



Flood risk and property

Impacts on commercial & residential stakeholders' strategies

Authors

Sarah Kenney, Research Office at the College of Estate Management

Gaye Pottinger, Senior Research Officer at the College of Estate Management

Dr Frances Plimmer, Senior Research Officer at the College of Estate Management

Yasmin Pocock, Research Officer at the College of Estate Management

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Note to readers

The literature review and report was prepared prior to the Office of Deputy Prime Minister (ODPM) being renamed as the Department for Communities and Local Government (DCLG) in May 2006.

In the context of flooding the DCLG now has responsibility for issues relating to planning and specifically the revision of Planning Policy Guidance 25 (PPG25).

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The College of Estate Management

Whiteknights

Reading RG6 6AW

Tel: 0118 9861101

Fax: 01189 755344

EXECUTIVE SUMMARY

Increasing flood-risk coupled with development pressures pose a complex conundrum for the future well-being of key economic locations in the UK and the ability of the UK to manage its future accommodation and social needs in a responsible and sustainable manner. The way that stakeholders in the commercial and residential property sectors respond to flood-risk will be all-important to the physical and economic security of homes and businesses in areas likely to be most affected. Research by the College of Estate Management therefore investigated stakeholder perceptions and their strategies for adapting, mitigating and coping with flood-risk, including the potential impact on property values. The research found:

- The availability of flood-risk insurance is a key determinant of property development and investment decisions in the UK.
- The UK is unusual in the current extent of privately available flood insurance for property, but is dependent on a global reinsurance market.
- Increasing flood-risk is likely to put a strain on insurance availability and have a significant impact on property lending and therefore on values in flood-prone areas.
- Flood-risk assessments on property acquisitions for development, investment and business occupation are generally only undertaken if a problem is suspected, not as a matter of course.
- Property investment portfolios are generally not subject to periodic monitoring for changes in the flood-risk status of sites and buildings.
- The presence of flood defences appears to be interpreted as equating to a lower risk of flooding, making defended sites appear more suitable for development.
- Property investors and occupiers are still eager to locate in London, on the assumption that the Thames barrier offers significant protection and that the government will take all necessary measures to prevent the capital from flooding.

How was the research done?

The research involved:

- a detailed and comprehensive literature review;
- a postal questionnaire that achieved 121 responses (9.8% response rate) from property developers, lenders, occupiers, investors and valuers, with a non-response follow-up that achieved 231 replies (20.8% response rate);
- 19 non-response follow-up face-to-face interviews; and,
- four case studies of residential and commercial development projects in the Thames region, including the Thames Gateway.

Why is flood-risk increasing?

Flood-risk to the built environment largely arises from historic settlement patterns. Coastal and river locations have provided economic advantages for transport and trade, and still offer commercial advantages for tourism and regeneration.

In the UK, perceptions that flood-risk is increasing have come about due to three main factors:

- the impact of climate change, increasing the level and frequency of flooding;
- the increased value of land and buildings subject to insurance claims; and,
- the pressure to build on flood-plains, to protect 'Green Belt' and to increase housing supply, particularly in South-East England, including the Thames Gateway.

While there is general acceptance that climate change is driving increased flood-risk, there is still disagreement about the reliability of future predictions, particularly for sea level rise, owing to a lack of clear and discernable evidence for uniform worldwide changes. Prediction techniques are hampered by data limitations and an apparent reluctance to make more use of available computer models. The resulting uncertainties make it harder to develop clear and detailed policy solutions toward new development and flood defences.

What property is affected?

Estimates suggest that in England and Wales over £220 billion worth of property is potentially at risk of flooding, from rivers, groundwater, sewers and coastal excesses. The coastal zone is occupied by 10 million people (within 10km of the coast), accounts for 40% of manufacturing industry, 40% of tourism expenditure and contains a concentration of energy installations.

Flood-risk maps first published by the Environment Agency in 2004, show 2.2 million UK properties at risk of flooding. However there are significant gaps in the information, which is admitted not to be completely accurate and there is confusion as to how the risk classification is interpreted. Traditionally flood-risk has been expressed in terms of a 'flood return period' and flood defences have been designed to maintain the risk level at no more than a 1 in 100 year flood return period. This is equivalent to a 1% annual risk of a flood.

The public at large appears ill-informed about flood-risk. For example, of the estimated 1.7 million homes currently located on flood-plains, 25% of homeowners are unaware of the fact and 13% would not know who to turn to for help and advice in a flood situation.

How does flooding physically affect buildings and people?

The literature search shows that research into the physical impact of flooding on buildings and their occupants has been concentrated on residential property. The vulnerability of flood-prone buildings to damage is largely a function of flood severity, construction characteristics and the state of preparedness of occupiers.

Historically, buildings in flood-prone areas were constructed from materials that reflected this risk, whereas modern UK homes tend to be built from more porous

materials, including bricks, blocks and concrete, with vulnerable services located on the ground floor.

Flood damage increases significantly with water depth. Depths of over 1m can damage the structure, due to increased velocity and hydraulic pressure. Contamination of floodwater contributes significantly to damage, because it changes absorption and drying out characteristics of materials, poses a threat to health and increases clean-up costs. The corrosive nature of seawater can increase flood repair costs by around 10%.

Frequently flooded property tends to suffer less physical damage because occupiers are better prepared. In 1993, severe storms across the UK led to less building damage in Scotland, where the adopted building standards are designed to cope with tougher weather conditions, as compared to those in England and Wales.

Floods also have significant physical and emotional effects on human health, both during the event and once residents return to deal with the aftermath. This can lead people to feel less secure in their homes and lose confidence in authorities and institutions perceived to be responsible for flood defences.

What are the difficulties in assessing flood damage?

The literature indicates a lack of knowledge amongst building surveyors and loss adjusters who deal with flood damage claims about the factors important to assessing flood damage and specifying optimal repair methods.

Surveyors are generally not present when a flood occurs and must rely on second hand information from local witnesses about flood velocity and contamination content, not evident once a flood has subsided. A lack of consistency in the process for assessing damage could result in varied repair methods being recommended for similarly affected properties. Further, while it might appear sensible to incorporate works to limit future flood damage, insurers will generally not pay for these additional works, nor offer either reduced premiums or excesses where flood-mitigation features are incorporated.

Who is responsible for flood defences?

In the UK a large number of organisations are involved in the provision and management of defences. The Institute of Civil Engineers has argued that the division of responsibility is confusing and a single authority is needed to deliver a sustainable and integrated approach to flood-risk management, although currently the government does not accept this view.

At present the DCLG (formerly ODPM) sets national policy on development and flood defence in conjunction with DEFRA, which is also responsible for coastal defence policy. The Environment Agency is the main body responsible for regional and local delivery. Other responsible bodies include local Flood Defence Committees, Water Plcs, Local Authorities and some private landowners (such as Network Rail).

However, the powers available to these operating authorities are discretionary, with no organisation having any statutory duty to carry out flood defence works. Hence failure to provide defences against flooding, or coastal erosion, does not give rise to a right to compensation on the part of property owners and occupiers.

The primary responsibility for protecting land and property against flooding therefore rests with landowners, who can defend their land providing they do not alter established watercourses, even if diverting floodwater would damage other land.

However, if land is already flooded, or flood-prone, landowners must not export the damage. Flood defences that involve building or engineering works may also be subject to planning permission, which may be refused despite clear advantages in terms of protecting the landowners' property, for example where such works are deemed out of keeping with the locality or viewed as increasing the risk to other property.

For new developments, applicants must satisfy local planning authorities that their schemes appropriately reflect flood-risk and take responsibility for the provision and maintenance of any necessary flood control measures, avoiding the need for additional publicly-funded flood defences.

Are flood defences sustainable?

The current design approach to flood defences has concentrated on providing certainty, through keeping flood-risk at a 1% annual probability. However, floods are dynamic and variations must be expected over the design life of defences. Estimates suggest that the impact of climate change and the need to protect existing communities could require a 20% upsizing of existing defence schemes.

In recent years, funding has been concentrated on maintaining existing flood defences and new provision has declined. Defences are not in place in all areas at risk, existing defences vary in standard and some defences are failing. It seems routine maintenance is not always a priority and defences may be allowed to decay to the point of needing emergency repair, the funds for which come from a different public budget. There is also evidence that existing storm water and sewage infrastructure is failing in part because of lack of maintenance. Simple and relatively cheap maintenance, for example the unblocking of culverts, are not undertaken routinely.

Settlements along the south and east coasts of England are at the greatest risk of coastal erosion, yet the cost of new coastal defences to protect relatively few properties or agricultural land is increasingly hard to justify. Non-statutory shoreline management plans, introduced in 1995, represent a significant step forward, but barriers to implementing integrated coastal management persist, including uncertainty about climate change impacts, lack of resources, lack of strong political will, inadequate public awareness and complex conflicts of interest.

It is apparent that the longer term, engineering solutions to raising flood defences are the least sustainable option. The emphasis must shift to 'softer' managed solutions, including allowing rivers more space in urban areas (free from impermeable surfaces), provision of sustainable urban drainage systems and managed realignment of the coast, even though such policies are likely to be controversial, not least because there is no right to compensation for those adversely affected.

Why is flood-risk insurance so important?

Most developer respondents to the research said that they would abandon development plans if flood-risk insurance was not available or if a site had flooded in the last five years and been subject to claims for damage. Most of the lenders questioned would not lend if flood-risk insurance were unavailable and occupiers said they would abandon negotiations to lease such business premises. Occupiers' inability to obtain insurance cover would also act as a disincentive to investors.

Insurance against environmental hazards, including floods is a norm in the UK and is fundamental to the efficient operation of the property market. Insurance can certainly

help speed recovery following a flood event. However, there is no absolute need or right to have insurance cover and not all risks are insurable. While it seems likely that the British desire for full insurance stems as much from cultural as financial drivers, in the property investment sector it has become a central concept of the Full Repairing and Insuring (FRI) lease, underpinning the security of the investment income and the stability of the UK investment market.

Is there a current problem with flood-risk insurance?

Most of the property developers, business occupiers and investors responding to the research had not experienced any difficulty in obtaining flood insurance because a site or property was located in a flood-risk area. Of the small number that had experienced a difficulty, this had resulted in either higher premiums or higher excesses on policies. None of the respondents had been refused cover or had flood damage excluded from the policy.

Interviews for the project show that the availability of insurance can differ for residential and commercial property. Whereas business occupiers will use a broker to secure their insurance and can negotiate with and inform underwriters about flood-mitigation works, in the residential market the volume of policies means that underwriting decisions are automated with no room for consideration of other factors. This means that in some locations commercial buildings may be insured against flooding while adjacent residential properties are not. This could mean that residential developers would disregard sites attractive to commercial developers.

Most business occupiers and investors also believed they were adequately insured against flood-risk. However, firms tend to over-estimate the amount of cover provided by insurance and research by insurers AXA (2003) shows that 80% of businesses affected by a major incident either never re-open or close within 18 months.

Following extreme weather events in the UK between 1995 and 2000, flood-risk became uninsurable in some areas. The Association of British Insurers (ABI) also published a statement of principles, renewed in 2006, amounting to a conditional agreement with government that continued cover for households and businesses will be dependent on greater investment in flood defences, curtailment of development in flood-prone areas and faster and more effective decision-making on flood defences. However, in August 2006, DEFRA announced a cut in funding for the Environment Agency which resulted in a £14.9 million reduction in the flood defence budget.

Is flood-risk insurance sustainable in the UK?

The UK is unusual in the world in the current nature and scope of availability of private flood insurance for property, but there is a real danger that climate change could undermine the future availability of such insurance.

Of the natural hazards, floods account for about a third of economic losses worldwide, but only about 10% of insured losses, because in many markets flood cover is conservative or unavailable. Nevertheless, the absolute amount of insured losses has increased significantly in flood-prone areas due to increases in population, property values and the vulnerability of new developments.

The insurance industry plays a significant role in risk evaluation and is taking flood-risk very seriously. Reinsurance, that protects insurers against catastrophic risks, operates globally and climate change means re-insurers are likely to become increasingly selective about the risk portfolios they cover.

Major UK insurers, Norwich Union, have developed their own flood-risk maps to enable them to assess premiums for individual addresses. Increased precision in flood data and prediction promises benefits for risk management, but complex repercussions for society, the property owning community, their advisers and for government, because the relationship between risk and insurance is fundamentally altered. Insurance is not designed for frequent predictable events, but relies on a significant element of uncertainty. The system of 'mutuality' could unravel in the UK as policyholders outside flood-risk areas withdraw from policies that package this element of cover. The reduced loss-bearing capacity of premiums could leave insurers unable to fund flood damage claims.

In many other countries the principle of 'mutuality' does not function for the very reason that the transfer of losses from those affected by flood hazard to the wider community cannot operate at an economic premium. Insurance schemes in some countries are therefore government-backed. For example, the USA government operates a National Flood Insurance Programme requiring mandatory risk mitigation from communities, including controls on development location, in exchange for cover.

Moves by insurers to demand risk mitigation as a condition of cover will only work if it evokes an appropriate response from other stakeholders, particularly governments, property occupiers and / or owners and developers. Otherwise increased risk will translate into higher premiums, reduced cover or abandoned cover, with the danger that an insurance underclass will develop.

Despite the reduction in flood defence funding, the ABI, in its report on coastal flood-risk to the east of England (ABI 2006b) continues to point to the need to improve coastal defences and reinforces the insurance industry desire to keep flood insurance cover as standard for UK policy holders, but making clear that it will *'continue to signal to customers and government where the pressures are becoming unsustainable'*.

How does flood-risk affect development location?

Respondent developers appeared more willing to develop on sites with a 1% flood-risk where defences are in place, than on sites with a lower risk of 0.5% but with no flood defences. This suggests that the response to the presence of defences is not wholly rational, because defences are interpreted as lowering the risk of flooding, making sites more suitable for development, even if the stated risk is still higher than for other sites.

The literature also showed that the presence of defences and availability of insurance tend to allow property values to rise, rather than provide an incentive to relocate to a less hazardous area.

The susceptibility of land to flooding is a material planning consideration and PPG 25 requires Local Planning Authorities (LPAs) to adopt a risk-based approach to development applications in flood-prone areas. However, the current planning approach is criticised as unreliable because about 27% by value of new homes in England are built in flood hazard areas against the advice of the Environment Agency. Most respondent developers said that, faced with this situation, they would proceed with a modified scheme to reflect Environment Agency concerns, although a small number of house builders said they would abandon development plans.

Much well-founded research funded by government points to an urgent need for more strategic action on flooding, yet the government response has been disappointingly limited to a review of PPG25, which proposes to raise the status of

the Environment Agency to a statutory consultee on planning applications, encourage provision of flood-risk assessments and develop a more strategic approach to coastal flooding and erosion risks.

When are flood-risk assessments undertaken?

Most respondent developers conducted a flood-risk assessment as soon as a site was being considered for development and before acquisition, although about 20% of the residential developers said they would wait until after acquisition, which may include those taking options on sites.

Most lenders and occupiers said they would only conduct a flood-risk assessment on a property only if a problem were expected, as would about 50% of the investors and valuers. About a third of respondent investors undertake an assessment as standard.

Amongst the interviewees for the research, most undertook flood-risk assessments in conjunction with property acquisitions. However, none of the investors conducted periodic reviews of the flood status of property held in their portfolios, even though they may monitor other aspects of building performance. This suggests that they could be unaware of changes in the level of flood-risk to which their properties are exposed, for example because of climate change generally or because the dynamics of a floodplain or river have been altered by development either up or down stream. This could have knock-on consequences for insurance policies and result in property being over or under valued for investment or accounting purposes.

How are South-East locations affected?

Generally, the increased level of flood-risk in London and the South-East had not changed respondents' attitude to locating or investing in the area, although some now carry out greater due diligence on acquisitions.

The interviews and case studies showed that the economic strength of the South-East still acts as a draw. London continues to be the preferred location for many businesses to establish their headquarters and occupiers and investors remain eager to locate in the capital. However, investors' confidence appears to be based on the belief that the Thames barrier offers significant protection and that the government will take all measures necessary to prevent the capital from flooding, including a more effective replacement when the useful life of the existing barrier comes to an end.

Regional plans for the southeast include 128,500 new homes allocated to the Thames Gateway by 2016, particularly to provide much needed 'affordable' housing. The ABI has given a clear indication that insurance cover cannot be assumed for new properties in flood-prone areas, including the Thames Gateway, and has set out key considerations deemed vital for insurance to be available to the overall 200,000 new homes proposed by the Sustainable Communities Plan. In particular the ABI has warned that the level of the residual risk of new housing behind flood defences in East London could be £26 million per year, although a sequential approach to developing the lowest risk areas first could reduce losses in the Thames Gateway by up to 52%.

