flood risk maps. Therefore, the insurers are likely to adopt a cautious approach to future risk of flooding after an event.

Flood resilient buildings are generally encouraged by the insurance industry and flood resilient repair is a potential opportunity to reduce vulnerability in the building stock. However, the responsibility and cost for flood resilience generally has to be borne by the homeowner. Insurance companies are reluctant to offer flood resilience within their existing policies as this would increase the cost of premiums. There is also an additional cost that is involved in flood resilient repair that is not welcomed by most insurers. Basically this is the effect of the competition in the market for insurance.

There are previous instances of insurers offering lower premiums where resilient repair has been undertaken. For example, after the Carlisle floods of January 2005 for some properties the policy excess increased significantly. However, the installation of measures to prevent flooding, e.g. door and window boards and air vent covers, resulted in the excess being reduced. There is potential for the insurers to encourage flood resilience in repair by the following range of measures:

- To educate and inform homeowners on available products for flood resilience.
- To develop insurance policies that specifically offer flood resilient repair in the event that a flood occurs.
- To provide flood resilient repair as standard across the industry, perhaps trading-off with government on investment in flood defences. In other words government increases spending on defences, whilst insurers offer a 'better deal' to their clients.

In terms of the small urban catchments situation any one of these approaches would be of benefit. However, there would be difficulty in engaging homeowners who have never been flooded and who do not perceive a risk. The main role of insurers in floods associated with small urban catchments would be to inform and where possible change attitudes.

In any flood repair situation the appropriate standard of repair should be determined from the level of risk, this is the approach taken in CIRIA's guidance (Garvin et al, 2005). Homeowners and insurers can take this advice as a starting point in determining whether or not there is a need for a flood resilient repair.

Public and land owners

Riparian landowners are responsible for culverted watercourses underneath their buildings but invariably do not have the means to fulfil their obligations. The general public are poorly informed about the risk of urban pluvial flooding and are confused on who does what and who is responsible for urban flooding. Support may be good on the day of the event but disappears once the water has receded. There is a great underestimation by many in authority of the ongoing personal and societal effects of flooding.

Flood data and climate change

The availability of data adversely affects urban flood risk management. Historical data is poorly recorded and it is in the hands of several agencies. Forecasts of urban flooding due to intense short-duration summer storms are virtually non-existent. The consideration of climate change within planning is too arbitrary and needs to better reflect the true risk according to that specific location. In December 2007 the Cabinet Office published a report on lessons to be learnt from the severe flooding in many parts of England in June and July 2007, *Learning lessons from the 2007 floods An independent review by Sir Michael Pitt* (the Pitt Review). This report covers wide-spread flooding in several parts of England in June and July 2007 following the wettest three month period since records began. Whilst there were no reports of serious flooding in Greater Manchester in 2007, there is considerable synergy on coinciding issues between the interim conclusions in the Pitt Review and in the findings and recommendations from this study.

Case study

General description of the hydrological and flood situation in Heywood

The Greater Manchester case study covers pluvial flooding in the Heywood area of Rochdale, an old industrial town to the north-west of the Greater Manchester conurbation. Located at 53° 35' N and 2° 17' W and at an elevation of around 130 metres above mean sea level, Heywood is in a storm prone area immediately south and west of the Pennine Hills (the first uplands in England in line with westerly air-streams from across the Atlantic Ocean). The undulating terrain on fluvio-glacial deposits left by the retreating Devensian ice-sheets is drained by two streams flowing into the River Roch from south to north across an urbanised catchment of about 8 km² (Figure 1). Although the main urban development took place between 1750 and 1900, since 1960 many brownfield sites, both within the town and on it southern margins, have been occupied by new housing and new low-rise, large warehouses on a new distribution centre (Figure 2). Heywood is still primarily drained by combined sewers, the utility company having inherited an antiquated system on privatisation in 1989. Many of the privately owned sewers in Heywood are still unknown to the utility company and Rochdale Metropolitan Borough Council (MBC) reports that illegal sewage attachments may still be being made from new developments to old sewers.

Like the rest of the world, North-West England is being influenced by climate change. Climate change in the North West will result in increased temperatures, more winter rainfall, higher wind speeds, fewer winter frosts, perhaps more variable weather, higher sea-levels and perhaps more stormy weather and higher wave heights (Shackley et al., 1998). However, increased major floods could well happen in the summer despite north-west European summers becoming drier. Seemingly paradoxically, computer models predict an increase in *intense* summer rainfall with global warming. Instead of the less rain being spread across summer months, there will a tendency for this precipitation to clump into extreme weather events (Christensen and Christensen, 2003). At present, the Heywood area experiences heavy rainfall from two types of rain event, large widespread storms that produced prolonged rain for many hours, at rates of around 10 mm per hour, particularly in winter, from westerly depressions that move across the Atlantic into western Britain and short duration, high intensity, summer thunderstorms that may produce intensities of the order of 20 mm in 15 minutes and 50 mm in 1 to 2 hours. However, Heywood had no previous record of flooding affecting property until summer storms on 3 August 2004 and 2 July 2006 resulted in severe sewer flooding in six distinct and identical areas on both occasions. The 2006 event resulted in over 200 homes being flooded with up to 900mm of sewage contaminated water for up to 3 hours and around 90 properties had to be evacuated for varying time-spans whilst renovation was taking place. All six areas which experienced flooding are located along the two streams which were, to a large part, culverted soon after the area was developed (Figure 3) and some reaches of these streams are still to this day part of a combined sewer system. Neither of these streams is included in the EA's *Register of Critical Ordinary Watercourses* which means that the flood events are outside the remit of the EA, and fall under the auspices of various departments within the Local Authority, the utility company and riparian landowners

Figure 1 Terrain map of Heywood
Figure 2 Land use change (infill) in the Wrigley Brook catchment Heywood, 1968 (black) to 2007 (red)
Figure 3 Wrigley Brook and Millers Brook Heywood and location of floods 2004 and 2006