The ABI has therefore urged government to develop stronger and more strategic land use planning policies and guidance as the most cost-effective means of reducing flood losses and avoiding unnecessary risks. However, in the Thames Gateway, planning measures alone are not judged sufficient and increased investment in defences will be needed, although this option is not judged 'climate-proofed'.

How can property be protected from flooding?

Respondent developers largely believed that they could successfully mitigate against flooding from rivers, sewers and rising ground water, but less than 20% believed they could counter coastal and estuarine flooding.

The most popular approach to mitigating flooding on new development sites was to raise the ground level. Residential developers were more likely than commercial developers to adopt building-specific measures, usually raising the ground floor of buildings. Those developers investigating new methods of flood-mitigation were looking at ways to provide more flood-plain capacity, new flood defence structures and raised floor designs for buildings.

How is flood-risk rated as an environmental peril?

Most respondent developers, investors and occupiers felt their organisations were highly aware of flood-risk issues, although a few occupiers said awareness levels were very poor. Also, most respondents incorrectly interpreted a '1 in 10 year flood return' to mean a flood would occur only once in every 10 year period, rather than a 10% annual probability. This finding supports moves to change the terminology and express flood-risk as an annual percentage, because understanding the probability of flooding is crucial to managing the risk.

Comparing flood-risk against other environmental perils of contamination, storm damage and subsidence, most respondents attached greatest importance to contamination risk, followed by flooding. Land contamination is the most highly regulated of the perils, suggesting respondents were not just concerned about physical impacts, but also with the associated legal liabilities, regulatory obligations and duties.

The interviews indicated that flooding has become a more significant issue for property stakeholders in the past few years. Their experience of flood events influenced their perception of this risk and how they should deal with it. While there was great variation in interviewees' level of risk aversion, from the highly cautious to the less averse, there appears to be consensus that flood-risk and / or a history of flooding would adversely affect value. The reasons included increased difficulty in selling property and a limitation on development options. Therefore impact on value is not only a depreciation effect due to the potential physical damage to buildings, but also a stigma effect in terms of discouraging future buyers or blighting development.

How does flood-risk affect commercial property values?

The literature search found very little research into the impact of climate change, and specifically flooding, on the value of institutional investment property. This study identifies one discussion paper (Mansley and Dlugolecki, 2001) for the Universities Superannuation Scheme (USS).

Respondent valuers for the current study indicated, that given scenarios of a 0.5% or 1% flood-risk, they would make yield adjustments on investment valuations in the range 0.5 – 1.5% on a base yield of 10%, which would result in capital value reductions of around 5 – 15%. An increase in flood-risk driven by climate change could therefore have a significant value impact in affected areas.

In circumstances where flood insurance was unavailable, respondent valuers suggested they would either make a significant adjustment, taking the yield to 12.5% – 25% and considerably reducing the valuation, or simply advise against purchase.

This wide range of opinion indicates that the 'no-insurance' scenario is not only viewed as a serious risk to value, but also suggests a lack of information on which to base a valuation. Several respondents felt a need for more guidance on valuing flood-risk property and it is possible that the relatively low response from valuers to the questionnaire indicates that many simply do not know how to value in this situation.

The literature indicates that there is little consistent information available to valuers on flooding and flood-risk, and most rely on personal knowledge and local experience. It also suggests that few lenders would refuse a loan based on climate change impacts unless the issue was highlighted in the surveyors report, which could mean that in the event of subsequent loss or damage lenders, may seek to imply negligence on the part of surveyors who omit relevant advice.

How does flood-risk affect residential property values?

The literature search found more research in recent years into flooding impacts on the value of residential property.

UK-based research shows that while recent flood events affect property values, the effect is marginal where properties have not yet flooded although they are deemed at risk. Recent flood events can typically result in a discount to open market value of about 12%, although severe floods in 2001 resulted in a 20% reduction in house prices in Maidstone, Kent, whereas less severe flooding in Sussex had minimal effect.

Previously flooded properties recover in value over a number of years, provided there is no repeat event and defensive actions are taken. Flood defences, existing and proposed, are shown to have a positive effect on property values.

In the USA, where insurance is underwritten by the state and legislation requires vendors to inform buyers of potential natural hazards, houses in flood-plains tend to sell for less than those located outside flood-plains. In extreme cases, abandonment of flood-damaged homes has also blighted surrounding properties.

What needs to be done now?

This research therefore indicates a need for:

- greater accuracy and level of detail in publicly-available flood-risk information and maps, incorporating flood history and site specific information, produced by the Environment Agency;
- the early implementation of revised planning policy guidance (PPG 25) and increased Environment Agency powers in relation to development applications;
- education to raise the general awareness of occupiers, investors and their professional advisers about flood-risk issues;
- greater promotion and use of flood resilient design and construction materials in flood-risk areas, possibly through amendments to the Building Regulations, in new development, major refurbishments and reinstatement works to flood damaged property;

- guidance produced by the valuation profession on the approach to valuing flood-risk property, particularly in cases where flood-risk insurance becomes unavailable or too expensive;
- more valuer education and training specific to undertaking valuations in flood-risk areas and of individual flood-prone buildings;
- periodic reviews by investors, particularly pension funds, insurers and their advisers of flood-risk levels attaching to property investment portfolios; and,
- scenario planning, involving leaders in the property sector, insurance sector and government to agree strategies for mitigating flood-risk for existing communities and new development, to cover the eventuality of properties becoming uninsurable for flood-risk as a result of climate change.

Aspects requiring further research include:

- the impact of flooding on commercial property values and property investment portfolios;
- the design and content of education and training courses for property professionals to enable them to respond effectively to flood-risk issues in the built environment; and,
- the effect on consumer behaviour of the reduced availability and / or increased cost of flood-risk insurance.

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ACRONYMS

ABI	Association of British Insurers
BRE	Building Research Establishment
cf	confer (compare)
CIA	Climate Impact Assessment
CIWEM	Chartered Institution of Water and Environmental Management
CRISP	Construction Research and Innovation Strategy Panel
CSG	Community Support Group
CSO	Combined Sewer Overflow
DCLG	Department for Communities and Local Government
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DTLR	Department for Transport Local Government and the Regions (no longer in existence, many of the responsibilities now covered by the DCLG and the DfT)
EA	Environment Agency
EPSRC	Engineering and Physical Sciences Research Council
ESAs	Environmental Sensitive Areas
FRAs	Flood-risk Assessments
FRI	Full Repairing and Insuring (lease)
GARDIT	General Aquifer Research and Development Team
GLA	Greater London Authority
HBF	House Builders Federation
IDBs	Internal Drainage Boards
IPCC	Intergovernmental Panel on Climate Change
LEAPs	Local Environmental Agency Plans
LPA	Local Planning Authority
MAFF	Ministry of Agriculture, Fisheries and Food (no longer in existence, responsibilities now covered by DEFRA)
MWEFAS	Maidenhead, Windsor and Eton Flood Alleviation Scheme
NFIP	National Flood Insurance Programme
OD	Ordnance Datum
ODPM	Office of the Deputy Prime Minister (no longer in existence, responsibilities now covered by DCLG)
OFWAT	Office of Water Services
plc	Public Limited Company
PPG25	Planning Policy Guidance Note 25 : Development and Flood-risk

PruPIM	Prudential Property Investment. Managers
R&D	Research and Development
RICS	Royal Institution of Chartered Surveyors
RSL	Relative Sea Level
SLR	Sea Level Rise
SMEs	Small and Medium-sized Enterprises
SMP	Shoreline Management Plan
SUDs	Sustainable Urban Drainage Systems
TGLP	Thames Gateway London Partnership
TTD	Thames Tidal Defences
UKCIP02	UK Climate Impacts Programme 2002
USS	Universities Superannuation Scheme

1. INTRODUCTION

1.1 The research commission

The College of Estate Management carried out this independent research during 2005 and 2006. The project was designed to examine the impact of current and future flood-risk on the perceptions of key stakeholders in the commercial and residential property sectors and to examine their strategies for adapting, mitigating and coping with such risks, and the potential impact on values.

The project also examines five case study sites within London and the South-East to identify best practice within the residential market and explore the issues surrounding commercial property values and flood-risk.

The research was sponsored by the Prudential Property Investment Managers; Norwich Union; Peter Brett Associates; Marsh Ltd.; English Partnerships; Fairview Homes; King Sturge; and the Harold Samuel Trust. This section of the report outlines the background to the research and explains the scope of the study in more detail.

1.2 Background

The impact of climate change on commercial and residential property in the UK is a diverse and complex topic. Due to the intricate nature of our climate, the changes predicted to the numerous climatic variables have resulted in many and varied scenarios for future weather systems and our way of life. Some projections suggest that in many areas, extreme summer temperatures will lead to a reduction in the level of comfort for those on public transport and workers (GLA, 2002a). Changes in climate may also lead to droughts, an increase in the occurrence of subsidence, and reduced air quality in our major cities. The indications also show that we can expect an increase in the risk of flooding in the long term. The Foresight report on '*Future Flooding*' predicts that by 2050 we can expect that the number of people at a high risk of flooding will have risen by 90% from the 2002 figure, with the cost of flood damage increasing by around £13 billion over the same period (OST, 2004a).

In recent years there have been a number of major floods, which have made the headlines. For example, the August floods of 2000 saw the worst weather for over 300 years in England and Wales with 10,000 properties flooded at a cost of about £1 billion to insurers (ABI, 2004a). More recently, in August 2004, the flash floods in Boscastle have shown that this is an issue, which can affect whole communities at anytime and have a devastating impact on property and people.

Prior to the Easter floods of 1998 the general public's awareness of the risk of flooding was low. Whilst there had been major floods in the past (such as Lynmouth August 1952, The Clyde 1977, Bristol in July 1968), the effects of these events were short-lived and quickly forgotten, leading to complacency on the issue (Fleming, 2001).

However, the recent, severe floods, which have made the news headlines, have heightened awareness of this problem. For the first time, insurance companies have begun to differentiate the claims for flooding from other weather-related claims (ABI, 2000). Reinsurance (the mechanism by which insurance companies protect themselves from claims resulting from catastrophic events) operates within a global market and, with the increase in natural disasters across the world, it is likely that re-

insurers will become increasingly selective of the portfolios they are prepared to accept (ABI, 2004b). Also, many organisations have started to take a serious look at this problem and ask what they can do to mitigate the effects (for example, GLA, 2002a).

The recent move to take the risk of flooding more seriously has emerged from a realisation that climate change will make flooding a more frequent and more extreme event. For example, the European Environment Agency suggested that the change to our climate is going to *“increase the frequency of extreme flood events in Europe, in particular the frequency of flash flood”* (European Environment Agency, 2004).

Government research by DEFRA (2001) also shows that whilst a single flooding event cannot be directly attributed to climate change, the increases in the frequency and magnitude of heavy rainfall, which have been seen over the past 50 years is a contributing factor. In addition the UK Climate Impacts Programme (UKCIP) (Hulme *et al.*, 2002), has shown that the average sea level rise around the UK over the past century has been 1mm per year, which will increase the risk of coastal flooding. With the link between climate change and the increase occurrence of flooding being made, we can expect flooding to remain a major issue, which will continue to affect property and people in its path.

The effect of flooding on property and people is extremely relevant due to the numbers of people, communities and property at risk. It is estimated that there are about 1.8 million homes in England and Wales that are situated within a floodplain (Halcrow, 2001). The main reason for this is the historic preference for settlements to be built upon floodplains because of the fertile land and good transport links. This pattern of settlement is however set to continue, with the policy of developing brownfield sites, many of which are on existing floodplains. However, it is not only residential properties, which are at risk; it is estimated in that there are around 140,000 commercial properties which are at a direct risk of being affected by flooding (*ibid.*).

1.3 Research aims, objective and methodology

1.3.1 Aims

The aims of the research are as follows:

- to assess the perceptions of property stakeholders on the risk that flooding poses to properties; and,
- to examine stakeholders' strategies in dealing with this potential problems and issues that an increasing risk of flooding may raise.

1.3.2 Objectives

To achieve these aims the research had the following objectives:

- to examine the perceptions of key stakeholders shown in Table 1 below, in relation to properties at risk from flooding at a national and local case study level;
- to examine stakeholders' policies and strategies with regard to flood-risk to both commercial and residential property;
- to establish the current strategies of residential developers to building new properties in areas at risk from flooding, to determine what issues they see as important and the measures they are employing to reduce the risk of flooding and also lessen the impact of flood water should it occur;
- to examine the drivers for change (including market response, more stringent planning, building regulations and withholding of insurance) in the design and construction for new residential properties, which are being built in areas at risk from flooding;
- to highlight best-practice examples of flood-risk adaptation and mitigation;
- to gain an understanding of the approach that commercial investors take in relation to property at risk of flooding nationally and at case study level in London and the South-East;
- to assess the perception of flood-risk held by occupiers and what their strategies are in relation to occupying property at risk; and,
- to investigate the role that insurance plays in property investors' strategies.

Table 1 Key Stakeholders in the Research

Stakeholder groups	
Developers	Residential and commercial property developers, whose understanding of flood-risk, affects decisions about the location of new development, site purchase, building design and site-based flood-mitigation measures.
Lenders	Who provide finance for property acquisitions and development.
Property occupiers	Covering a range of industry sectors including retail, professional, ICT (information and communication technology), finance, industrial and leisure.
Property Investors	Including property companies (who provide a return to shareholders), institutional investors (including pension funds and insurance companies) and private estates.
Valuers	Who provide valuations of property, mainly to lenders and investors, when buying and selling property.

Research methodology

The research aims and objective were achieved through a literature review, questionnaire survey, structured interviews and a case study analysis.

Literature review

The research began with a desktop review of the literature relating to flood-risk and property, examining previous research and reviewing policy. The literature review covered overseas experience, where appropriate, together with a focus on natural hazards and consequential risk.

Questionnaires

The first stage of the research consisted of national postal surveys of developers (residential and commercial), lenders, occupiers, property investors and valuers; 1,000 questionnaires were sent out. The purpose of the survey was to investigate attitudes and perceptions to risk and also assess how different interest groups were dealing with flood-risk.

Interviews

The survey was followed by a series of structured interviews with representatives of the key stakeholder groups to develop more detail on the questionnaire results and highlight other significant issues.

Case studies

Residential focus - The research examined sites, which have been classified as being at risk, to investigate the strategies adopted by developers to mitigate the risk of flooding, with the aim of highlighting best practice in mitigation strategies.

Commercial focus – The research looked at the approach taken by investors when acquiring buildings under threat of flooding and how this risk was accounted for in the properties value, with the aim of understanding how the investment decision-making process is responding to flooding.

1.4 Report format

The report comprises the following sections:

(Literature review sections 2-7)

- Section 2 Flood-risk
- Section 3 Flood damage and property
- Section 4 Flood defences and mitigation measures
- Section 5 Flooding and insurance
- Section 6 Flood-risk and property values
- Section 7 Questionnaire results and analysis
- Section 8 Interview results and analysis
- Section 9 Commercial case study
- Section 10 Residential case study
- Section 11 Conclusions and further research

2. FLOOD-RISK

2.1 Introduction

“Floods can only be managed, not prevented, and the community must learn to live with rivers.”

(Institution of Civil Engineers, 2001: 73)

This section introduces the nature of flood-risk and its relationship to human settlement. The types of flooding are defined, including flooding from rivers, the sea and as the result of sewers overflowing. The impact of climate change on the incidence and severity of flooding is also discussed, as is the uncertainty surrounding flood protection.

2.2 Flood-risk and human settlement

Flooding is an entirely natural process and only causes problems when it impacts on human settlements and infrastructure.

“Flooding is a natural phenomenon and cannot be prevented. However its impacts can be minimised through flood protection and flood forecasting.”

(Institution of Civil Engineers, 2001: 6)

Worldwide there is an increasing number of people exposed to the risk of flooding who have never before have experienced such an event (Loster, 1999), because the following factors have meant people are settling in areas which previously they may not have considered:

- Dramatic increases in population in some areas, creating the necessity to settle in areas that are at risk;
- Movements of refugees to areas with which they are unfamiliar; and,
- Increased mobility and the desire of people to live in beautiful natural environments and certain climates.