A Relevance and requisites of the societal environment for non-structural flood measures

A 1 Stakeholders and public attitudes

A 1.1 The insurance industry

25 respondents talked about their situation with regard to insurance. The first reaction of a Heywood property owner who has been flooded is to contact the insurer of the property. After the two Heywood flood events, the insurance companies met all claims in full, but subsequently the insured property owners faced varying increases in premiums and in the "excess", the initial amount of the uninsured loss that they would have to pay. 8 of the 25 who talked about insurance gave actual values of the claims. These ranged from £20,000 to £60,000. The insurance payments did not cover the costs of temporary accommodation whish for most people was required for 3 to 8 months. 7 people put precise values on their excess charge increases, these ranged from £200 to £15,000. However, more than these 7 reported no increase in their excess charges. Premiums also went up in some cases, one rising for £400 before the 2004 event to £1200 after the 2006 flood. This was in Miller's Brook Close, where United Utilities refunded excess charges. Elsewhere the company paid a nominal compensation amount. In a few cases further insurance was refused. In one instance, the insurer refused to renew the insurance, but offered to lend the householder money to spend on resilience measures. Following the July 2006 event in Heywood, the utility company undertook, despite not being legally liable, to consider making a contribution to homeowner's uninsured losses.

There was no evidence in Heywood of insurance companies offering to contribute to flood resilience measures. For householders in one area of Heywood, the cost of the infrastructure required to mitigate flooding would be likely to exceed the total amounts paid to claimants (Example 1).

A 1.2 The utility industry

United Utilities (UU), the utility company in Heywood is under pressure from its customers to act. The company is unable to offer either a medium or long-term engineering solution to Heywood's problems because the national industry standard is to design new sewers to cope with rainfall events up to a 1:30 year storm and it maintains that Heywood's system is fit for purpose. It is unclear how and when the utility company arrived at this assessment of the hydrological capacity of the Heywood system and whether or not the assessment process took note of recently increased run-off from new developments as well as the impact of changing climatic conditions. UU admit being unable to do anything with regard to climate change; they maintain that Defra's (EA's) +10%/+20% approach to assessing the impact of climate change is unworkable because of cost and that efforts should be directed towards resilience and 'living with water'.

In Heywood UU are further constrained in providing capital for new drainage infrastructure by the DG5 Register despite an awareness of the necessity and the cost-effectiveness of such investment (Example 1). The 3 August 2004 and 2 July 2006 storms were considered to be exceptional; for the July 2006 event UU maintain that the rainfall across the Rochdale area was recorded at between 52.8mm and 59.3mm in 5 hours and that this equates to a 1:56 to 1:73 year storm. However, the EA's two nearest rain-gauges, at Heaton Park some 6 km upwind to the south south-west and at Cowyn Reservoir some 9 km downwind to the north east of Heywood respectively recorded rainfall during the same storm at 19.8 mm and 17.2 mm in 15 minutes, 25.6 and 33.2 mm in one hour and at 30.2 mm in 2.25 hours and at 52.8 mm in 3.5 hours. It is quite likely that the Heywood drainage system was overwhelmed by the intense rainfall during the first 15 to 60 minutes of the event and that the utility company's assessment of the return period for the event over a period of 5 hours is inappropriate. Records from the automatic raingauges in the area are too short (Heaton Park data only began in 1990) for accurate assessment of return periods of more than 20 years.

Only one property in Heywood has been placed on The DG5 Register (Example 1). The alternative criterion for inclusion on the Register is by a flood victim's request but people in Heywood are unaware of this and are also concerned about property blight.

A 1.3 The Local Authority

Rochdale MBC is arguably the most important agency in flood risk management in Heywood. It is also the agency with local knowledge and local accountability. However, flooding is low priority for Rochdale MBC which has one of many planning departments that no longer employ a drainage engineer and it is to rely on the EA and the utility company for information concerning local flood risk management. Also, local control is further weakened because highway maintenance in Rochdale is sub-contracted to the private sector and there is evidence that gully cleaning in Heywood has been neglected.

Rochdale MBC was unconcerned about flood risk in Heywood prior to 2004, yet the flood that year and again in 2006 were clearly exacerbated by planning actions taken by the Authority over many years. Planning permission was, and still is, granted without consideration to the effects of increased runoff on an antiquated drainage system (Examples 1 and 2). Rochdale MBC would now like to have the services of a flood risk manager with local knowledge who could work in close co-operation with the other agencies with responsibility for flood management. The need to conduct a SFRA has acted as a positive driver for flood risk knowledge but financial constraints and limited data availability means that the soon to be published Greater Manchester regional SFRA does not include pluvial flood risk. In addition, the consultants undertaking the SFRA recognise that the application of an arbitrary +10%/+20% event severity to cover climate change is not realistic in areas such as Heywood and Rochdale. However, the Association of Greater Manchester Authorities (AGMA) now recognises the need, subject to the availability of robust data, to include pluvial flooding in forthcoming sub-regional SFRAs.

A 1.4 The Environment Agency

The situation in Heywood is technically outside of the remit of the EA, yet it is still to the EA that Rochdale planners refer. However, it is clear that the EA does not possess robust local knowledge of the issues surrounding pluvial flooding in Heywood. Heywood, despite having suffered repeated recent flooding, is not shown to be at risk on the EA's flood risk maps because the two urban streams which undoubtedly contributed to the flooding in Heywood have not been designated critical ordinary watercourses.

A 1.5 The general public and the effects of the flood events on private property

The damage to the homes in Heywood which experienced internal flooding was typically to all downstairs flooring, plaster, furniture, fixtures and fittings. In most cases, water entered the homes through doors, air vents and from under suspended floors. People generally are ill-informed about how best to protect their properties. Only 20% of Heywood homes flooded internally in 2004 and 2006 have actually taken some form of precaution against future flooding such as acquiring flood gates, retaining sand bags, improving doors and changing or blocking air vents. However, an additional 25% of those flooded would like to take preventative measures but do not know how to do so, or felt that there was nothing they could do to avoid being flooded.

Many Heywood residents, whose life savings and ambitions are invested in their homes, had to evacuate them and suffered both physical and social disruption for up to 8 months whilst renovation was taking place. All who experienced internal flooding reported effects on their health and well-being; many were evacuated for long periods and found being in temporary accommodation with young children particularly stressful. Perhaps more importantly, homes in the areas of Heywood which experienced flooding are blighted and un-saleable. The residents now have high stress levels, living in fear every time that heavy rain is forecast and being reluctant to leave their homes unattended at such times. Most people would like to have a single contact to deal with all their problems relating to flooding and flood mitigation.

A 2 Legislative obstacles and constraints

The Heywood case has highlighted some of the legislative obstacles to effective urban flood risk management, as follows:

- The EA lacks local knowledge and has no active part to play in managing pluvial flooding;
- the Rochdale MBC maintains that the utility company should be improving the drainage system;
- UU claim that Rochdale MBC's Highways Department has failed to maintain the drains, that the planners have failed to take account of increased run-off and that they themselves are constrained by legislation in undertaking capital projects.
- The public feel victimised and let down by the actions of legislators and agencies who should be protecting them; they are concerned that nothing appears to be being done to mitigate against future flood risk.

The lack of legislation concerning the availability of data to all stakeholders, including the general public, is a further significant issue adversely affecting flood risk management. There are no legal requirements or common strategies in place to retain and make available data on pluvial flood events and information covering many urban pluvial flood events is either unrecorded or in the ownership of a single agency (utility company, LA or insurance company) with issues surrounding the sensitivity of the data. Much data is in the hands of a private company: for example, ownership of important data such as The Manual of Sewer Condition Classification is now in the ownership of WRc, a private consultancy. Historic information may also be difficult to find within agencies as it can rest within differing departments dependent upon internal policies and the extent to which there is accurate recording and retention of data has been unclear. Furthermore fear of property blight constrains the general public in reporting pluvial flood events. Consequently decisions connected with the provision of drainage infrastructure are invariably based on poor information.

Example 1

Millers Brook Close, Heywood

Issue

Planning permission for a cul-de-sac development of 14 detached and semi-detached town houses on the vacated site of the former St. Luke's school was granted in 1987. The area is low-lying and in a small dip in the ground at the bottom reaches of Millers Brook and there is empirical evidence by local residents that the school yard was regularly flooded. Planning permission included consultation with the Borough Engineer, North West Water Authority and Environmental Health and there were neither comments nor objections. The applications state that surface water and foul sewage will be connected to the main drainage system which was an old combined sewer.

Outcome and concerns

The Close now suffers from sewer flooding in the road and to garages most winters and all but two of the properties which are on raised ground suffered internal flooding in 2004 and 2006. There is an area of made ground between the close and Millers Brook which could potentially house a detention basin or large swales. The utility company has in fact publicly stated that the flooding to Millers Brook Close could potentially be remedied by a holding tank costing in the region of £600,000. This sum is quite possibly less than the total value of all the insurance payouts made to people in Millers Brook Close in 2004 and 2006.

Following the 2006 event, one property only in the Close was chosen at random for inclusion on OFWAT's DG5 Register but it has a low priority rating and no remedial action will be taken during the current 5 year Asset Management Plan which lasts until 2010. Residents are frustrated by the lack of action to mitigate against future flood risk.- One resident at a meeting with the utility company asked: *"How many times do I have to be flooded before I am at risk of being flooded?"*

The area is now severely blighted: one house was recently sold for rental at just under half of the pre 2004 value. At a meeting between residents the LA, a local councillor and representatives from the utility company issues raised included the following:

- property blight due to one of the property's inclusion on the DG5 Register
- uninsured losses and insurance cover
- whether the LA would be culpable because planning permission should not have been granted unconditionally
- the lack of a requirement in 1987 to upgrade the drainage system and to convert it from a combined to a separated system
- how legislation can be allowed to precluding action when an acceptable cost-effective remedy will be ignored for the foreseeable future because of Millers Brook Close's low priority rating.

Example 2

New housing development at Lane End, off Middleton Rd. Hopwood, Heywood.

Issues
Rochdale MBC has granted planning permission for approximately 100 new homes on a disused, grassed-over MOD site. The gardens of neighbouring houses have experienced flooding, even during moderate rainfall, since the site was raised and levelled using imported fill. Local residents report observed that the fill was blocking a local natural stream. The developer has undertaken to solve the problem and has provided a temporary solution by installing a bund to protect gardens and by pumping the water directly to nearest local road drain pending the installation of an as yet unknown permanent solution.

Rochdale MBC Planning Department Officers consulted with the EA, the statutory consultee, who raised no objections. On the LA planning officer's instigation, details of surface water drainage to the land must be submitted to and approved in writing by the Local Planning Authority. The LA did in fact consult with the utility company who responded with a standard letter stating that they had no objections. The LA planning officer voiced considerable concern that the LA has to rely on the EA despite the EA's lack of knowledge of the local drainage system and of localised pluvial flooding. The officer stated that he, as a planner, would have welcomed the LA employing a local drainage officer.

Concerns
The area of this new development ultimately drains into the Wrigley Brook where pluvial flooding occurred in 2004 and 2006.

- Local flooding could probably be alleviated through the installation of a basin or swales. However objection was raised by local residents on health and safety grounds. Furthermore both the LA and the developer were not prepared to consider SUDs because of concerns about their ownership and ongoing maintenance.
- No-one has assessed whether or not the local drainage system can cope with the increased runoff from this development. The planning officer admitted that they are unable to undertake a proper hydrological assessment because they do not possess the expertise, UU's response suggests that they have not revised their assessments to include the increased runoff and the EA lack intimate local knowledge of pluvial flooding.