Flooding is, according to Loster of the Geoscience Research Group of Munich Reinsurance Company (Munich Re) (*ibid.*), the leading cause of losses from natural hazards and is responsible for a greater number of damaging events than any other type of natural event. At least one third of all economic losses due to nature's forces can be attributed to flooding.

Thus, the problem is normally defined in the light of its impact on human settlement and infrastructure, specifically in the form of insured losses, although there is a significant impact on agricultural and other rural activities.

Historically, human settlement occurs often in locations that facilitate transport links, and these include river crossing points, along valleys, the confluence of rivers, and along estuaries and natural marine harbours.

“Many of the properties and much of the land at risk to flooding arise from historical land use practice.”

(Institution of Civil Engineers, 2001: 70)

Rivers provided and continue to provide fertility to the land, a power supply for economic activities, as well as a natural defence against attack, and coastal settlements developed because of the locational importance for trade and marine activities.

“Almost all the ancient towns and cities of England and Wales have locations alongside rivers, with some properties vulnerable to flooding (e.g. London, York, Winchester, Norwich, Exeter, Oxford, Cambridge, Carlisle, Chester, Gloucester, Worcester, Shrewsbury and Cardiff).”

(Institution of Civil Engineers, 2001: 7)

Today, the attraction of coastal and fluvial locations has more to do with the aesthetic and leisure benefits than trade, although there remain significant economic benefits associated with waterfront locations.

Flooding is not a new event affecting our built environment, nor is the potential risk of flooding likely to be a disadvantage for development – on the contrary, today; rivers and coastal areas continue to offer commercial advantages, both for tourism and for the promotion of regeneration. However, it is important to recognise that continuing to develop in traditional locations can increase risks of damage caused by fluvial and tidal events. Specifically, development within coastal areas can be threatened by coastal erosion and development within a floodplain affects the ability of the fluvial system to manage excessive volumes of water naturally.

“Within river systems, flooding is the natural way for the system to discharge the water arising from the occasional large rainfall event. There is no problem at all until man decides to use some of the natural flood-plain for his own use, and chooses to protect against inundation.”

(Institution of Civil Engineers, 2001: 16)

Floodplains are created naturally by the river system as a result of the occasional need to contain unusually large volumes of water. Flood-plains are, therefore, an integral part of a river system, even when the presence of defences prevent flooding (ODPM, 2001 para. 23) and by seeking to control or limit flooding within a flood-plain, we are interfering with a natural process. Thus, section 23 [PPG 25] defines flood-plains as:

“flat low-lying areas’ adjacent to the river. This is questionable. For hydrologists, these flat, low-lying areas are an integral part of a river, not just an adjunct that occasionally floods. The difference is subtle, but leads to a very different perspective of development on flood-plains.”

(Reeves, 2001: 112)

Thus, the Institution of Civil Engineers (2001: 26) suggests that flood storage should be a recognised land use, allocated within the development plans. Similarly, the CIWEM (2004) recommend the creation of ‘blue belt’ land within flood-plains, where development is severely restricted or banned altogether for the good of the public and the environment. Such a policy would also discourage subsidies to land owners

and tenants for flood-mitigation, which is not sustainable (Institution of Civil Engineers, 2001: 27).

In certain locations, it may be appropriate to encourage, through government incentives, the restoration of undeveloped flood-plain for the storage of water and for the reduction of peak flows downstream.

There are probably three significant factors that are affecting our perception of flood-risk, (each of these is discussed later in detail):

- climate change and the threat of more rainfall together with more severe winds;
- the increased value of the properties (land and buildings) which are the subject of insurance claims, and the linkage between insurance cover and mortgage/investment finance; and
- pressure to build on the flood-plains in order to protect the Green Belt and increase the supply of residential properties, particularly in the South-East of England.

In addition, there are major concerns about both the effectiveness of existing flood and coastal defences and their ability to withstand the increased severity of events resulting from predicted climate change. There are (often unforeseen) consequences for areas up-stream and down-stream of new flood defences, causing significant flood events in locations which had no or little previous experience of them; and there are changes in rural land uses and management, in part, driven by the EU's Common Agricultural Policy, which could result in the neglect, and therefore the potential failure, of existing drainage systems. All of these demonstrate the wide-ranging and complex nature of the issue.

Central government has stated (DEFRA, 2005: 2) that it “... will involve stakeholders at all levels of risk management, and ... will achieve a better balance between the three pillars of sustainable development (economic, social and environmental) in [its] risk management activities.”

An added difficulty is apparent confusion in the meaning of the terms used to identify levels of flood-risk. In the past, flood-risk has tended to be expressed as a ratio, for example, an area might be identified at risk of a ‘1 in 100 year return flood’. This can be misinterpreted to mean that there is a major flood once every 100 years, rather than the correct interpretation of a 1% risk in every year. Thus, the terminology is now being changed to a ‘1% annual flood-risk’, to recognise that the odds are the same each year, although some documents still contain the old terminology. This research has demonstrated (refer to section 7.3.4) the need to change the terminology and improve understanding, because understanding the probability of a flood occurring is crucial to devising a response and to managing the risk.

2.3 Types of flooding

Floodwater can originate from two sources, rainfall (meteorology) and the sea, and from the combined efforts of both rainfall and tidal surges. However, in addition to the presence of water, there must also be appropriate topography (ground conditions).

2.3.1 River flooding

According to the Institution of Civil Engineers (2001: 21) British river flooding can be categorised thus:

- sudden onset in natural catchments – where telemetered (measurement data automatically transmitted from remote sources) information is unlikely to be effective in achieving damage avoidance, but may prevent loss of life. Examples of such events include:
 - catastrophic local rainstorms (typically in excess of 125mm of rain in a few hours at the centre of the incident);
 - breach of a flood levee;
 - dam-break or canal-bank-break flood;
 - ‘sunny day’ flood, due to geotechnic or structural failure;
 - storm overtopping; and
 - ice-jam flood.
- seasonal saturation flooding in natural catchments – where catchment telemetry can be expected to lead to damage avoidance. Examples of this type of event include:
 - regional flooding;
 - groundwater flooding;
 - snowmelt, often triggered by rain;
 - rain on snow on frozen ground;
 - river flood, high tide and sea surge into estuary coincide;
 - landslide blocking flow before washing out;
 - ‘bog-burst’; and
 - rising-bed flood, due to aggradation (raising or filling of the level of a river bed) or cessation of dredging.

A review of published literature on process-based fluvial research during 2000 and 2001 by Dollar (2002) covers the long-term effects of climate change and tectonic activity as well as short-term factors in the evolution of rivers that help explain gradual processes. The paper indicates that linking past climate change events to changes in river channels and floodplains by examining geological sedimentary sequences is subject to severe methodological limitations. However, palaeoflood hydrology techniques have been successfully applied, for example in the US, to show that the frequency of recurrence of large floods has been subjected to abrupt changes over time and during periods of rapid change there is a tendency for more frequent occurrences of large and extreme floods. This *“has implications for flood-risk*

and flood management, particularly in an era dominated by the threat of global warming” (ibid.: 125).

However, publications on floodplains have been limited, which is of concern because “floodplains contain significant clues of channel response to climate, tectonic and environmental change” (ibid.: 127). River scientists believe that informed river management requires good science, and that river management is best achieved by managing rivers as ecosystems, involving a multi-disciplinary approach to managing the physical, chemical and biological components of river systems, rather than relying on administrative divisions of responsibility, such as on a local authority basis.

Analysing climate characteristics and predicting flood impacts is even more difficult in complex mountain terrain, as examined by Nachtnebel (1999) based on a case study of a mountain basin in the Austrian Alps. Factors that could contribute to an increase in winter runoff and or flood events include:

- increased temperature, reducing the storage of precipitation as snow cover; and
- greater coincidence of snow melting and rain.

Factors that could decrease runoff events include:

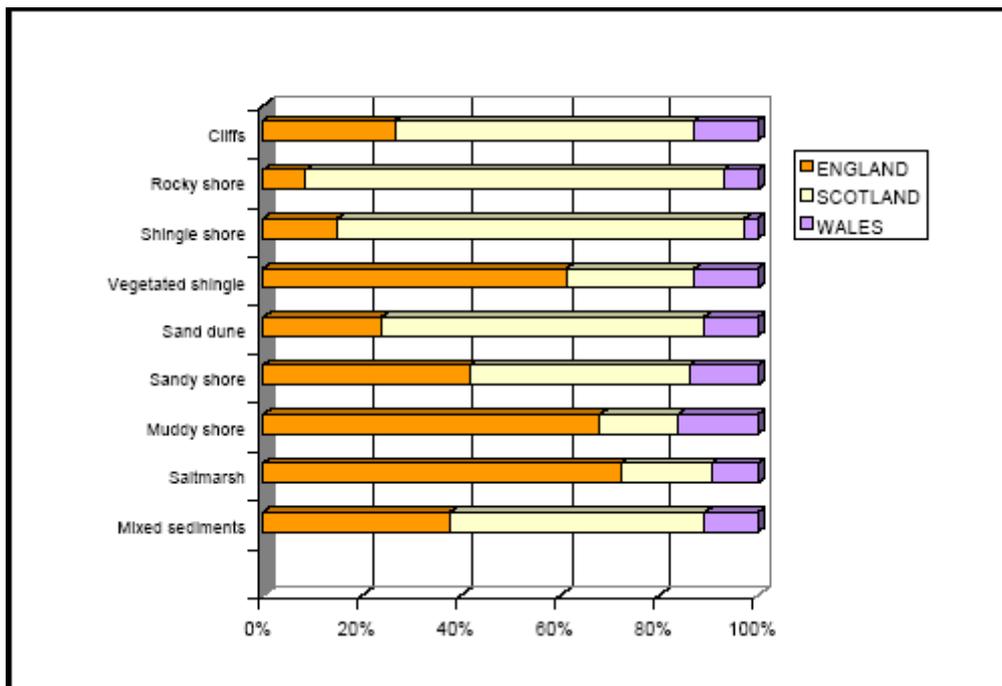
- increased evapo-transpiration in late summer; and
- increased vegetation growth, including a change in the tree line, coupled with greater efficiency of water uptake by plants under higher CO₂ concentrations.

However, the feedback mechanisms within mountain basins are poorly understood and rarely considered in modelling approaches.

2.3.2 Coastal flooding

The UK coast is over 12,500 km or 7,760 miles long in England and Wales. There is a great diversity of coast types (see Figure 1) and “In terms of coastal erosion, the most vulnerable areas in England and Wales are the weak glacial drift cliffs of eastern England and the clay shores of southern and eastern England” (de la Vega-Leinert and Nicholls, 2000).

Figure 1 UK distribution of major coastal types



Source: (de la Vega-Leinert and Nicholls, 2000: 68)

Areas of low-lying coastal land, below 5m Ordnance Datum (OD) are extensive, particularly around the main estuaries, which includes the Thames. Further, extensive land reclamation since the medieval period has increased the natural susceptibility of low lying areas to inundation.

According to the RICS Rural Faculty (RICS, 2001: 22), coastal flooding can be caused by:

- high tides that can cause back-up in gravity out-flow systems;
- wave overtopping, tide overflowing or breaching of a flood defence;
- erosion of a cliff line; or
- breach of sea walls.

South-East England is slowly subsiding and projected trends for Sheerness on the south shore of the Thames Estuary show the area is particularly at risk (refer Sections 6 – 9 for more details). However, although much data has been collected on UK sea-level trends, the data is scattered and no clear consensus exists about historical and recent rates of sea level rise (SLR).

The UK, lying in the path of North Sea and North Atlantic depressions, is also exposed to large storms and the risk of storm surges on its east and west coasts. For example, the 1953 storm, which affected the east coast of England, caused an estimated £2 billion of damage at 1966 prices. With storms and the incidence of high water expected to become more frequent, the need to upgrade coast defences and the associated cost is a cause of increasing concern.

SLR and other impacts of climate change may trigger salinisation of ground water supplies, exacerbated by over-exploitation of coastal groundwater for irrigation and industrial uses. Saline penetration of coastal aquifers is already occurring in a number of areas, including the north-east Kent and Sussex coasts.

Two current methodologies for assessing coastal vulnerability to climate change and sea-level rise are evaluated by Klien and Nicholls (1999):

- the Common Methodology for Assessing the Vulnerability of Coastal Areas to Sea-Level Rise, published by the Intergovernmental Panel on Climate Change (IPCC) in 1992; and,
- the Technical Guidelines for Assessing Climate Change Impacts and Adaptations, published by IPCC in 1994.

A notable difference between the two approaches is the use of scenarios: the Common Methodology prescribes the use of scenarios, while the Technical Guidance allows maximum freedom in selecting and developing scenarios. The Common Methodology is the more widely applied and evaluated of the two.

When assessing impacts of sea-level rise, it is the local change (or rate of change) in relative sea-level which matters, rather than the global or regional average. Relative or observed sea-level is also influenced by vertical movements of the land, which are mostly natural but can be induced by human activity, for example through the abstraction of ground water leading to subsidence.

Vulnerability studies therefore need to assess the extent of local sea level change, before socioeconomic impacts can be assessed. The potential socioeconomic impacts are categorised as:

- *“direct loss of economic, ecological, cultural and subsistence values through loss of land, infrastructure and coastal habitats;*
- *increased flood-risk of people land and infrastructure and the above mentioned values;*
- *other impacts related to changes in water management, salinity and biological activity.”*

(Klien and Nicholls, 1999: 183)

While the Common Methodology has contributed to understanding the consequences of sea-level rise and encouraged long-term thinking about coastal zones, a number of problems have been identified:

- a shortage of accurate and complete data, for example, on coastal topography, the spatial distribution of relative sea level and regional climate scenarios;
- concern that the methodology stresses a protection-orientated response, rather than a full range of adaptation options; and
- market evaluation frameworks have proved inappropriate in many subsistence economies and traditional land-tenure systems.

Vulnerability assessment for sea-level rise also needs to be integrated with present-day coastal management practices, to allow consideration of the direct effects of

human activity on vulnerable coast zones which strongly influence “*how impacts of sea-level rise will become manifest*” (Klien and Nicholls, 1999: 184).

These authors also stress the dynamic interaction between natural and socioeconomic systems that are increasingly viewed as developing in a co-evolutionary way, with feedback occurring from the socioeconomic system to the natural system impacting on sea level rise. However, in the use of scenarios to study potential impacts “*the fact that climate change will trigger socioeconomic developments that in turn affect the manifestation of coast impacts, is as yet often ignored*” (Klien and Nicholls, 1999: 186). Impact and adaptation scenarios therefore need to be linked. The authors conclude that the construction of plausible scenarios is not yet possible although sensitivity analysis based on trends could be helpful in providing insights. Most coast vulnerability assessments will therefore be of a basic nature and cannot be expected to have widespread application for day-to-day coastal management, although improvement is expected “*as further experience is acquired, coastal databases improve and better analytical tools and techniques are developed*” (*ibid.*).

2.3.3 Sewers

It is recognised (Roaf *et al.*, 2005: 169) that existing storm water and sewage infrastructure is failing, partially as a result of climate change and altering rainfall patterns but also as a result of increased urbanisation including a failure to maintain and develop the capacity and efficiency of the original infrastructure and also development over previously porous surfaces.

The Institution of Civil Engineers (2001) estimates there are 8,660 properties at risk of flooding twice in ten years and another 17,960 once in ten years, due to overloaded sewers. It is estimated that some £50,000 per house is required to remedy the problem but that only £1 million has been allocated over five years. At this level of investment, the problem will be solved for only 20 houses (less than 4%) of those at risk. The Institution of Civil Engineers reports “*... considerable cause for concern at the low level of investment to overcome the risk of sewer flooding.*” (2001: 32-3).

Sewers are usually the responsibility of water plcs. However, these bodies are not statutory consultees in the planning process. Also, they have limited control over the water discharged into their sewers because legislation gives people the right to connect to a sewer, even if its capacity is inadequate (Institution of Civil Engineers, 2001).

In addition to the problem of sewers and flood defences being faced with a flow in excess of that for which they were designed, there are a number of recognised human-induced causes of flooding. These include the blockage of culverts, drains and gully entries by the dumping of rubbish, and the failure to clear natural debris and sediment. Also the urban streams and brooks and associated culverts which are often the responsibility of the local authorities, and tend to be poorly maintained, with many local authorities outsourcing their maintenance, and it seems that there are difficulties in specifying maintenance standards in such cases.