B Structure and effectiveness/efficiency of non-structural measures in small urban catchments

B 1 Resilience measures

B 1.1 Capacity building and human resources

Heywood residents were unaware of risk from flooding and were unprepared for the flood events of August 2004 and June 2006. A strong sense of community has evolved, there is a champion or a spokesperson in four out of the six areas which were flooded, and victim's knowledge of the reasons for the floods is high. However, most victims were confused as to who does what and who is responsible for pluvial flood risk management. They are ill-informed about how best to protect their properties. None of the agencies responsible for flood management has provided personal counselling or advice on flood mitigation methods to either the flood victims or the local community. Insurance companies have been efficient in providing reparation but have generally failed in communicating about possible resilience. The Chairman of Heywood Township Council and the Member of Parliament for Middleton and Heywood have been active and supportive; they have instigated public meetings and have canvassed the flood management agencies.

Most people in areas of Heywood which were flooded expressed the desire for a single contact to deal with all their problems relating to flooding. They perceive a need for a single 24 hour contact point for the general public connected with all aspects of flooding, both during the events themselves and in dealing with the aftermath. The research indicates that a dedicated flooding expert attached to the LA would be well placed to accept responsibility for communicating with actual and potential flood victims. This person(s) within the LA should be able to offer advice/action on flood mitigation and resilience measures to both those who have been flooded and to people living in areas with a potential risk of being flooded in the future.

B 1.2 Land use control

The flooding in Heywood illustrates the consequences of lack of awareness of catchment scale flood risk issues and the need to consider the consequences of development not only in an isolated context but also with regard to catchment drainage issues. Whilst the Unitary Development Plan (UDP) for Rochdale includes general guidance in relation to flood risk such as the requirement to consider the impact of new development on the capacity of water-courses and that development will not be permitted in areas identified as flood plains unless an appropriate flood risk assessment has been carried out; the UDP guidance fails to offer advice on pluvial flooding. Rochdale Development Control made the point that flood risk was only one of a series of issues concerning planning permission for new developments and that it was of low priority; the primary issue for objection usually being

concerns by the highways department, congestion, separation distances from existing developments and design issues (Gillespie, 2007).

The English planning system and the effectiveness of local land use and development planning in England has been systematically reviewed for this project (Appendix 2). The Planning Policy Framework in England is complex. PPS 25 seeks to strengthen planning guidance on flood risk. It reminds planners and developers of the need to consider all sources of flooding, including surface water flooding. Despite this and other recent significant advances that increase the linkages between planning and flood risk management, there is evidence that actual land use decisions in Heywood are not influenced by all the relevant information (Example 2). The Heywood study has also highlighted several planning related issues detrimentally affecting flood risk management, such as:

- a tendency for flood risk to be assessed on a site by site basis, inhibiting the potential for strategic mitigation solutions;
- a lack of involvement by the local community and key stakeholders when forming local planning policy;
- ongoing difficulties balancing socioeconomic and environmental priorities against flood risk concerns;
- local planning policy on flood risk is often generic and fails to tailor national policy with local circumstances;
- planners lacking flood risk management expertise and having to work with limited data on flood risk, such as EA maps and personal judgement on runoff, whilst they do not have access to the DG5 Register;
- lack of consultation between planners and the utility company because the utility is not a statutory consultee in individual development decisions and it lacks interest in becoming more pro-active in the process.
- how changing land use and land form (by filling and levelling) alters the flood risk and often increases the hazard, illustrating the need to asses what the flood risk will be after any development has been completed.

B 1.3 Flood preparedness

B1.3.1 Forecasting

Weather forecasting at a geographical scale where it can reliably inform on the type of summer storms which caused the 2004 and 2006 flood events in Heywood is not, at present, available. Despite the availability of weather radar it would be over optimistic to expect the reliable spatially accurate quantitative prediction of flash flooding from convective rainfall of the type that hit Heywood in 2004 and 2006 to extend beyond 1 or 2 hours ahead before 2017 (Collier, 2007). Flood response plans have to rely on the EA's or the Meteorological Service's forecasts. Also, a general worry with all forecasting is inaccuracy leading, in the longer term, to inaction by potential victims, the so-called *crying wolf syndrome.* Unfortunately people in Heywood, both those who have experienced flooding and those who are aware of the experience of their neighbours, are now extremely nervous whenever storms or heavy rain are forecast, despite being aware of the vagaries of these forecasts. A hydrological model of the area could better inform on the severity of an event with the capacity to cause flash flooding over a specific area, but it will be severely limited by the present locations of raingauges able to supply robust data on past events and on the locations likely to suffer from the maximum intensity of the storm.

B 1.3.2 Flood warning and flood risk maps

The EA's flood risk maps still form the benchmark in England for flood warning and thus flood preparedness. However, they are not as yet of any value in providing preparedness for pluvial urban flooding such as that which occurred in Heywood and the data available to SFRAs which include pluvial flooding is likely to be at too coarse a resolution to reliably inform exactly which neighbourhood locations are at risk of flooding and which are not. Effective pluvial flood risk maps will require robust local hydrological studies and will also benefit from awareness of potential hot-spots in the drainage system. In Heywood there are several sewer junctions where the combined capacity of the inflowing sewers is greater than that of the outlet sewer (Figure 4). Identification of hot-spots cannot identify areas at risk, but does provide a further point of triangulation to run alongside sewer flow models and also helps to explain why areas identified as being at risk may flood (Morrow, 2007).

LIDAR mapping of urban terrain would greatly assist in designating the topographic lows on the urban surface where flood waters tend to accumulate (Priestnall et al., 2000, Ashley et al., 2006). There are major constraints using GIS tools such as LIDAR in terms of the need to undertake extensive data collection to allow the generation of useful flood maps that are not dominated by modelling uncertainties and overcoming these concerns requires robust recording of historical flooding and ground-truthing to ensure flow paths are correctly represented (Hankin et al., 2008). This suggests that robust urban pluvial flood risk maps are only likely to become a reality with considerable local "on the ground" knowledge and the appointment of a dedicated flooding expert within LA planning departments who is able to collate appropriate information from a variety of sources could be important to this process.