2.3.4 Runoff

Runoff is a system, which contributes both to sewer flooding and also fluvial flooding. According to Lowe (2001), there is a significant proportion of non-coastal flooding which is not directly linked to rivers, and there is a need to incorporate appropriate

solutions to controlling the runoff from large impermeable areas of land, which tend to result from increased development.

According to the Institution of Civil Engineers (2001) heavy rainfall which generates runoff can result in the following localised problems:

- failure of a drainage pump or jammed sluice gate;
- high water level in the receiving river that flows back up the drain or sewer;
- sewer manhole broken open to create a drainage route or cover lifting off due to over-filling;
- balancing storage, fills and spills into a channel no longer able to accept the 'natural' flood event; and
- rising groundwater levels under cities.

There is also the recognition that additional urban developments are decreasing the area of permeable surfaces and thereby increasing the volume of surface runoff (the so-called 'Tesco' effect), and thus there is the danger that future development will increase the area of impermeable surfaces and so increase the risk of flooding, where previously such a risk did not exist (ABI, 2004a). Baines (2001) proposed the re-establishment of 'porous cities' to ensure more absorbent surface areas which will reduce runoff, pointing out that tree canopies, for example, serve to slow the rate at which rain water reaches the surface.

This has given rise to interest in the potential of Sustainable Urban Drainage systems (SUDs) that include:

- diverting runoff to soakaways;
- making hard surfaces (e.g. car parks) permeable;
- creating temporary storage for runoff e.g. in ponds or underground storage tanks; and
- incorporating 'swales' i.e. wide shallow sloping drainage ways, with the ability to store, convey and infiltrate (Institution of Civil Engineers, 2001: 35-6).

Such solutions do, however, have limited application. They may not, for example, be appropriate in areas of soil with low permeability; or in winter where ground is frozen (*ibid.*) Nor are they applicable in flood-plains (Roaf *et al.*, 2005: 169), and the channels would need to be kept free of blockage by silt or debris. It seems however that there is some reluctance on the part of local authorities or water plcs to accept the responsibility for the maintenance of SUDs, because of the uncertainty surrounding their long-term performance (Institution of Civil Engineers, 2001: 36).

2.4 Drivers of flood-risk

The Foresight Future Flooding report (OST, 2004a; 2004b; 2004c) groups the drivers of fluvial and coastal flooding into climate change, catchment runoff, fluvial processes, coastal processes, human behaviour and socio-economics and concludes (*ibid.*: 225-7) that potentially the most important drivers are the most uncertain. In addition, stakeholder behaviour and public perception are identified as

being key influences in any future flood management programme; some of these issues are discussed in more detail below.

2.4.1 Flood-risk and climate change

There is a large array of literature discussing the various evidence and causes of climate change; some use models predicting various potential scenarios (refer for example, the so-called UKCIP02 Report (Hulme *et al.*, 2002)), which provides the basic scenarios for much of the predictions from other sources); some outline the causes and results of climate change (e.g. European Environment Agency, 2004; Smith, undated). However, there is major disagreement on the reliability of predictions for the future and, without a degree of certainty, there is unlikely to be any clear and detailed policy for solutions. Nevertheless, there is a general acceptance that climate change will affect the level of flooding and should be taken into account when dealing with flood-risk (see, for example, ABI, 2004a).

2.4.2 Uncertainty surrounding climate change

“... there is no consensus on the vital question on how much the Earth will warm up this century. Nor do we know what effect temperature increases may have on the climate of the globe, nor the extent to which the sea levels may rise.”

(Guidberg, 2001: 45)

Indeed, some authors dispute the fact that climate change is occurring at all (for example, CEI, 2006; see also Barnett, 2004). Thus, the International Policy Press (2004) believes that claims are exaggerated in order to support political agendas. Such opinions challenge the research based on the fact that the models used do not accurately represent past climate nor reflect appropriate assumptions about the future. Thus, doubt is expressed as to whether the climate is in fact changing and to what extent human activity has been responsible for accelerating or aggravating climate change. Indeed, there is published research from the USA on flooding (e.g. Bartosova *et al.*, 1997; Frigden & Schultz, 1999; Tobin & Montz, 1997) which makes no mention of climate change as being a contributing factor to the event.

However, there is clear understanding among many scientists that:

“Through its possible effects on climate variability, global warming has the potential to cause changes in the frequency of extreme events especially storms and associated waves and surges.”

(Bray *et al.*, 1997: 18)

This uncertainty as to cause should not undermine clear evidence that our climate is changing and we should be investigating both the nature of that change and adaptation strategies necessary to protect society – both people and the built environment.

2.4.3 Scenario Planning and Modelling

“Scenarios are plausible descriptions of how things may change in the future, built to reflect what is possible, not what is preferred ... They are meant to be politically and morally neutral constructs.”

(Roaf *et al.*, 2005: 66)

Scenarios, based on previous experience and current activity, are used extensively in the UKCIP98 and UKCIP02 reports (amongst others) as a device for modelling future climates.

“Scenario planning involves looking at a range of alternative futures, using projections of current trends, and applying different boundary conditions and strategies to case studies. ... Contrasting scenarios can then be ‘scripted’ and tested ...”

(Roaf *et al.*, 2005: 65-66)

Models are used to measure the costs and benefits in the future of continuing with or altering our current way of life and activities. Much of the information available, particularly regarding climate change, is based on the outcome of models, which are constructed (in part) using historic data. This is because:

“significant uncertainties remain in estimating the amount of future warming ... Results are, therefore, expressed in terms of likely scenarios of change based on different assumptions.”

(Bray *et al.*, 1997: 16)

The predictions based on the constructed models and resulting scenarios are clearly only as reliable as the underlying form of the model and the quality and quantity of the data input. It is also important to differentiate between reliance on historic (factual) data, which is used to establish a projection, and estimates of how current trends will be affected by existing or future events. There are critics of both approaches. It is recognised (e.g. Bray *et al.*, 1997: 16) that the availability of data (both in terms of geographic range and time-scale) is limited. In addition, it remains unclear whether extrapolating from existing (i.e. historic) data will provide dependable predictions for the future, or even whether current models are reliable, regardless of the quality of data.

Despite the certainties surrounding the form of the models and, therefore, the predictions based on them, there is a recognised need (Institution of Civil Engineers, 2001: 73) to make greater use of computer modelling techniques to simulate both the variables related to flooding and the effectiveness of flood defences.

2.4.4 Evidence of climate change

Evidence of climate change is based on an impressive number of reports which rely on scientific observation and predictions which rely in their turn on modelling and a range of scenarios; for example, the Impacts of Europe’s changing climate (European Environment Agency, 2004) and the UKCIP02 Report (Hulme *et al.*, 2002) and specifically their impacts on flooding; for example, the Foresight Report (OST., 2004a; 2004b; 2004c).

In relation to the effects of climate change, risk comprises vulnerability (which includes the opportunities and capability of adapting to change); exposure, based on geographical location and the patterns of climate change; and hazard, typically described in terms of the size of the risk and the frequency with which it is experienced. Risk can be defined (Roaf *et al.*, 2005: 65) as the potential for damage to occur and impact thus:

$$\text{(possible) hazard} \times \text{vulnerability} \times \text{exposure} = \text{(possible) impact}$$

2.4.5 Implications for flooding

The Foresight report into future flooding (OST, 2004a; 2004b; 2004c), concluded that climate change will result in a substantial increase in flooding. The Institution of Civil Engineers (2001: 55; refer also, Roaf *et al.*, 2005) identifies that climate change will impact on the following aspects which in turn relate to the risk of flooding:

- changes in rainstorm intensity for a given frequency;
- changes in the prior wetness of a catchment area at any particular storm season;
- a different partition between rain and prior snow;
- higher snowmelt rates;
- lower expectation of frozen ground (or ice-jam flooding) and a shorter season for such surface impermeability; and
- higher mean sea-level against which to discharge, with changes in tidal surge magnitude for a chosen frequency.

There are also important issues about which more knowledge of their likely variability which can be anticipated under climate change is necessary:

- rain duration;
- multiple storm sequencing in a single season; and
- frequency and location of stationary heavy rainstorm systems.

“... a general rise in global temperature will lead to modest rises in the rain-producing mechanisms that give either small or large downpours but with little change to medium-size ones.”

(Institution of Civil Engineers, 2001: 56)

A study of the October / November 2000 floods in the UK undertaken by the Centre for Ecology and Hydrology and the Met Office for DEFRA (Department for Environment, Food & Rural Affairs) (DEFRA, 2001) addressed two main questions:

- how unusual were these floods in a historical context? and
- can these floods be linked to climate change?

The report concludes that the rainfall and flood events were extreme, but could not in themselves be attributed to climate change. However, the frequency and magnitude

of such events has increased over the last 50 years. The pattern of change is also consistent with predictions of how human-induced climate change would affect rainfall, but it is not possible to say the extent to which the October / November 2000 events could be attributed to climate change as opposed to natural variability.

The researchers make a number of recommendations about improving the UK capability to predict flood events and the impact of climate change. In particular, they recommend strengthening the climate modelling capability as soon as possible, including:

- the development of global models with greater resolution (around 100km rather than 3-400km), coupled with improving the representation of critical processes, such as clouds and rainfall;
- the development of regional models at even greater resolution (10-25km), which would take account of the effect of rainfall on features such as hills and the coast;
- research to better estimate sea-level rise on a regional basis, since high estuary levels played a part in the events of 2000;
- research to quantify the extent of uncertainty in predictions in a statistically rigorous way; and
- greater research into quantifying and understanding natural climate variability.

Estimates are that the cost of damage from tidal flooding could increase by 477% from £209 million in 2001 to £1,001 million in 2075. Estimated damage from fluvial flooding is expected to increase by 131% from £447 million in 2001 to £588 million in 2075 (based on a 10% flood flow increase) (Halcrow, 2001).

2.4.6 Flood defences

Climate change is also predicted to have an impact on our flood defences in terms of the level of protection they offer. It has been estimated (Halcrow, 2001) that flood defences which are currently able to offer protection to a '1 in 50 year' flood event may only be able to protect to a '1 in 25 year' flood event by 2075.

It has also been suggested that investment on defences may need to be increased by £30 - £60 million a year to ensure current standards of protection are provided in the future. Inevitably, therefore, improved standards of protection which reflect the effects of predicted climate change will cost even more.

2.5 Changes in relative sea level (RSL)

The UK coastline is being affected by changes in relative sea level (RSL), as well as by the natural action of the sea on the land. Changes in RSL may result from global warming, they may result from the natural changes in ocean volume (eustatic component) or a combination of both (Bray *et al.*, 1997: 15).

“Short-term sea-level variations related to tidal cycles and meteorological effects combine to produce storm surges and extremely high sea levels. Knowledge of the frequency of occurrence of such conditions forms the basis for estimating the risk of flooding or failure of particular defences and the standards of protection that are afforded.”

(Bray *et al.*, 1997: 17-18)

Currently, sea levels can be modelled reliably and in general terms but only on a global scale (Bray *et al.*, 1997) and a policy response to potential damage from rising sea levels is mainly a problem for regional coastal zone management. An optimal protection strategy will be decided at a local level and be different for different coastlines (Fankhauser, 1995). Thus,

- poorer nations will have lower protection at least in part because of lower land values;
- countries with a lower density of population will also have lower protection;
- densely-populated countries will have higher protection, even for a relatively low sea-level rise; and
- countries with a heavy reliance on seaside tourism will also have increased protection. (*ibid.*: 311-2)

This assessment based on global data, would probably hold true within a regional UK setting.

Currently, however, there is doubt (Bray *et al.*, 1997) whether global warming is affecting sea-levels or whether any changes are only a minor influence because of the lack of significant evidence of discernable uniform worldwide changes in sea - level (eustatic) rises.

In any case, the impact of any predicted sea level changes will vary depending on local conditions, such as meteorological conditions, coastal type and the nature of the wave and tidal regimes. Thus,

“Both the design of specific protection schemes and the formulation of policies to manage coastal cells ... require accurate allowances for sea-level rise that relate to local conditions.”

(Bray *et al.* 1997: 15)

and, where available, the near-continuous measurements produced by tide gauges are the most appropriate data sources (*ibid.*).

Nevertheless, there is clear evidence, in the UK and specifically for this study, that changes in RSL are having a significant effect in the South-East of England.

2.6 Changing agricultural land use practices

The European Environment Agency (2004) recognises that, amongst other things, annual river discharge has been adversely affected by land-use change. The role of agricultural land in the recent history of flooding is examined by Boardman (2001), who asserts that the influence of changes in farming practices on flood problems in rural areas has been ‘glossed over’, as the government, Environment Agency and media have placed greater emphasis on climate change and the “foolishness” of allowing development on floodplains.

For example, in the late 1970s the introduction of winter cereals led to an increase the incidence of flooding from runoff in the vulnerable months of October and November, when fields are bare and annual rainfall peaks. This caused particular

problems in the English South Downs area between 1976 and 1993, and during October / November 2000.

Other agricultural land uses implicated in flooding in the last ten years include:

- the spread of maize as a crop in southern England;
- the increase in outdoor pig farming in East Anglia; and,
- steeply-sloping linseed fields in Devon.

In addition to any flood damage caused, runoff from farmland carries with it pollutants, including soil, nitrates, phosphates, pesticides and herbicides.

The best protection against flooding in rural areas is grassed or wooded landscapes. A reversion to grass has been brought about in some areas through agricultural 'set-aside' and payments for environmental sensitive areas (ESAs). The then Ministry of Agriculture, Fisheries and Food (MAFF) also issued guidance on controlling erosion and protecting neighbouring land. However, these measures are all voluntary and if flooding occurs, the only redress for individuals and their insurers is through potentially difficult and expensive legal action.

To help resolve flooding problems in rural areas, Boardman (2001) recommends:

- targeting ESA payments to sites at risk;
- better communication and co-ordination between local authorities, so they can learn from each others' experience; and
- action by the Environment Agency to relate control of pollution and water quality issues to land-use measures.

2.7 Summary

This section has reviewed the main sources of flooding, from rivers, the sea and sewers, and shown how flood-risk is defined in terms of its impact on human settlement and infrastructure. Historically people have settled in areas that facilitate transport links, including river-crossing points, along valleys and close to inland and coastal waterways. Much flood-risk to the built environment therefore arises from historic land use patterns.

Locating development on attractive river frontages and in coastal locations can still offer commercial advantages, for tourism and regeneration, but the risk of flooding needs to be recognised and ideally development should be discouraged or banned in areas of natural flood-plain, where flood defences or mitigation measures are not sustainable. Flood-plains should therefore be treated as part of river systems, rather than as land with potential for development. This is not always easy to enforce and dramatic increases in population in some parts of the world are resulting in settlement pressure in flood-prone areas, placing more people and property at risk.

In the UK, much of the existing flood protection devices (including storm water sewers) are inadequate and many suffer from inadequate maintenance. Given the increased level and frequency of flooding risk from climate change, there is a serious risk to much of the land, buildings and public health in vulnerable parts of Britain.

In the UK, perceptions that flood-risk is increasing have come about due to three main factors:

- the impact of climate change, increasing the level and frequency of flooding;
- the increased value of land and buildings that are subject to insurance claims; and,
- the pressure to build on flood-plains, to protect 'Green Belt' and to increase the supply of housing, particularly in South-East England, including the Thames Estuary.

Although there is a general acceptance that climate change will affect the level of flooding, there is still major disagreement about the reliability of predictions for the future. There is particular scepticism about the reliability of predictions for sea level rise due to global warming, owing to a lack of clear and discernable evidence for uniform worldwide changes in sea levels.

Scenario planning is a useful tool for examining a range of alternative futures. However, data limitations relating to all the variables connected with flooding, and an apparent reluctance to make greater use of available computer models, act as barriers to developing techniques for simulating the potential effects of flooding and the effectiveness of flood defences. The resulting uncertainties make it harder to develop clear and detailed policy solutions toward new development and flood defences.

3. FLOOD DAMAGE AND PROPERTY

3.1 Introduction

“Traditionally, the risks of a property flooding, and the damage caused, have been offset by the material and aesthetic benefits of a waterside location.”

(Wordsworth and Bithell, 2004: 105)

This section considers the evidence from recent literature and related research into the way in which floodwater damages residential property, the cost of cleaning up flood damage and the extent to which people and businesses are able to resume normal life after a flood. The consequences of flood-risk for future insurance cover and for property values in terms of sale prices, rents and investment values are then the subject of more detailed examination in the following sections.

3.2 Flood damage

Floods can cause damage in a number of ways, including:

- damage to physical property in the building, including carpets, furniture, kitchen ‘white goods’ and fittings;
- damage to the physical fabric of the building, some of which may be temporary (such as smell, staining) and some of which may be permanent (for example, structural);
- contamination of sites, where toxic pollutants are able to leach through soil either into water courses, other sites or to the surface (refer, for example, Roaf *et al.*, 2005: 167);
- emotional trauma to residents; and
- depreciation of the value of buildings, either through the reaction of the market and/or through the withdrawal or imposition of conditional forms of insurance (refer to section 6). It should be remembered that, in particular for residential owners, any such depreciation makes a significant reduction in (what for most people is) their single largest investment, as well as damaging their home – with all the emotive connotations associated with such property.

3.2.1 Flood damage to buildings

“Each flood is unique in terms of depth, velocity flow, contaminant content, time duration etc. Subsequently, damage caused to a property is unique to each particular flood.”

(Nicholas *et al.*, 2001: 2)

Flood damage (the measure of the effect of a flood event on a building and its occupiers) comprises three elements:

- damage to the fabric and services of the building;
- damage to the contents and fittings;
- disruption and loss of income during the flood and the reinstatement.

(Wordsworth and Bithell, 2004: 106)

The damage caused by floodwater to buildings is a function of:

- flood characteristics, that is:
 - depth of floodwater;
 - velocity of floodwater in contact with the dwelling;
 - contamination content (including sewage and fasciae);
 - duration of the flood; and,
 - flood source (such as river, stream, dam, sewer, coast).
- building characteristics, including:
 - frequency of flooding;
 - materials the building is constructed from;
 - drying characteristics of the building materials; and,
 - building condition prior to flooding.

Flood depth has been subject to much research and is often considered a key factor influencing the scale of damage (DTLR, 2002), usually because of the increased hydraulic pressure on the building accompanied by abrasion or scouring.

Damage increases significantly once floodwater rises above floor level and depths of over 1m may damage the building structure, unless the water pressure is allowed to equalise over the entire property (ABI, 2004c: 17). Repair costs therefore increase with flood depth (Nicholas *et al.*, 2001: 3; Wordsworth and Bithell, 2004: 106). A half-metre of floodwater in a modern semi-detached house will on average result in a repair cost of around £15,000 and around £9,000 to replace the contents (DTLR, 2002). Floodwater velocity also increases with depth, and the greater the velocity of the water, the greater the probability of structural damage to buildings.

It is recognised (ABI, 2004c: 17) that it is difficult to keep water out of a property for more than a few hours. Historically, properties that were prone to flooding were made with materials which reflected this risk, such as stone slab ground floors, and occupiers adapted their use of the lower floors of the buildings to minimise damage (*ibid.*). Recently, however, more properties are becoming flood-prone, many of them constructed with modern porous material, and with services located on the ground floor level, including underfloor heating systems. Thus, the vulnerability of a property

to damage will be affected by the materials used in the construction and the extent to which the occupiers are prepared for the event.

Floodwater contaminants contribute to building damage because they can:

- affect the water absorption characteristics of building materials;
- affect the drying out time of materials;
- transport micro-organisms that threaten health and are difficult to remove, possibly requiring sterilisation techniques; and,
- increase repair costs through the work involved in physical removal of deposits (Nicholas *et al.*, 2001: 2).

Seawater flooding can corrode metals, for example, ducting, electrical switchgear and steel reinforcement in concrete. However, existing literature indicates that “*at present flood damage assessment generally ignores factors relating to contaminant content*” (DTLR, 2002: 96).

Generally, the longer the flood lasts the more damage it will cause, mainly because many UK properties are constructed of solid porous materials, such as brick, blocks and concrete. Therefore, the longer the floodwater remains, the greater the absorption into the building structure and the longer the building will take to dry out and repair. If floodwater has been contaminated by effluent, scrupulous cleaning will be required prior to any repair work and/or resumed occupation. Similarly, any hazardous waste which may have been stored within the property will be added to the contaminants in the floodwater. Thus, Nicholas *et al.* (2001: 3) hypothesise that:

“the level [and cost] of ‘cleaning’ is a function of the contaminant content (nature/concentration) of the floodwater.”

Buildings must be allowed to dry out thoroughly before any repair work is undertaken, in order to avoid any mould growth, timber rot and therefore subsequent work, and the use of dehumidifiers and heating systems can speed up the process (*ibid.*: 4-5).

“Frequently flooded properties tend to undergo less damage than those that are flooded infrequently ... This is because occupiers of ‘frequently’ flooded buildings tend to be more prepared for such emergencies.”

(*ibid.*: 6)

It is worth noting that there are specialist flood damage limitation products available and when reinstating a building, works to limit the damage from a future flood event should be incorporated. However, Wordsworth and Bithell (2004: 106) report that insurance loss adjusters were not prepared to pay for such measures, nor were such measures successful in reducing either the premiums or excess for properties in which they had been incorporated.

Research into the extent to which building surveyors consider flood characteristics when assessing flood damage to domestic properties, based on 289 survey responses from building surveyors and loss adjusters, indicated a general ignorance of factors important in assessing flood damage and specifying ‘optimal’ repair methods (Soetanto and Proverbs, 2004). It would appear that flood damage is “*considered by many to be a simple problem to resolve, whereas in reality it is a complex phenomenon*” (*ibid.*: 95). Understanding how to assess and repair flood damaged domestic property is highly important to helping homeowners, insurance

companies and repair specialists to mitigate damage and return property to its pre-flood condition.

The survey (Soetanto and Proverbs, 2004) investigated the surveyors' perception of how a flood's characteristics dictated the level of damage to buildings and the relevance of information about flood characteristics to damage assessment. Respondent surveyors considered sewage and faecal content of floodwater to be the most important characteristic, followed by contamination content, depth, duration and source of floodwater. More experienced surveyors placed greater emphasis on these factors than those with less experience of inspecting flood-damaged property. Flood velocity was regarded as least important, regardless of the surveyors' experience. This is possibly because surveyors are not present when the flood occurs and there are few physical signs after it has subsided to indicate the velocity. Also, the flow velocity of most UK floods is relatively low and not usually very destructive to property (Boscastle in 2004 was unusual in this respect).

In determining the flood characteristics, most surveyors relied heavily on physical site inspections and local information or witnesses. Local information and witnesses were particularly important for gathering information about contaminant content, sewage, faecal content, duration and source of floodwater, which "... suggests that current assessment of flood-damaged properties contains subjectivity and may therefore be prone to variation" (Soetanto and Proverbs, 2004: 103). Physical inspection was important for determining flood depth.

About a quarter to one third of surveyors also sought information from public health departments, local authorities, water authorities and the Environment Agency. Independent consultants were also employed to assess contamination, sewage and faecal content of floodwater.

The researchers found little consistency in the processes adopted by surveyors when assessing flood damage, which could therefore result in varied repair recommendations for similar flood-damaged property. This suggests a need to develop benchmarks for the assessment of flood damage (Soetanto and Proverbs, 2004: 103) to improve performance in damage assessment and consistency in repair strategies for flood damaged domestic property.

Similarly, there is little consensus of opinion regarding damage assessment procedures of 'optimal' repair methods following the exposure of property to flood water (Nicholas *et al.*, 2001: 1).

3.2.2 Impact on health and attitudes

"The human health impact of future flooding will be strongly determined by the improvement in warning and rescue measures."

(European Environment Agency, 2004: 76)

In addition to the damage to buildings, there is both a direct and an indirect effect on human health, both physical and emotional. Deaths tend to result from flash flooding which occurs without warning, rather than from events, such as river floods and storm surges, for which advance warning can be given (European Environment Agency, 2004: 75-6) Injuries can also occur when residents return to clear up after a flooding event. Similarly, lack of medical help resulting from flood damage to infrastructure; poisoning from ruptured pipes, storage tanks, contamination of soils and increases in related diseases can increase the adverse effects of a major flooding event (*ibid.*).

“ ... many psychological health problems arise from geographical displacement, damage to the home, or loss of familiar possessions, and often from lack of insurance.”

(*ibid.*, see also Tunstall *et al.*, 2004)

Research commissioned by the UK Environment Agency, Thames Region, following the Easter 1998 flooding in Banbury and Kidlington (Flood Hazard Research Centre, 1999), investigated the extent and nature of health impacts and changes in the ambient health of communities following the flood. The flood return period in this area exceeded 1 in 100 years. Focus groups were conducted with flood victims from particularly vulnerable groups of people, including the elderly, single parents, ethnic minorities and those with lower socio-economic status.

The findings are relevant to the current study in relation to the impact on attitudes of residential occupiers in flood-risk areas. Following the flood, people not only reported health problems and increased stress levels, but that they felt less secure in their homes and experienced a loss of confidence in authorities and institutions perceived to be responsible for providing flood defences. This was manifested in:

- fear that authorities would fail to protect or warn against future flood events;
- disbelief that the flood was due to ‘natural forces’; and,
- anxiety about recurring flooding, when rain storms are forecast, leading to regular monitoring of river levels.

3.3 Cost of flood damage

As stated previously, flood damage results from the impact of a flood on human settlement. Where insurance cover is available, the level of claims made is one way of estimating the amount of damage caused.

It is reported (International Policy Press, 2004: vii) that, according to recent studies in the USA, increasing losses from floods and hurricanes are a result of social changes in wealth, population and other demographic factors, rather than evidence of the increase in such events and thus climate change.

Thus, where floods (or other natural disasters) affects unpopulated or sparsely populated poorer regions of the world, the amount of damage caused may be said to be insignificant in monetary terms, although in terms of human suffering, it could be considerable.

The Association of British Insurers (ABI) report produced following the UK floods during 2000 (ABI, 2001a) confirmed the ABI’s earlier predictions (ABI, 2001b) that a significant inland flood could result in insurance costs of £1-2 billion. However, the true costs to society are considerably higher than the insured losses because of:

- Lack of insurance amongst households and businesses – 25% of households do not have contents insurance;
- Under insurance – an informal survey in Lewis, Sussex indicated around 15% of residents were underinsured by £5,000 to £20,000;
- Emergency measures - where the costs fall on the government – in 2000 DTLR paid out about £3.8 million to local authorities; and

- Hidden costs - such as health care and days off work due to sickness and to deal with the aftermath of floods.

3.4 Recovery

Insurers provide an invaluable element in the recovery process following a flooding event (Clark, 1998: 341). In part, this is affected by the financial pay out following an insurance claim which is able to hasten the remediation work and increase the speed with which social and economic normality is resumed.

3.5 Summary

The literature review into the physical impact of floods on the fabric of buildings and their occupants has shown that research in this area has been concentrated on residential property. Nothing was found specifically relating to commercial sites and buildings.

The vulnerability of buildings to flood damage is largely a function of flood severity, construction characteristics and the extent to which occupiers are prepared for such an event.

Historically, buildings in flood-prone areas were constructed from materials that reflected this risk, for example using stone slab ground floors. It is still the case that frequently flooded properties tend to be subject to less damage, because occupiers are better prepared to deal with the event. However, modern UK homes tend to be constructed from more porous materials, including bricks, blocks and concrete, with essential services, such as heating installations, located on the ground floor, which makes them more prone to damage. In 2002 the average repair cost for a modern semi-detached house flooded to a half-meter depth was assessed at £15,000, with £9,000 to replace contents. However, many homes are under-insured and about 25% of households do not carry contents insurance.

Flood damage increases significantly with water depth, particularly once floodwater rises above ground floor level. Depths of over 1m can damage the structure, due to increased velocity and hydraulic pressure on the building. Contamination of floodwater also contributes significantly to damage, affecting absorption and drying out characteristics of building materials, as well as posing health hazards and additional costs for removal of debris and cleaning. The corrosive nature of seawater can increase flood repair costs by around 10%.

It would appear that there is a lack of knowledge amongst building surveyors and loss adjusters who deal with flood damage claims about the factors important to assessing flood damage and specifying optimal repair methods. Surveyors are generally not present when the flood occurs and must rely on second-hand information from local witnesses about flood velocity and contamination content, which are not evident once floodwaters have subsided. An apparent lack of consistency in the process for assessing flood damage could also result in varied repair methods being recommended for similarly affected properties. Further, whereas it might appear sensible when reinstating buildings to incorporate works to limit future flood damage, insurers will not generally pay for these works, nor offer either reduced premiums or excesses.

Floods also have significant physical and emotional effects on human health, both during the flood event and once residents return to clear up the aftermath. This can lead people to feel less secure in their homes and lose confidence in authorities and institutions perceived to be responsible for flood defences.

4. FLOOD DEFENCES AND MITIGATION MEASURES

4.1 Introduction

“Of all the aspects of the built environment, settlement pattern is probably the most enduring ... Thus the most urgent problems posed by climate change relate to riverine flooding and coastal inundation, where the impact is catastrophic for those affected, and where risk is determined by the relationship between settlement pattern and geography ...”

(Lowe, 2001: 54)

This section considers the strategies already used to protect property against flooding, both in the UK and in other parts of the world, particularly the USA and the Netherlands. The planning and engineering approaches by the UK Environment Agency and local authorities to river and sea defences are discussed, nationally and on a local basis. Physical measures that can be implemented by individual owners and developers, to protect existing buildings and new schemes, are also examined. The following section then discusses the crucial inter-relationship between flood defence measures and the availability of insurance.

4.2 National flood defence policy

A large number of organisations are involved in the provision of flood defences, resulting from the division of responsibilities between national policy strategy and regional and local delivery, as well as the fact that coastal protection and flood defence are separate (RICS, 2001: 13). Thus, national policy on development and flood-risk for England is set by the Department for Communities and Local Government (DCLG) (formerly the Office of the Deputy Prime Minister (ODPM)) together with DEFRA being responsible for flood and coastal defence policy in England.

There is also a perception that *“the Environment Agency remains constrained by project appraisal techniques routed through MAFF from the Treasury which excessively emphasise economic efficiency rather than wise decision-making.”* (Penning-Rowsell, 2001: 110). This focus on costs is echoed in the level of protection given to different property types in different locations by Crichton (2000: 26).

4.2.1 Responsible bodies

The Environment Agency, regional and local flood defence committees, the water plcs, internal drainage boards, local authorities, maritime local authorities, community groups and some private owners (such as Network Rail) all have a level of responsibility for the management and prevention of flooding (refer, for example, RICS, 2001: 13). However, it should be noted that the powers available to such operating authorities in relation to flood defence works are permissive, not mandatory.

In England and Wales, it is the district councils and the Environment Agency which have the main operational responsibility for coastal protection and sea defence (Bray *et al.*, 1997: 13; RICS, 2001: 13) and these authorities, together with county councils (and other bodies with statutory interests) have formed regional coastal groups to ensure consultation and strategic analysis.

The Environment Agency has a general supervisory duty over all issues involving flood defence. It has both strategic and operational responsibilities, carrying out a programme of flood defence maintenance and operational work on sea defences and 'main rivers', as well as providing plans to deliver the government's objectives for flood and coastal defence (RICS, 2001; ODPM, 2001). It also has the lead role in the dissemination of flood warnings, and flood-risk mapping (RICS, 2001). It has, however, only a discretionary power to undertake flood-defence work – there is no statutory responsibility in the UK for defence against flooding (Institute of Civil Engineers, 2001: 68).

With regard to flood warnings the Environment Agency introduced a new coding system to try to simplify the warnings after the Autumn 2000 floods. The current four tier-system is as follows:

(a) Flood watch



Flooding of low-lying land and roads is expected. Be aware, be prepared, watch out! This recommends that members of the public in affected areas should:

- Watch water levels;
- Stay tuned to local radio or TV;
- Ring Floodline on 0845 988 1188;
- Make sure you have what you need to put your flood plan into action;
- Alert your neighbours, particularly the elderly;
- Check pets and livestock; and
- Reconsider travel plans.

(b) Flood warning



Flooding of homes and businesses is expected. Act now! Advice to the public is as with Flood Watch (above), but in addition:

- Move pets, vehicles, food, valuables and other items to safety;
- Put sandbags or floodboards in place;
- Prepare to turn off gas and electricity;
- Be prepared to evacuate your home; and
- Protect yourself, your family and others that need your help.

(c) Severe flood warning



Severe flooding is expected. There is extreme danger to life and property. Act now!

Advice to the public in affected areas is, as with Flood Warning, plus

- Be prepared to lose power supplies - gas, electricity, water, telephone;
- Try to keep calm, and to reassure others, especially children;
- Co-operate with emergency services and local authorities; and
- You may be evacuated.