An actual warning of a flood is usually obtained by signing up to, or by calling, the EA's Floodline. Floodline only covers areas recognised by the EA to be at risk of flooding, which would exclude nearly all pluvial flooding. Other warning devices are flood risk and severe weather reports on national and local radio, and by LA loud speaker vans when advance knowledge exists. There is little time, two hours or less, in which to respond to a reliable forecast of a flash flood. Reverse 999 emergency telephone communication exists and could be used to warn people whose property is at risk even when they themselves are absent from the property. However, Governmental concerns about freedom of information mean that it can only be used when people register their desire to be included on an existing warning list and the only flood risk warning list in operation is the EA's Floodline. The unfortunate consequence of this is that it precludes many from installing temporary flood resilience methods such as barriers in time.

Figure 4 Hot-spots in a sewer system

B 1.3.3 Obtaining and recording data on past flood events

The lack of historical flood data of past flood events restricts flood prevention and affects effective flood risk management. It can also result in the lack of disclosure of vital information during property transactions. For example, a property in Heywood which had experienced internal flooding in 2004 was sold in 2005. The search undertaken by the buyer's lawyer failed to disclose that the property had experienced the 2004 flooding. Home Information Packs (HIPs) are now steadily becoming a requirement for all property transactions and there is considerable evidence that this document should be able to reliably inform on the risk of flooding and that it could also become part of the database of historical flooding. However, the only requirement of a HIP to record the risk of flooding is in Paragraph 21 of the regulations which requires the inspection of records to reveal whether the property is at risk of flooding as a result of an overloaded public sewer, has flooded as a result of an overloaded public sewer or is not recorded as being at risk of flooding for this reason (Home Information Pack (No. 2) Regulations, 2007). "At Risk" properties are described as "*those that the water company is required to include in the Regulatory Register.* Thus all the properties in Heywood that have experienced flooding would not show as having suffered from flooding on a HIP, with the sole exception of the single property in Millers Brook Close which has now been included on the DG5 register (Example 2). The Heywood case study suggests that HIPS should not rely on whether or not a property is included on the DG5 Register but should address the question of whether or not the property has actually experienced flooding. This case study indicates that HIPs would be more effective by also recording whether or not flood prevention methods have subsequently taken place, where SFRAs which include all types of flood risk exist, and whether or not the property is at risk of being flooded in the future. HIPS could then become a valuable source of information on historic flooding.

B 1.3.4 Emergency Services

In major emergencies the police are responsible for co-ordination of the emergency services and other support organisations. They will investigate the incident in conjunction with other support services. Areas with a high risk of flooding such as Salford and Manchester in Greater Manchester have a flood response plan which comes into force by receipt of a flood alert from the EA or when a flood has occurred. These plans detail roles, responsibility, procedures, and specific infrastructure and areas most at risk of flooding, as for example in Manchester and in Salford (Manchester City Council, 2007 and Salford City Council Emergency Planning Unit, 2007). The Salford plan is a multi-agency response plan and also benefits from the Salford SFRA whereas the input into the Manchester plan is that of the City Council's Emergency Planning Unit. Rochdale, and by extension Heywood, does not have a flood response plan and Rochdale MBC sees flooding as part of a wider problem and flood emergency is dealt with under the General Emergency Plan. Weaknesses in flood response plans are that they have to rely on EA data where no SFRA exists and that they do not include flood mitigation which means that they are only reactive and not proactive. Emergency Services are also concerned about taking pre-emptive action unnecessarily because of both cost and the possibility of not being taken seriously in the future.

Residents of Heywood whose homes were flooded in 2004 and 2006 felt that the response of the emergency services was slow and insufficient to reduce the impact of the event. Of particular concern was the failure by the Fire Brigade to rapidly pump away quite localised inundation and delays in closing roads. The latter resulted in heavy vehicles passing through flooded areas and creating a wash which caused secondary flooding to several houses. The general feeling was too little too late. However, it is also evident that the LA's Environmental Health Department and Social Services were most efficient in dealing with the immediate needs of the evacuees. Heywood residents were also frustrated by having to make contact with several different agencies and they felt the need for a single 24 hour contact point for the general public covering all aspects of flooding, both during the events themselves and in dealing with the aftermath.

B .1.4 Contingency measures

Flood victims look primarily to the insurance industry for redress. Furthermore, home owners who have never experienced flooding and do not consider themselves to be in areas at risk of flooding feel that an insurance policy is their most effective flood risk mitigation strategy. The ABI encourage householder action on flood resilience through awareness-raising and they are actively discussing with Government about how best to roll out large scale resilience programmes. However, homeowners are generally still poorly informed about how to make

their properties more resilient to floods. Whilst insurance companies are currently unable to finance flood resilience measures, the Council of Mortgage Lenders (CML) have confirmed that their members are willing to provide loans for resilience measures.

B1.5 Measures for buildings resilience

In new buildings resilience can be designed in from the outset. The location of individual buildings can be determined as well as their vulnerability through carrying out a risk assessment for a site. Actions such as raising the level of the ground or using certain types of building material can be considered. In existing buildings the opportunities may be limited by the design, construction, and materials, used as well as by the location and level of risk. There is reluctance typically by homeowners in the Heywood area to invest in flood resilience for buildings and a preference for the professional engineer to remove the risk through management of drainage and infrastructure. Homeowners typically did not indicate any level of trust in the performance of flood products.

In the Heywood study there was localised flooding in seven streets that affected a number of properties. The properties ranged in type and age, spanning from early 1900s to 1989. However, it was noticeable that in only one case was the depth of flooding reported to be as much as one metre, with the majority being no more than 300 mm depth inside the buildings. One of the major issues was that the flooding that occurred was from either sewers or culverted streams. This meant that the flood water was contaminated and dirty, resulting in significant need for decontamination as well as drying after the flood. The extent of damage that occurred varied, with some homes requiring not much more than cleaning to others that required replacement of building fabric components as well as item such as carpets. Damage to items such as insulation in cavity walls can be particularly difficult to repair and, if necessary, to replace.