(d) All clear



Flood Watches or Warnings are no longer in force for this area.

- Flood water levels receding;
- Check all is safe to return; and
- Seek advice.

The Environment Agency is a consultee within the planning process and can advise against planning consent within a flood-plain or where development is likely to increase the flood-risk elsewhere (Environment Agency & LGA, 2004). There is, however, no Environment Agency veto over development in flood-plains (Penning-Rowell, 2001: 109) and some 12% of the developments to which the Agency has objected go ahead (ODPM, 2005a; refer also Wordsworth and Bithell, 2004: 108).

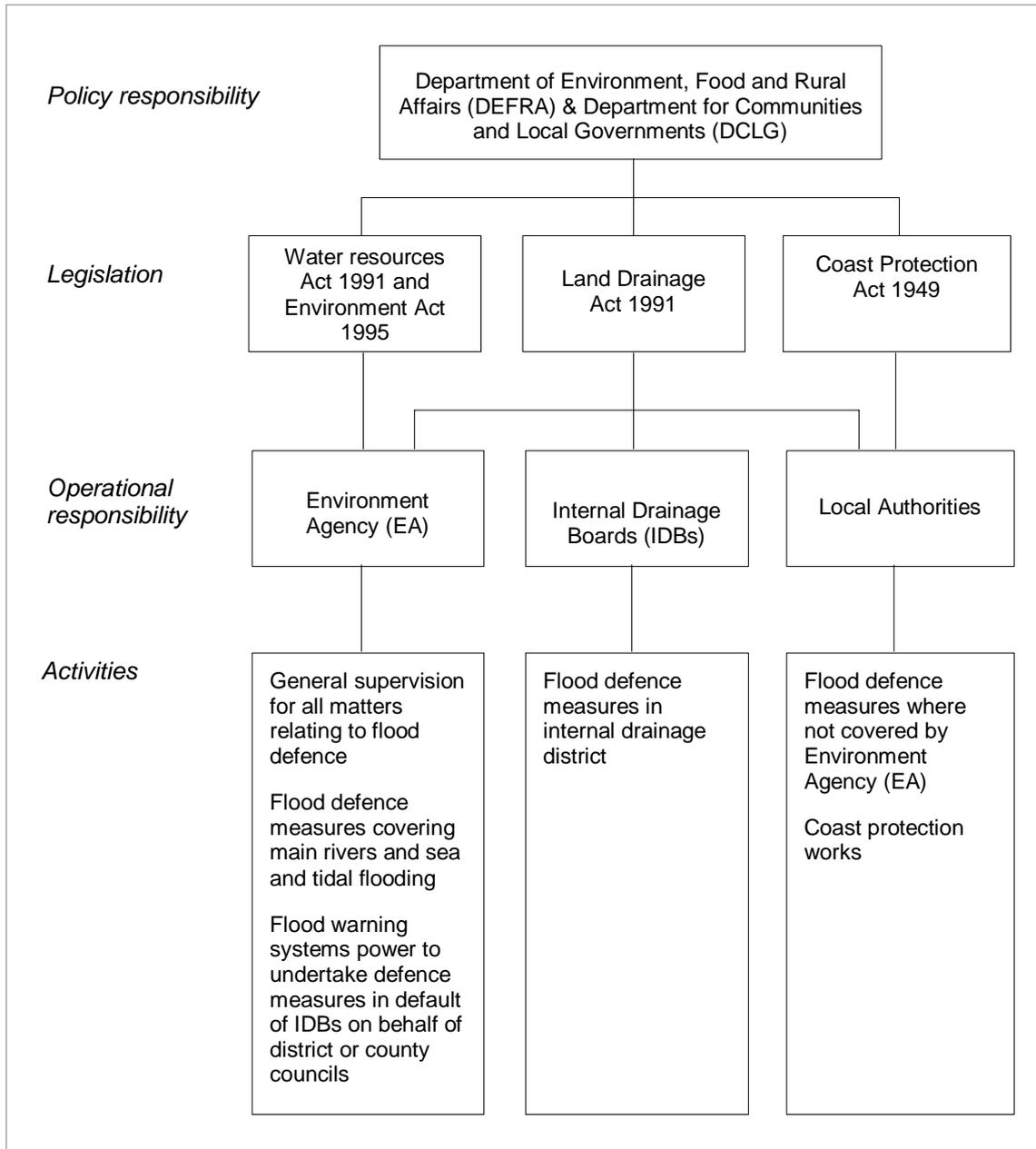
There is a view (e.g. CCN, 2000: 4) that the Environment Agency should have powers of discretion over planning refusals and conditions, although the rights of appeal against such decisions and the issue of any compensation for ensuing damage will need to be carefully drafted in amending legislation. There have also been calls from MPs for the government to give a public explanation if it allows development to proceed contrary to the Environment Agency's advice (Planning Resource, 2006). PPG 25 is currently being revised (it will be re-issued as PPS25) and with a proposal of elevating the status of the Environment Agency to a statutory consultee for any development on a flood-plain.

The Institution of Civil Engineers (2001:35) recommends that the division of responsibility be reviewed and a single responsibility identified, in order to achieve economies of scale and to ensure a holistic and integrated approach to flood-risk management in urban areas specifically, opining (*ibid.* 70) that the multiplicity of responsibilities causes confusion and alienation, both of which can adversely affect the implementation of appropriate solutions to flooding issues.

“flood-risk management needs an established chain of responsibility, driven by a single responsible authority with the skill and experience to implement and deliver a sustainable flood-risk management policy developed by government.”

(Institution of Civil Engineers, 2001: 68)

Figure 2 Bodies responsible for flood and coastal defence



Source: (adapted from RICS, 2001: 14)

However, recent government statements (DEFRA, 2005) go no further than *“We will be consulting on extending the Environment Agency’s statutory consultee role in areas that are at flood-risk. We will strongly encourage the inclusion of Flood-risk Assessments at all levels of the planning process ...”* (ibid.: 4) and, in relation to

coastal issues, the commitment is to “ ... *develop a more strategic and integrated approach to managing coastal flooding and erosion risks ...*” (*ibid.*). Commitments to rural concerns are limited to the role of rural land management techniques (*ibid.*) and, for integrated urban drainage management, the government is limited to a review of on-going best practice and the funding of pilot projects. Given the quantity and quality of research available, much of it funded by government itself, and the clear urgency for effective and strategic action, the DEFRA report is non-committal, indecisive and disappointing.

4.2.2 Key legislation

The following UK legislation relates to issues of flood and coastal defence (RICS, 2001: 15):

- The Environment Act 1995 (flooding);
- Land Drainage Acts 1991 & 1994 (flooding);
- Sea defence and Land Drainage byelaws;
- Coast Protection Act 1949 (coastal erosion or sea encroachment);
- The Water Resources Act, Section 105; and
- Town and Country Planning Act, Section 106 (planning obligations relating to flood defences).

The above give operating authorities the power (but not the obligation) to undertake flood and coastal defences.

In addition, the following European legislation impacts of flooding:

- Habitats Directive;
- Human Rights;
- EU Environmental Impact Assessment Directive;
- EU Water Framework Directive; and
- European Strategic Environmental Assessment Directive.

Perhaps of most significance to this research, there is the possibility that interpretation of the European legislation on Human Rights could result in compensation for a landowner if flood defence protection is withdrawn (RICS, 2001: 29). Currently, there is no right to compensation for the failure of any operating authority to provide defences against flood or coastal erosion (*ibid.*), although there is a right to compensation should the Environment Agency (in exercising its powers under s. 165 of the Water Resources Act) cause damage, provided that there would have also been a right of action at common law in respect of that damage (i.e. nuisance or negligence).

4.2.3 Flood-risk and defences

“Floods are a natural occurrence and the risk they pose is wide ranging. However, in societal terms, the main focus is the risk to people and property. It is neither practically nor economically feasible to eliminate all flood-risk. The most suitable approach for dealing with flood water must, therefore, be to manage the risk best.”

(Institution of Civil Engineers, 2001: 15)

Flood-risk is expressed as a 1% probability in any one year (with no return period being specified). This is to avoid the perception that, after a major flooding event, there is unlikely to be another such occurrence during the next 99 years. Instead, it is important to recognise that the odds remain the same each year, regardless of any recent severe occurrences (Institution of Civil Engineers, 2001).

According to the Institution of Civil Engineers' report (2001), up to now, the confidence in protection design has concentrated on the certainty of the flood defences. Typically, the design approach has focused on the 1% annual probability of flooding, with flood alleviation measures appropriate for a predicted magnitude of flood. A degree of risk may therefore be reflected within the design of the protection, but it is often implicit, and will not protect against the effects of floods greater than that for which the protection has been designed.

Flood event conditions are dynamic, both in time and space, and so also is flood-risk assessment. Thus, variations and uncertainties must be anticipated, both during an actual flood event and over the design life of the defences which protect against flood events.

In considering flood hazards it is important to distinguish precision and accuracy. Precision is an indication of the fineness of the measurement of an attribute; and accuracy is governed by the appropriateness of the attribute and its definition (Clark, 1998). Thus, it is possible for engineers to provide relatively accurate predictions of where flooding will take place and, given the scale of the flood, such information as the extent of the flooding, its duration, rate of rise, flood depths, velocities and damage can all be predicted. Unfortunately, these techniques have not been applied sufficiently and there are issues relating to the precision and appropriateness of the data, as well as the fact that such flood events as flash floods can occur anywhere – although certain events are more predictable than others.

The Institution of Civil Engineers' report (2001) uses the source-pathway-receptor model to demonstrate the risk relationships.

Source	Precipitation	no control
Pathway	Rivers	limited control
Receptor	Buildings and infrastructure	greatest control

4.2.4 Funding

Funding for flood defences comes from the following sources (RICS, 2001: 19):

- levies on local authorities;
- drainage charges;
- grant aid;
- contributions from internal drainage boards; and
- borrowings.

The majority of the funding is directed through the revenue support grant, which comes from the DCLG, and the council tax. Such funding is focussed on maintenance of existing flood defences, rather than on the provision on new defences. It is reported that total spending on flood and coastal defence was to have exceeded £400 million in 2001-2.

However, the RICS Rural Affairs Faculty (2001) reports on the outcome of a Ministry of Agriculture Food and Fisheries report in 2000, which stated that capital investment in flood defences would have to be doubled to maintain the (then) existing standards. According to the Institution of Civil Engineers (2001), there is a need to reverse the decline in the investment into research and development and to increase the level of funding to improve the national capability to manage flood-risk.

The Institution of Civil Engineers has recognised a skills shortage which is affecting the ability of the country to manage the flood-risk. According to the RICS (2001) a number of local authorities are unable to inspect and report on the condition of the defences and critical watercourses in their area because of a lack of resources or expertise. The Institution of Civil Engineers (2001) has identified a serious skills shortage in river engineering, as well as difficulties in attracting, training and retaining appropriately experienced staff with detailed and local knowledge. Against the background of declining interest in science and engineering in universities and the length of time necessary for training in hydrology and hydraulics and river engineering:

“... there must be concerted effort to attract and retain professionals and technicians with the necessary interest and skill in river basin flood-risk management.” (ibid: 27) [because] “The technical response to flooding in this century will be totally dependent on the quality and number of appropriately qualified staff.” (ibid: 70).

4.3 The decision to install flood defences

Current government policy reflects the following priorities (RICS, 2001: 12):

- protection of human life;
- provision of flood warning systems;
- urban coastal defence;

- urban fluvial flood defence;
- rural coastal defence and replacement rural fluvial flood defence and drainage schemes; and
- building new rural flood defence and drainage schemes.

The decision to construct flood defences should reflect social, economic and environmental aspects of each case, rather than the political imperative, funding opportunities or impact mitigation assessment.

Appropriate forms of flood defences should (Institution of Civil Engineers, 2001: 38) be chosen based on:

- the environment in which the defences will be constructed;
- the impact that the defences will have on both the local and the wider environment;
- the performance of the defences in a wide range of flood events; and
- the risks and uncertainties involved.

Flood defences often take the form of engineering works (and these will continue to provide one of the main options for the foreseeable future) but the total application of such a solution is impractical, uneconomic and unsustainable.

“We do not have defences in all places where flooding may occur, those defences we have are built to varying standards ... and some defences are structurally weak and cannot deliver the level of service for which they were initially constructed.”

(ibid: 16-17)

The 2001 Department of Environment Food and Rural Affairs (DEFRA) report (*National Appraisal of Assets at Risk from Flooding and Coastal Erosion*), has estimated that the replacement value of fluvial flood defence infrastructure in England and Wales at around £5.5 billion, with an equivalent figure for all flood defences and coastal protection infrastructure at £16 billion. According to a National Audit Office 2001 report, the state of some 40% of the defences are in a ‘fair’, ‘poor’ or ‘very poor’ condition. The current level of investment in maintaining existing flood defences is around £80 million, which is considered (Institution of Civil Engineers, 2001: 44) as the minimum level to maintain the existing defences in a safe condition but is a level which:

“will almost inevitably lead to the gradual decline in the state of the flood defence infrastructure.”

(ibid, 2001: 44)

It seems also that there is a high level of ignorance surrounding the condition of existing flood defence assets (Institution of Civil Engineers, 2001: 33).

Because of the nature of the funding arrangements, it seems that routine maintenance is not always a priority for the allocation of funds to coastal defences (RICS, 2001) and defences may be allowed to decay, until a breach requires an

emergency repair, the funds for which will come from a separate budget. Supporting the recommendation of the National Audit Office report, the Institution of Civil Engineers (2001) recommends a 100% increase in the amount of capital investment in flood defence expenditure and a similar (100%) increase in the level of maintenance expenditure.

“there is a need for increased investment in flood and coastal defences if present standards of protection are to be maintained.”

(*ibid*: 70)

Also, it is recognised (Institution of Civil Engineers, 2001) that even where effective flood defences exist, a flood event may exceed the level of protection provided. Thus, providing protection against a 1% annual probability of flooding means accepting that, for those events with a probability of less than 1% in any year, overtopping may occur. It therefore suggested that any scheme design should reflect higher than current design flows to reflect the anticipated increased risks resulting from climate change and land use changes.

The government (ODPM, 2001, para. 31) recommends that flood defences should include allowances for climate change and, where these are provided for new residential developments, they should protect against river floods with an annual probability of 1% and coastal flooding with an annual probability of 0.5%, for a period of 50 years. Reflecting the anticipated increase in the impact of climate change (refer 2.4.1) and the objectives of protecting communities could require a 20% upsizing of the capacity of existing flood defence schemes (Institution of Civil Engineers, 2001: 57). PPG 25 sets a safety standard of a 100 year return period event for inland flooding, 200 years for coastal flooding, and 1,000 years for London (Crichton, 2003: 25).

“The longer term sustainable option is to let rivers have space in urban areas and to encourage the development of an urban river corridor that can accommodate increased flood capacity in sympathy with the urban use of the land.”

(Institution of Civil Engineers, 2001: 39)

Addressing the issue of runoff at source is likely to be the most sustainable solution, although storage further down the system (such as storage on farmland, regulated flood storage reservoirs, river restoration) can also be effective. The least sustainable options include raising flood defences to constrain a river “*within a bank*” (Institution of Civil Engineers, 2001: 38). However solutions should reflect each individual circumstance.

Such solutions can include flood proofing (that is making buildings resistant to flood damage), and localised flood-mitigation measures (Institution of Civil Engineers, 2001: 39), and ensuring that design solutions anticipate future climate change.

Further flood-risks could be more striking due to population growth and associated building than to countryside change or climate change. This is because the urbanisation effects on flooding are one-sided, whereas with the other postulated changes, there are normally ‘swings and roundabouts’ in the change of impermeability and storage.

Flood defences remain a vital part of protection against flood damage. However, there is a real need for a sustained programme of investment in flood defences as

well as in the development of more accurate methods of estimating and forecasting floods.

According to Roaf *et al.* (2005: 167) spending on flood defences was due to rise from £411 million in 2002 to £564 million by 2005:

“although this falls short of the investment required to protection people in areas vulnerable to flooding from the increased risks they face due to climate change.”

(*ibid.*)

The ABI (2004: 13) reports the financial cost of damage after a single flood (up to £30,000 per property) and the current costs of flood defences (the initial outlay estimated at £5,000 to £8,000 per property). Thus, building defences into the design of the development could prove highly cost-effective over the long term.

Eves and Brown (2002) report that flood defence is seasonal. Following a flood event, flood defence works may be proposed, but if there is no significant flooding over a period of five to ten years after the last event, the level of flood defence development may not continue.