The entry of flood water into the buildings in Heywood was generally via the air bricks or around doors, in one instance it was from groundwater through the floor. The few instances where homeowners had taken action to prevent water ingress into the building were through the following items:

- Flood gate to the property
- Flood proof door
- Door board.

The approaches taken were intended to break the pathway between the source (flood water) and the receptor (inside of the building). However, these approaches had been ad-hoc with little input from insurers or the agencies involved in flood risk management. Current guidance related to flood resilience of new and existing buildings indicates that the two general approaches are as follows:

- Wet proofing – in this approach water is allowed to enter the buildings, but the building structure and materials are not damaged and can be readily cleaned and dried.
- Dry proofing – in this approach water is prevented from entering the property by sealing the building or by using flood alleviation products (otherwise known as household products).

In reality flood resilient repair, when it does occur, may contain elements of both wet proofing and dry proofing.

Recent guidance from the CLG (2007) sets out the approach for flood resilience of new developments. The guidance sets out an approach that can be summarised as follows:

- For flood depths of less than 300 m depth use dry proofing.
- For flood depth between 300 mm and 600 mm use dry proofing with some wet proofing measures.
- For flood depth greater than 600 mm use wet proofing measures.

For small urban catchments, especially for repair of existing buildings, the preferred approach would be dry proofing even up to 900 mm depth. In this way the following main objectives are achieved:

- Contaminated flood water is prevented from entering the building.
- The degree of recovery and repair to the inside of the building is limited or the need is eliminated.

There are a range of measures that can be taken to dry proof homes. These are included in Appendix 3 and come into the following categories:

- Temporary dry proofing measures
- Permanent dry proofing measures.

The measures may be expensive. In the case of temporary measures they will require installation quickly once the threat of a flood is realised. This latter point can be critical to the success of the measures undertaken. An obvious problem with small urban catchments floods is that areas such as Heywood are not well covered by existing flood maps or warnings. Floods from surface water run-off, sewers and small streams have occurred with little warning and therefore the opportunity to install the dry proofing equipment is limited. Repair should therefore focus upon the use of permanent dry proof measures where possible and be supported by temporary measures.

Additional wet proofing should be included where the nature of the repair required presents the opportunity, or where there is a specific risk that more than 900 mm of a flood will be experienced. Resilient repair for buildings should follow the standards and guidance provided by CIRIA (Garvin et al 2005). This is based upon carrying out a risk assessment of the flood events that occurred. An appropriate standard of repair for either of the floor, walls or fenestration can be selected. The approach can be used for small urban catchments floods as well as fluvial and coastal flooding.

B 1.6 Building regulations

There is an assumption in the planning guidance for England & Wales that development should not take place in areas that are at risk of flooding. Flood resistance or resilience is not currently a requirement in Schedule 1 of the Building Regulations 2000. Approved Document C of the building regulations does not give advice on particular measures to be taken for flood prone areas or to alleviate flood risk. Part C does, however, provide guidance for different levels of exposure to wind driven rain and to the impacts of ground contaminants.

Part C now directs builders to particular flood issues and to the provision of further guidance on flood resilient construction. CLG recently produced guidance on the construction of new buildings to cope with flood risk (CLG, 2007). This guidance has been referred to above and should be the first source of guidance when building new. The main drawback is that the guidance would not necessarily result in flood resilient construction in small urban catchments. Indeed the guidance does not specifically deal with sewer flooding and is concerned with inland river and coastal flooding.

The research workshop (September 2007) has shown that the range of stakeholders and indeed homeowners would expect building regulations to include flood resilience in the future. Building regulations are concerned primarily with health & safety, accessibility and energy efficiency (carbon reduction) and flood impact on buildings can certainly be considered as a health & safety issue. However, there are likely at least to be conflicts with accessibility and energy efficiency requirements of the building regulations.

Building regulations require a regulatory impact assessment to be carried out prior to being made mandatory. It is likely that this type of exercise would result in the economic case being made for flood resilient construction. However, flood risk management and control is viewed as a planning consideration, with PPS25 being the main guidance for England & Wales. In addition, it is unlikely that any development of building regulations would be applied to all new buildings constructed. It is more likely to try to target specific flood risk areas similar to the approach to building design to manage driving rain levels in different parts of the country. In this case small urban catchments are liable to be missed.

Building regulations generally apply to new construction, but they are also used for major refurbishment and for extensions. Some parts cover work to existing buildings (e.g. Part L energy efficiency). It might therefore be argued that the role of building regulations in flood management should be undertaken as follows:

- For new construction – where the flood risk is estimated as greater than 1 in 75 years (or 1.3% annual probability of flooding). Guidance on resilient construction would be based upon the existing CLG guidance (2007).
- For existing construction – for all flooded buildings there should be a requirement to consider flood resilient construction. This would include a flood risk assessment to be undertaken and appropriate technical measures to be undertaken when there is a risk of a return flood, even when this occurred outside a floodplain or coastal flood area.

At present repair to buildings after a flood are not typically subject to building regulation control through the local authority (or other building control authority). Bringing repair within building control may result in delay to repairs occurring and extend the time involved in repair work and cost. There would therefore be a need to a ‘fast track’ to flood resilient repair by the local authority, although not at the expense of other work.

The Pitt report recommends that building regulations include greater provision for flood resilience than at present. However, it is clear that the issues are not always straightforward for small urban catchments.

<u>B 1.6.1 Insurance, lending and building regulation</u>

The insurance industry perspective on flood repair has been set out in an earlier section and recommendations determined for small urban catchments. The insurance industry has no direct influence on building regulations, although insurers may advise government on the development of the regulations. Common areas where insurance claims arise with respect to buildings are wind storm damage, rain leakage into buildings from driving rain and leaking pipework. The first two of these issues are covered by the building regulations in Parts A and C, with appropriate guidance being given in the approved documents. However, there is no such requirement for flood resilience. It is understood that insurers would welcome building regulations that reduced the amount of damage experienced in a flood and the subsequent cost and time of repair.

It is possible that by including the repair of flood damaged buildings within building regulation requirements as a first step that resilience can be achieved through the building regulations. Insurers will not provide insurance to any owner of a building that has not achieved full building control compliance. Therefore, the future insurability of the building will depend upon compliance with a resilient repair assessment under the building regulations.

Insurers could lead on resilient repair through specific insurance products or customers being offered resilient repair as standard by insurers in return for government commitment to higher spending on flood defences. An alternative may be to involve the mortgage lenders, who are typically supportive of flood resilient repair. The insurance industry has promoted the idea of mortgage lenders paying for resilience by allowing homeowners to add to their existing mortgage in order to fund the difference between a like for like repair and a flood resilient repair.

Flood protection measures are estimated by the Association of British Insurers to cost between £2,000 and £6,000 to deal with flash-floods using dry proofing measures, and from £20,000 up to £40,000 to make buildings resilient for long duration floods. However, flood resilient repair can save between 50% and 80% of the cost of a future flood (Association of British Insurers and National Flood Forum, 2007). For small urban catchments the approach set out previously is based upon these dry proofing measures to make buildings resilient. Whether or not the mortgage industry would be prepared to invest in technologies such as door boards, air brick covers and flood skirts is open to question. Mortgage lenders will lend on the cost of homes that include fully fitted white goods and other short lived products so there is a form of precedent, but the use of such household products for flood resilience may not be acceptable.

Mortgage lenders, similarly to the insurance industry, will not provide investment until full building control compliance is achieved. Any move towards the introduction of flood resilient repair within the building regulations would therefore requirement the support of the mortgage industry; most especially if the insurers do not pay for resilient repair.

B 2 Flood probability reduction measures

B 2.1 SUDS

SUDS systems typically involve above-ground localised storage of water, which requires consideration during master-planning through to development of individual sites and an intimate knowledge of the urban environment. There are no SUDS in Heywood, nor are there any plans to develop them despite several areas where they potentially could be beneficially employed (Examples 1 and 2). Parts of the Wrigley Brook were only culverted after 1960 and there is potential for re-opening some of these to create flood basins to the north and south of Egerton Street where the land is under allotments or greenspace. Swales could be constructed lower down the Wrigley Brook on Pilsworth Road.

The utility company in Heywood is reluctant to consider SUDS, their Policy/Strategy Manager states that *"SUDS are the best thing since sliced bread but they are not adopted because they are not part of the sewer system"* and SUDS are not being considered by the LA as a form of mitigation in the areas which experienced flooding in 2004 and 2006 or in any new developments.

Summary and way forward

Localised urban pluvial flooding is likely to increase and well established urban areas unrelated to designated rivers and flood-plains with no previous history of flooding are increasingly at risk; there are no existing records of any previous flooding whatsoever in all six areas of Heywood where homes experienced internal flooding in 2004 and 2006. Only in one of the six areas is there some evidence of minor flooding having affected the street and a former school play-ground that has since been built upon, and this is only empirical hearsay evidence (see Box 2).

The research has shown that the plethora of agencies and the fact that many public services are now in the private sector creates a lack of cohesion and invariably constrains effective responses to urban pluvial flood events. There is an active tendency for one agency to apportion the blame for flooding to another agency. The interviews with the various stakeholders demonstrated a need to readdress current responsibilities and to encourage more effective and integrated working relationships, especially improved communication between the EA, LA, utility industry, OFWAT and the insurance industry. The evidence suggests that the utility industry should be more closely involved in the planning process and should help develop a code of practice detailing when they should be consulted and that Utility Companies should be more active in the planning process. It has also been demonstrated that better data should be made available to planners to make better decisions. For example, the local SFRA and/or the DG5 register should inform planning departments on areas they need tighter surface water control policies, such as inhibiting the paving of front gardens. The indication is that more use of strategic solutions, such as strategic storage and mitigation options should be pursued and guidance provided on how these could be carried out.

The general public are confused about who does what and who is responsible for pluvial flood risk management, and are ill-informed about how best to protect their properties. The research strongly indicates that there is a great underestimation by many agencies of the ongoing health and social effects of flooding. Support may be good on the day of the event but disappears once the water has receded. Most people interviewed would like to have a single contact to deal with all their problems relating to flooding.

The research suggests that a feasible way forward is the development of a national policy unit and integrated management to provide for more effective working relationships between the agencies involved with flooding and a co-ordinated and integrated local response to flood risk in small urban catchments. Flood risk managers and flood victims indicated the need to readdress current responsibilities and they supported the development of a national policy to determine and co-ordinate more effective working relationships between the EA, LA, utility industry, OFWAT and the insurance industry. They indicate that a coherent voice and strategic guidance could be provided by an overriding agency or by allocating responsibility to an existing agency. LAs, because of their responsibility to the local community and their local knowledge and connections to the public, could be empowered to accept a leading role in this area as they are well placed to deliver effective local urban pluvial flood risk management. A cost-effective solution may be that the overriding agency provides operational guidance to a new dedicated flooding expert within all LA planning departments where there is risk of urban flooding. The prime function of this person(s) should be to amalgamate data and expertise from the EA, the utility company, LA highways departments, planning departments and emergency services at local or sub-regional level with the objective of working closely with them to provide an integrated flood management service at local level. This person(s) should also be able to offer advice/action on flood mitigation and resilience measures to the general public and could also usefully be empowered to initiate practical issues, such as instigating localised urban flood risk mitigation schemes (for example SUDS and drainage routes). It was further suggested that because flooding is national issue finance for this post could be ring-fenced by the Government, however we recognise that the implications of putting these suggestions into practice requires further research.