Also, the Institution of Civil Engineers (2001: 17) recognises that there is a need to supplement flood alleviation measures with flood response measures including:

- installation of foundations for demountable flood defences;
- making buildings more resistant to flood damage;
- development of a reliable flood warning system; and
- planning of an appropriate emergency response.

In addition, there are potentially significant benefits to developing a whole range of flood response activities, including a long-term education initiative, the communication of response plan measures to members of the public and their vulnerability.

“The human health impact of future flooding will be strongly determined by the improvement in warning and rescue measures.”

(European Environmental Agency, 2004: 76)

It is however important to take a holistic approach to flood-risk management based on catchment areas, and the Environment Agency lead the setting up of catchment plans for England and Wales. Such plans will require evaluation and regular review in the light of experience and significant changes to the catchment area, although it seems that they will not be sufficiently comprehensive to conform to the standards required by the EU's Water Framework Directive (Institution of Civil Engineers, 2001) which includes water supply and pollution control. There is also a need to ensure that such plans are converted into effective and efficient actions, with prominent leadership and supported by professional skills, stakeholder commitments and financial resources.

4.4 Local planning authorities

Local planning authorities (LPAs) have an important role to play in flood-mitigation works. They are, of course, the body which awards planning consent and which must balance development pressures with the need to mitigate potential flood damage.

Planning Policy Guidance 25 (PPG 25) (ODPM, 2001) provides central government guidance to local authorities on how flood-risk should be minimised during the planning and development of land. Thus, the susceptibility of land to flooding is a material planning consideration, and LPAs are required to adopt 'a risk-based approach' (ODPM, 2001: paras. 27 and 30) to applications to develop in flood-risk areas, although such an approach has been criticised as unreliable (Noel, 2001). LPAs are required to consult with the Environment Agency and other appropriate bodies in relation to applications to develop in areas at risk from flooding.

Specific central government advice to local planning authorities includes its 'Advice on better practice' (ODPM, 2004a), which, for example, encourages local planning authorities to avoid surface water issues by consulting sewerage undertakers when considering planning applications.

In relation to flooding, the advice states that it is 'desirable' to avoid providing additional flood defences (*ibid.*: 36), with local planning authorities being told that:

"developers are responsible for identifying, implementing and funding the provision and future maintenance of any flood control measures necessary because of the development."

(*ibid.*: 41; see also ODPM, 2001: 61)

There is also advice to 'planners and developers' from the Insurance industry (ABI, 2004a), reinforcing the messages of PPG 25 and illustrating potential solutions which may result in continued insurance cover (and therefore security value) for properties at risk of flooding.

Nevertheless, 27% by value of new houses in England are constructed in flood hazard areas, against the advice of the Environment Agency (Critchon, 2003: 25, citing Lord Renton of Mount Harry, House of Lords Debate, Hansard, 18 Dec. 2001: column 215).

Recognising the limited success of the application of the current PPG 25, the government is consulting on a draft PPS 25 (ODPM, 2005b) with consideration being given to a number of measures designed to strengthen planning policy for flood-risk areas, including a flood-risk Direction (requiring all applications for major development in flood-risk areas to be referred to the Secretary of State for possible call-in); a requirement that Flood-risk Assessments should accompany all planning applications in flood-risk areas; and the potential for the Environment Agency to become a statutory consultee in any planning application in flood-risk areas.

PPG25 requires planning authorities to apply the sequential test when considering a planning application and demonstrate that there is no alternative site at a lower risk of flooding. The draft PPS 25 will clarify the sequential test by classification of the system by the vulnerability of the development to flooding, so that appropriate uses can be matched to flood-risk levels,

Table 2 shows an explanation of relationships.

Table 2 Flood-risk zones: appropriate uses

<p>Zone 1: Low probability of flooding: All land uses appropriate.</p> <p>Zone 2: Medium probability of flooding: Water compatible, less vulnerable, more vulnerable and essential infrastructure uses all appropriate. Highly vulnerable uses should only be permitted if they pass the exception test (this means that departure from the sequential approach can only be taken in exceptional circumstances, where it is necessary to meet the aims of sustainable development).</p> <p>Zone 3a: High probability of flooding: Water compatible and less vulnerable uses permitted. More vulnerable and essential infrastructures uses only permitted if they pass the exception test. Highly vulnerable uses should not be permitted.</p> <p>Zone 3b: Functional floodplain: Water compatible uses permitted. Essential infrastructure uses should only be permitted if they pass the exception test. Less vulnerable, more vulnerable and highly vulnerable uses prohibited.</p> <p><i>Source:</i> edited from ODPM 2004b</p>
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4.5 Landowners and flood defences

It may not generally be appreciated that:

“the primary responsibility for safeguarding land and other property against natural hazards such as flooding remains with the owner.”

(ODPM, 2001: para. 15)

Thus, it is not the responsibility of government (or any government agency) to protect land and property from flooding, although government recognises (*ibid.*) that there are wider social and economic benefits for doing so. Thus, such authorities as the Environment Agency have ‘permissive powers’, but no statutory duty to carryout flood defence works (*ibid.*).

Despite the liability of landowners for protecting their property against flooding, the recent case of *Arscott v Coal Authority* (2004) held that a landowner can defend its land against flooding, even if this would divert the water, and thereby damage someone else’s land (Dowden, 2004). However, if the owner’s land is already flooded or if flooding is inevitable, the landowner cannot ‘export’ the damage. This rule applies only to defence works that do not alter the established watercourse, as opposed to the flood-plain (*ibid.*). According to Dowden (*ibid.*), the ruling is significant because of the UK government’s (OST., 2004a; 2004b; 2004c) report, which concluded that the projected risk of flooding has more than doubled, and, unless those systems responsible for intra-urban flooding are repaired, the ABI predicts that some properties may be uninsurable.

Defences designed to protect individual or groups of properties from floodwater that has overtopped defined channels (such as rivers and streams) can include freestanding barriers and removable items such as flood boards and airbrick covers. The provision of barriers against the free spread of water carries with it risks of:

- increased flooding to properties upstream and downstream; and,
- sudden inundation if the barrier fails or is overwhelmed.

Flood resilient construction is generally only possible for new development, although there may be actions which individual owners can take when, for example, refurbishing ground floor accommodation, such as choosing concrete floors rather than timber, plastic or ceramic kitchen units rather than chipboard (ABI, 2004a: 17, refer 4.6.2).

However, common law gives reasonable legal protection to those who need to prevent flooding of their properties and the courts have established that such activities can largely be carried out without fear of liability for nuisance, even though the risk to others may be increased as a result. There is also no liability in nuisance to other members where protection is provided on a group basis and the use of Kite-marked flood protection products in accordance with the manufactures instructions should reduce the chances of a charge of negligence.

Therefore, although the Environment Agency and local authorities are generally expected to provide flood defences and they have the powers to do so, they are not under a duty and “...*have certainly not had funding to meet all requirements for flood defence schemes*” (Wynn, 2004: 110). This has led to recent recognition that flood defence cannot be left to public agencies alone and that householders should be encouraged to take measures to protect their own properties.

However, of particular concern is the recent announcement (Environment Agency, 2005) that:

- 25% of homeowners did not know that they lived on a flood-plain; and
- 13% would not know where to turn for information about flood-risk to their homes.

Such levels of ignorance mean that any risk-management or preventative measures must first be preceded by a public programme of information, without causing public alarm.

The government provides guidance (for example, ODPM, 2003a) for home owners to prepare for floods, but if the level of public ignorance is not addressed, such guidance will have little effect.

4.6 Development decisions

“The first issue we have to communicate is the vulnerability of any location to flooding”

(Institution of Civil Engineers, 2001: 18).

Developers are responsible for assuring the local planning authority that flood issues have been appropriately reflected in their proposals in a Flood-risk Assessment. If necessary, the developer is responsible for providing appropriate flood defences (often funding) for any new development undertaken (ODPM, 2001: paras. 20 and 72). In assessing the flood-risk, the Environment Agency makes available any

relevant information (subject to their charging policy), although its advice may not be heeded.

There is a clear risk in developing within flood-plains which government recognises (ODPM, 2001). Clark (1998: 342) calls for a closer partnership between insurers and planners to improve the regulation of new development in flood hazard zones.

Recent Government guidance (DEFRA/Environment Agency, 2005) provides a generic framework for assessing and managing flood-risk for new developments in England and Wales. The framework provides for:

- links between the different decision-making scales and strategic or site-specific Flood-risk Assessments;
- links to the related activities of flood-risk management planning and Sustainability Appraisals; and
- direction to users to the latest research and development (R&D) and new or existing guidance and tools, identifying gaps in understanding of flood-risk and development that will be filled by ongoing R&D projects.

The generic approach (which is at the core of the framework) is based on the *Guidelines for Environmental Risk Assessment and Management* (DEFRA and Environment Agency, 2005), which is generally recognised within the UK as the best practice approach to assessing and managing environmental risk.

The project has resulted in:

- an improved means of communicating risk-based approaches;
- an improved understanding of the practical application of risk-based approaches within development planning;
- an improved understanding of the relationships between development planning compared to flood-risk management planning; and
- a recognition that the majority of current guidance is still applicable.

Section 2.4 of the DEFRA and Environment Agency report discusses Stakeholder Engagement, providing general guidance when assessing and managing flood-risk for new developments. It identifies insurance companies and the ABI as stakeholders with general responsibilities for the “*insurance of properties and other assets*” and to “*encourage action by Clients to reduce risk*” (insurance companies) and to act as a “*representative body for insurance companies*” (ABI) (*ibid.*: 76). Their responsibilities in flood-risk management and/or development planning are identified thus “*provides insurance; set conditions for provision of insurance; provide financial rewards for reduced risk*” (insurance companies) and “*co-ordinate insurance industry flooding matters; ensure fairness of insurance cover*” (*ibid.*) Insurance companies are further identified as responsible (with others) for flood awareness, flood preparedness, post-flood clean up and recovery, and improved knowledge (*ibid.* 77).

The Institution of Civil Engineering (2001: 74) supports “*the need for flood-risk assessments to accompany proposals to new development in flood-plain locations linked ... with models and data deriving from the process of preparing catchment flood management plans.*”

“From a flooding aspect, further change (in England ...) could be more striking due to population growth and associated building than to countryside change or climate change. This is because urbanisation effects on flooding are one-sided, whereas with the other postulated changes there are normally ‘swings and roundabouts’ in the change of impermeability and storage.”

(Institution of Civil Engineers, 2001: 56)

There are (according to Smith, undated: 7-8) compelling reasons for not developing below the five meter contour at or near coasts, as it is “*inevitable*” that sea levels will rise.

Nevertheless, there are an estimated 1.7 million homes situated in the flood-plains, with up to 200,000 of them thought to face a 1 in 75 risk of flooding (Roaf *et al.*, 2005: 166) and their owners will need government policies to protect them and their investments, regardless of the level of any new development in flood-plains. In addition to the existing level of properties at risk there are plans to build further homes within the South-East as part of the Sustainable Communities Plan (ODPM, 2003b).

According to the Director of General Insurance at the ABI:

“The government’s ambitious plans for new housing depend on managing the flood-risk, and the continued availability of property insurance.”

(ODPM, 2005a)

Roaf *et al.* (2005: 116-7) reports on the proposal for a multi-million pound ‘flood tax’ to be paid by developers which was announced by DEFRA in January 2003 to help raise over £20 million to construct coastal and river defence systems. The response of the House Builders Federation (HBF) was that this tax would push up the prices of homes. In the event, the tax was not introduced, perhaps because of a perceived overlap with both s. 106 obligations and the ‘land tax’, proposed by the Barker Review (Barker, 2004) and currently under consideration by the Treasury (Bill, 2004).

4.6.1 Impact Assessment

When developing within a floodplain it is necessary for developers to provide the local planning authorities with environmental impact assessments. The Institution of Civil Engineers (2001: 36) recommends that this practice be broadened so that planning authorities require a drainage impact assessment for all new developments. The ABI (2004a: 21) recommends strategic flood assessments for all new developments in the growth areas proposed by the government’s Sustainable Communities Plan, to ensure that appropriate and sustainable solutions are fully integrated into any new development proposals.

Riley (2000) similarly proposes that a Climate Impact Assessment (CIA) be undertaken for each new development. He recommends a Climate Impact Assessment in order to:

“ensure that the development is able to function properly throughout its design life without suffering any damage from the effects of climate change.”

(Riley, 2000: 715)

Thus, a CIA involves a complete analysis of the data and information about the building in the light of anticipated climate change, including any appropriate mitigation measures. The paper further recommends that a CIA be incorporated within the ownership and management responsibilities of local authorities for all civil buildings.

Within the current consultation on strengthening PPG 25, it is likely that the guidance on Flood-risk Assessments will be strengthened and that Flood-risk Assessments will be required to accompany all planning applications in flood-risk areas (ODPM, 2005b).

4.6.2 Flood resistance of buildings

Where development is proposed in areas at risk from flooding, there is an opportunity to build a level of flood resistance into the fabric of the structure.

The Institution of Civil Engineers (2001: 36) also recommends that such flood resistant requirements should apply to developments on the fringes of flood-plains and to development within defended areas, although to a lesser extent.

Research (for example, Smith undated; Sustainable Development Unit, 2005) into how construction design, methods and materials should alter to reflect the likely outcome of climate change includes how buildings should be able to withstand the greater intensity and frequency of storms as well as the development of flood resistance buildings. The changes envisaged include:

- increasing the pressure for water conservation and the harvesting and purification of both rainwater and grey water for use other than for human consumption;
- the design of substructures which should take account of progressive drying out of clay subsoils;
- in areas which are likely to be flooded, building techniques should ensure that the building is resistant to a level of flooding, (Smith, undated, suggests up to a one metre flood), either by raising the ground floor level or by ensuring that all openings less than say 1.5 metres above ground incorporate an effective seal (Smith, undated: 8);

However, with the wider use of timber frame buildings, the use of unsuitable materials which absorb water, and which may encourage infestations of mould and wet rot during any drying out period, should be regulated. Similarly, design of accommodation (including locating garages and storage facilities on the ground floor), appropriate flooring materials, location of main services above ground level; and avoidance of such facilities as underground heating on the ground floor, should all be considered.

It is clearly more sustainable to build in resilience from new than to do it retrospectively and the insurance industry, which holds the data on building failure and risk management expertise to reduce vulnerability has, potentially, a major role in adaptation (Critchon, 2003: 24).

Nevertheless, it is particularly important that the house-buying public should have an increased awareness of both the risks and the protection measures available, thereby allowing informed and realistic choices to be made about purchasing an asset at risk of flooding.

“The first issue we have to communicate is the vulnerability of any location to flooding.”

(Institution of Civil Engineers, 2001: 18)

Risk needs to be communicated to all those concerned, at all stages of the development and the protection processes, including the owners, occupiers, and users of the services provided by buildings and other infrastructure at risk.

Actions by individual householders to make their property more resistant to flood damage include:

- flood protection products; and,
- changing repair specifications on refurbishment and / or after a flood, from reuse of the same materials and techniques to more flood resistant alternatives (Broadbent, 2004).

These measures may lead to higher initial costs, but for properties subject to repeated flooding may reduce future repair costs and therefore over time offer significant savings. Improving the flood resistance of domestic properties has the potential to benefit all stakeholders, including occupiers, mortgage companies and insurers.

Every property is different and each must therefore be considered on its own merits when deciding the most appropriate measures for flood resistance. The most suitable or cost effective approach will depend on:

- the frequency of flooding;
- the likely depth and duration of flooding; and,
- the nature of the flood, whether from watercourses, groundwater, burst water main, sewer discharge or surface run off.

Products are available that provide demountable, temporary protection to prevent water ingress to buildings through openings (such as doors) and vents in buildings, which can be installed by the homeowner in the event of a flood warning, sometimes into a pre-installed frame.

A range of measures that could be taken to improve the flood resistance of a building are summarised by Broadbent (2004), which although not fully exhaustive *“is indicative of the most likely and practical options”* and provides *“useful initial guidance for those considering repair of flood damaged houses”* (Broadbent, 2004: 80). This includes 34 items covering general matters, floors, walls and interiors. For example, the measures include:

- moving vulnerable features, and those expensive to replace, above ground level, including electrical intakes, service meters, boilers, ovens and washing machines;
- putting one-way valves in drainage pipes to prevent flood and foul water backing up through service pipes, and creating external drainage channels to direct water away from the property;

- using materials and building techniques that are more water resistant, for example: treated timber floorboards (instead of chipboard), lime plaster or cement render (instead of gypsum plaster) and PVC-U windows and doors (instead of timber); and,
- recording the improvements made so that future purchasers and their surveyors can understand the flood resistant measures that have been installed, to save measures being destroyed and / or reinstalled unnecessarily.