Possible future work

1. Making institutions work and facilitating the effective translation of national planning policy aims into local level planning decisions. The case study envisages the establishment of an overriding agency to provide strategic and operational guidance on flood risk management via a dedicated flooding expert attached to each LA planning department. Research is required to study the implications surrounding the establishment of this modified flood risk management structure; to undertake a cost/benefit analysis; and to formulate the strategic role, the operational responsibilities and the job specification of the dedicated flooding experts.

2. Research is required into how best to secure increased use of SUDS. The existing legislation and good practice guidance recommends the use of SUDS to reduce the impact of flooding. However, they are much under-used due to problems concerned with the acceptance of responsibility for their installation and their ongoing maintenance as well as the public's perceived risk to health and safety. SUDS systems typically involve above-ground localised storage of water, which requires consideration during master-planning through to development of individual sites and an intimate knowledge of the urban environment. The plethora of stakeholders involved in the management of urban flood risk further constrains the development of SUDS.

   Eight years after their initial inclusion within PPG25 their use is still rare, yet this project has shown that there is a good deal of goodwill. Securing SUDS could take a localised approach focusing on one area, such as Greater Manchester, engaging with all relevant stakeholders and agreeing a way forward acceptable to all. The project could therefore aim to translate the aims of policy into practice and provide a practical framework for their promotion elsewhere.

3. Resilient buildings and their incorporation in building regulations will require further determination of the performance of the measures set out in Appendix 3 in a flood. Small urban catchments are not typically on flood maps and therefore are likely to be missed in standards approaches to flood risk assessment. This prevents difficulties when setting building regulations for new build and further work is required. For the repair of existing buildings the approach for small urban catchments is based on dry proofing approaches, but determining when to incorporate such measures requires further work.

Action resulting from the research

The findings from the case study have informed the House of Commons Environment, Food and Rural Affairs Select Committee inquiry into flooding chaired by Michael Jack MP.

Figures

Figure 1 Terrain map of Heywood

Figure 2 Land use change (infill) in the Wrigley Brook catchment Heywood, 1968 (black) to 2007 (red)
Figure 3 Wrigley Brook and Millers Brook Heywood and location of floods 2004 and 2006
Figure 4 Hot-spots in a sewer system

Appendices

Appendix 1
The organisation of surface water management and its relationship to flood risk and spatial planning. *A broad review of France, Germany, Scotland and England.*
(to be inserted)

Appendix 2
Effectiveness of local land use and development planning in flood risk management. *A broad review of England.*

Appendix 3
Buidings resilience - strategy: Heywood – small urban catchments

References

Ashley, R. , Blanksby, J., Adrian Cashman, A., Jack, L., Wright, G., Packman, J., Fewtrell, L., and Poole, A. 2007, Adaptable urban drainage –addressing change in intensity, occurrence and uncertainty of stormwater (AUDACIOUS). http://www.wapug.org.uk/past_papers/Spring_2006/D2006_Ashley.pdf

Association of British Insurers and National Flood Forum, 2007 *Repairing your home or business after a flood- how to limit damage and disruption in the future.* Prepared jointly by the Association of British Insurers and the National Flood Forum.

Christensen, J.H. and Christensen, O.B. 2003. Severe summertime flooding in Europe. *Nature (Lond.)* 421(6925): 805-806.

Collier, C.G. 2007 Flash flood forecasting: What are the limits of predictability? *Quarterly Journal of the Royal Meteorological Society,* 133, 3-23.

Communities and Local Government, 2007 *Improving the flood performance of new buildings, flood resilient construction*, CLG and Environment Agency, London, May 2007.

Cullingworth, J.B. and Nadin, V. 2002 *Town and country planning in the UK.* Routledge, London

Defra, 2006 *Flood and Coastal Defence Appraisal Guidance FCDAPG3 Economic Appraisal Supplementary Note to Operating Authorities- Climate Change Impacts October 2006.* Defra, London.

Garvin S L, Reid J and Scott M, *Flood repair standards for buildings*, CIRIA Report C623, London, 2005.

Gillespie, A. 2007 *Designing out pluvial flooding in residential environments: a case study of Heywood, Greater Manchester.* Unpublished MSc Thesis, School of Environment and Development, University of Manchester.

Hankin, B., Waller, S., Astle, G. and Kellagher, R. 2008 Making Space for Water: Screening for urban flash flood flooding. *Journal of Flood Risk Management (online accepted).*

Home Information Pack (No. 2) Regulations 2007: Procedural Guidance www.homeinformationpack.gov.uk/pdf/070509**ProceduralGuidance**forHIPRegs.pdf accessed 31/01/2007

Manchester City Council, *2007 Manchester Flood Response Plan* Manchester City Council

Morrow, B. (United Utilities Policy/Strategy Manager) 2007 Personal communication.

Priestnall, G., Jaafar, J. and Duncan, A. 2000 Extracting urban features from LiDAR digital surface models. *Computers, Environment and Urban Systems*, 24, 65-78.

Pitt, M. 2007, *Learning lessons from the 2007 floods An independent review by Sir Michael Pitt.* The Cabinet Office.

Salford City Council Emergency Planning Unit 2007 *Broughton, Lower Kersal and Charlestown Flood Response Plan.* Salford City Council

Shackley, S. Wood, R., Hornung, M., Hulme, M., Handley, J., Darier, E., and Walsh, M. 1998 *Changing by Degrees: The Impacts of Climate Change in the North West of England.* A Report Prepared for the "Climate Change in the North West" Group, Supported by the North West Regional Association, Environment Agency, The National Trust and Sustainability North West, Manchester.

White, I., Richards, J. and Carter, J. (2007) *Policy Issues, Vol. 2 – Urban*, Flood Risk Management Research Consortium Research Report UR8, at www.floodrisk.org.uk

White, I. and Howe, J. (2005) Unpacking Barriers to Sustainable Urban Drainage Use, *Journal of Environmental Policy and Planning*, 7 (1), 27-43

References to published material

9. This section should be used to record links (hypertext links where possible) or references to other published material generated by, or relating to this project.