Not all the measures will be appropriate in all cases. For example, where the risk is of shallow flooding below the damp-proof course, major investment in alterations would only be justified by a large number of repeat floods. Therefore while homeowners can do much to reduce the extent of flood damage, selecting the appropriate approach depends on many factors including the nature of the flood-risk and the individual characteristics of the property. Homeowners may therefore be advised to seek specialist advice from an appropriately experienced surveyor or engineer in consultation with the insurer.

However, according to CRISP:

“there is a widespread lack of awareness in the literature on adaptation, of the importance of competing drivers for change and, most importantly, of mitigation.”

(Lowe, 2001: 59)

A fact sheet produced for ABI by the Building Research Establishment (BRE) (ABI, 2004c) offers advice to homeowners on the most cost effective approaches for incorporating flood resilience measures into homes, either after a flood event or during the normal course of renovation. The document provides contacts for obtaining further information about the latest flood protection products and advises that although in the severest floods water may still get into the property despite flood protection measures, the water is often cleaner because mud and silt is kept out, which substantially reduces clean-up costs. This advice is curious, since there is evidence (Wordsworth and Bithell, 2004) that insurance companies do not pay for flood resilience works to be carried out on flooded buildings.

4.6.3 Skill requirements

The Institution of Civil Engineers also identifies a range of skill requirements, in addition to expertise in such engineering fields as hydrology, hydraulics, fluvial processes and modelling, to include strategic thinkers at government level; academic and research experts; technical, operational and management skills within the Environment Agency staff; academics to both teach and supply trained personnel and also to research new ideas. In addition:

“the need for improved training extends well beyond the engineering profession. In particular, there is a need for improved understanding of flood-risk assessment and flood-risk management amongst a range of professions such as town planners, architects, land surveyors, insurance and emergency managers. It is important that all the professions involved in flood-risk management have a shared understanding of the issues and can work together to a common purpose.”

(Institution of Civil Engineers, 2001: 60)

In addition, there is evidence (Roaf *et al.*, 2005: 168) that many planning officers and members of committees on local councils “*simply do not understand*” the issues involved in permitting further development within flood-plains. The authors aver that such officials do not have access to the methodologies for evaluating the risks for local communities. The failure of experts to agree on how to calculate flood-related impacts merely exacerbates the problem.

4.7 Coastal defences

Shoreline management planning was implemented by MAFF in 1995. A Shoreline Management Plan (SMP) document sets out “*a strategy for coast defence for a specified length of coast, taking account of natural coastal processes and human and other environmental influences and needs*” (MAFF, 1995).

SMPs are non-statutory plans, but should have a relationship with other voluntary plans, particularly:

- Coastal Zone Management Plans;
- Estuary Management Plans; and
- Local Environment Agency Plans.

SMPs are also “*intended to be used to provide information to support the preparation of Development Plan policies and assist Local Planning Authorities in determining planning applications in the coastal zone*” (MAFF, 2000: 1).

Development of SMPs is the responsibility of ‘Operating Authorities’, such as local authorities and the Environment Agency. The length of coast covered by the plan will be defined by natural coastal processes and may span several neighbouring local authorities, in which case one will act as lead authority for the plan production.

SMPs are intended to form the basis for production of subsequent strategy plans and for the implementation of appropriate schemes, monitoring programmes and studies. SMPs are therefore working documents and should be regularly reviewed and updated with the latest scientific information, and regional and national policy guidance.

According to de la Vega-Leinert and Nicholls (2000), shoreline management planning represented a significant step forward because it encouraged coastal defence strategies to consider the overall benefits and effects for relevant sections of the coast rather than within strict local administrative boundaries. About 40 SMPs cover the entire length of the coast of England and Wales.

In 1999 MAFF issued recommendations on regional rates of relative sea-level rise to be included in the design of new flood and coastal defences structures, which place emphasis on “*the continuation of natural processes, except when important national / regional assets are at risk*” (MAFF, 1999: 75). In practical terms this meant areas with low population density and low-grade agricultural land being left unprotected.

The planning and execution of coastal defences is the responsibility of the Environment Agency and local authorities, performed via the production of Local Environment Agency Plans (LEAPs), designed to balance the economic and environmental costs and benefits of flood defence schemes. A major challenge is the conflict of interest between stakeholders, for example:

- protection of public and private assets versus the environment;

- the quality and quantity of coastal habitats protected, destroyed and created;
- national versus local protection agenda; and,
- present versus future generations' resources and protection needs.

The UK has seen a shift from 'hard' structural coastal defences to 'soft' measures *"including beach nourishment and rehabilitation of coastal buffers"* (*ibid.*: 77). Soft measures are generally less expensive and can be implemented more quickly while conserving amenity value, but tend to be *"significantly less reassuring to the general public ... a key factor at the political decision stage of any flood/coastal defence schemes"* (*ibid.*).

Planning Policy Guidance in 1992 also recognised the need to *"keep options open for managed retreat, particularly in low lying areas"* (*ibid.*: 77). Since 1998 when the House of Commons endorsed the concept of *"managed realignment"*, this term has come to be preferred because managed retreat *"is often rejected by the public as it implies unplanned abandonment, while managed realignment better describes the planned landward readjustment to the line of flood defences ..."* (*ibid.*). The UK shoreline management agenda is currently strongly focused on coastal adaptation and adaptation measures considered include:

- the improvement of flood-risk identification and forecasting and awareness raising;
- the acceleration of investment in existing rolling programmes of coastal and river flood defences to protect flood-prone areas against increased risk of climate change; and,
- avoiding, or ensuring adequate protection for, new development in areas likely to be at increased risk of flooding.

Potential 'no regret' actions have been identified as:

- the improvement of flood-risk identification;
- raising the awareness of practical steps to minimise exposure to flood damage risk; and,
- the use of planning and insurance to help discourage future development in high risk areas.

However, there are a number of barriers to the implementation of integrated coastal management, including:

- pervasive uncertainty regarding the nature and magnitude of potential impacts in the coastal zone;
- lack of resources to fund comprehensive shoreline management strategies;
- lack of strong political will and / or adequate public awareness; and
- complex and multiple conflicts of interest in the coastal zone.

A review of the first generation Shoreline Management Plans (SMPs) commissioned by the Ministry of Agriculture, Fishers and Food (MAFF, 2000) examined the

recommendation of the Shoreline Management Advisory Group to provide guidance for second generation plans.

The researchers found that SMPs, as a unique initiative within Europe, have attracted much European and worldwide attention and interest. The initiative has resulted in significant skills in the UK coastal industry.

While the SMP process has had many beneficial effects on coastal defence policy in England and Wales, there are limitations and constraints which need addressing through supplementary guidance, drawing on examples of best practice, to facilitate the production of second generation SMPs. National guidance needs to set minimum standards but without being too prescriptive, to allow flexibility to accommodate local situations and needs. The research made a number of recommendations for second generation SMPs, particularly regarding consistency around the coast between SMPs and local jurisdictions. The review briefly refers to other issues beyond the scope of the report, including 'planning blight' and the need for further research and guidance on the use of intangible benefits in economic assessments, and for the assessment of the residual life of defences.

Estuary SMPs are encouraged for major estuaries to achieve a truly holistic approach towards flood and coastal defence, with the onus on the Environment Agency to lead on plan development.

The efficiency and function of natural defences (such as salt marsh, erosion/accretion, beach sediment loss / gain) also need to be considered in relation to standards of structural protection in the future, as beach management becomes more widespread and as the effects of sea-level rise and climate change intensify.

Some Plans also need to define more precisely risk areas, for example, using Environment Agency flood-plain mapping to identify land below certain contours or frontages subject to erosion, to indicate areas likely to become inundated / eroded should defences fail, or managed retreat strategies be adopted. Instead of adopting a 'defence line', as in most first generation SMPs, focus might be on the physical management of a 'zone' of coupled domains (such as beaches and dunes) which could be affected by coastal processes. This may also be extended to include structural solutions and be referred to as an integrated coastal defence system.

The study of first generation SMPs showed that present land uses are relatively easily determined to an appropriate level of detail, but estimates of future trends and development are more problematic, requiring careful inspection, interpretation of planning policies and planning applications, and consultation with local planning officers. Second generation SMPs should therefore place greater emphasis on land use trends and planning policy and identify areas of land, locations and types of asset at risk from flooding or erosion over the life of the plan. Scenarios of 'do nothing' or 'retreat' should also be identified. *"Such information should then be used explicitly to assist in determining planning applications and to contribute to Development Plan preparation / revision"* (MAFF, 2000: 29). The SMP should also summarise specific Development Plan policies relevant to the coast.

The review recommends: *"SMPs should be given greater weight as an instrument in statutory planning ... although it is not suggested that SMPs should become statutory documents themselves"* (MAFF, 2000: 29). The review also stresses:

- the need for engineers and planners in local authorities to recognise that they have complementary interests and that they need to interact closely to avoid dangerous risks in order to ensure, and

- there are a number of mechanisms within the existing town and country planning system that encourage integration between SMPs and Development Plans.

According to the RICS (2001: 24), the cost of flood defence which benefits a few rural and coastal properties at the expense of the majority of taxpayers, is increasingly hard to justify, particularly when there is a clear need for better public services. The protection of agricultural land may be particularly hard to justify, when the industry is seen to be producing a surplus. In the absence of any compensation, owners of such properties may have to accept the loss of their properties, as the defences are allowed to decay (refer BBC News Online, 2005a; Akwagyiram, 2004a; 2004b).

The Intergovernmental Panel on Climate Change (IPCC) has identified three broad strategies: retreat, accommodation and protection. Bray *et al.* (1997: 22) opine that (based on studies in the USA) the costs are not unacceptable when compared to the value of coastal assets at risk; however, comparable studies for the UK have not been undertaken.

“Timing of any response is very important and there are opportunities to avoid adverse impacts and minimize costs by acting now. Conversely, some protection responses are only effectively applied if and when problems arise. Options are maximised by planning ahead to see what is best done now and what can be delayed until scientific uncertainties are resolved.”

(Bray *et al.*, 1997: 22)

4.7.1 Retreat

Retreat is the planned abandonment of land and structures in vulnerable areas and the resettlement of inhabitants (Bray *et al.*, 1997: 22). It would include preventing all future development in that area and could involve land acquisition by public authorities, the use of ‘set-back’ zones, or economic incentives to abandonment (*ibid.*).

Legislation would be necessary to amend existing compulsory acquisition and planning regimes and also to permit the payment of compensation for those adversely affected (*ibid.*). There are clear social and political reasons why such policies should be implemented, although at present it seems that the scale of the problem is not sufficient to warrant such action (refer Akwagyiram 2004a; 2004b).

Implementation of retreat in the UK could lead to serious conflicts of interest because, at present, there are no means of compensating those that could be affected adversely, even though such costs might be much lower than those incurred by providing protection (Bray *et al.*, 1997: 22; see also BBC News Online, 2005b; 2005c).

Retreat has the advantage of allowing the coastline to adjust naturally and is a key concept in achieving geomorphological sustainable management (Bray *et al.*, 1997: 22). It is likely to have severe social and political repercussions if public policy, in particular a compensation fund for those who lose their properties to the abandonment, does not accommodate the strategy.

4.7.2 Accommodation

Accommodation allows the continued occupation and use of vulnerable areas by adapting to the impacts, by adapting buildings, changing land use, with inducements being provided through insurance programmes (*ibid.*: 22). Accommodation has the

advantage of flexibility and the ability to combine its strategies to optimise risk mitigation and cost-effectiveness but needs accurate and reliable data and local community support.

4.7.3 Protection

Protection is the defence of vulnerable areas using 'hard' engineering options, (such as embankments, groynes, and sea walls) or 'soft' engineering solutions such as beach nourishment, and although these require more maintenance, research and monitoring, they are more "*environmentally effective, because they work with natural systems*". In addition, they are more easily adjusted and abandoned in response to unforeseen circumstances (Bray *et al.*, 1997: 24).

"Protection has clear economic, social and political advantages because assets and investments are safeguarded while economic activity can largely continue unhindered. ... However, there are serious environmental and aesthetic disadvantages associated with a policy of continually improving defences in situ. Even economic arguments may become increasingly marginal if the pace of environmental change accelerates."

(*ibid.*: 24)

Issues relating to values ascribed to different uses of land e.g. recreational and conservation value, exacerbate the cost-benefit analysis approach to such decisions. Thus:

"some protection policies might need to be reviewed as new models and techniques of environmental economic analysis become available and concepts of sustainable development are more rigorously tested."

(*ibid.*: 24)

4.7.4 Protect or abandon

Government funding is not infinite, nor is there any legal responsibility on government or its agencies to provide flood or coastal protection for properties (see, for example, Akwagyiram, 2004b).

Indeed, there is evidence of settlements lost to the sea (Akwagyiram, 2004b; BBC News Online, 2005c) and to buildings being flooded on a permanent basis (Tobin and Montz, 1997).

However, DEFRA and the Environment Agency are responsible for assessing the defence needs of England and Wales, and, once DEFRA has taken the decision to fund protection for an area, the Environment Agency is responsible for implementing the relevant defences (Akwagyiram, 2004a).

In the UK, it is settlements in the south and east coasts of England which are at the greatest risk of coastal erosion, although there are also areas causing concern in parts of Scotland (*ibid.*).

While insurance may not be available to cover property losses, the absence of any other form of protection for home owners has led to calls for compensation, as being a cheaper alternative to the provision of sea defences (*ibid.*). However, there is no current government fund out of which compensation can be paid for property lost to

coastal erosion or flooding where there is no current coastal or flood defence in place nor is such loss liable for compensation under any existing legislation.

The effect of the recent devastation in New Orleans by hurricane Katrina has brought calls for the settlement to be abandoned, and while decisions to protect or abandon sites are likely to be based on a balance of the costs of protection versus the social and financial value of the property involved (Yohe and Schlesinger, 1998: 448; Akwagyiram, 2004a; BBC News Online, 2005c), there is also a political dimension which needs to be factored into any decision-making.

4.8 Striking a balance

A balance must be struck so that lives and property (including infrastructure) are protected from the worst effects of flood-risks which can be reasonably predicted and from that which may occur during the life of our existing and proposed buildings and structure. In some cases, it may be appropriate to develop (or improve existing) flood defences; in other cases, it may be appropriate to 'flood proof' a building; in some cases, flooding may be a regular and manageable event in the life of the property.

We need to recognise that:

- flooding in many locations is inevitable;
- buildings/infrastructure cannot always be entirely protected from flooding;
- the effects of flooding on human health must form part of the equation;
- pressure for new development is growing, particularly in the South-East of England, and the implications of flood-risk on such locations must be reflected in the development; and
- limited resources must be wisely spent to achieve acceptable outcomes.

The Institution of Civil Engineers (2001: 39) recommends that the target standard of protection should be against a 100-1 chance of flood, with lower standards being adopted only where there is an overriding justification for doing so. Thus,

"In the case of existing heavily urbanised areas and for new developments in flood-risk areas where there are over-riding reasons to develop, the balance should be tilted back in favour of human safety and technical soundness rather than environmental impact."

(Institution of Civil Engineers, 2001: 39)

The Institution of Civil Engineers (2001: 40) also suggests that into the existing performance indicators, which reflect only the risk to human life and the aggregate benefit cost ratio (for grant-aided schemes), an additional indicator, being the number of households damaged and distressed by flooding in year is also added.

Thus, the funding could be allocated to defences based on a cost-benefit analysis, provided that health and social benefits are also included, to reflect the significant and long-term damage which flooding can have on the health, social and financial costs faced by residential owners and occupiers.

“... a cost-benefit analysis may give greater priority to a scheme protecting any area with low housing density in south-east England than a scheme of high density housing in north-east England, solely due to the differences in property values. Were health and social costs included, the balance would be weighted more toward the scheme of high density but lower property value.”

(Institution of Civil Engineers, 2001: 20)

However, there are major issues in reflecting health and social benefits because of the difficulty in ascribing monetary values to such benefits (*ibid.*). But we also need to be realistic about the problem, the potential solutions and their costs, in financial, environmental and social terms, and avoid delaying the implementation of necessary protection measures.

Public perceptions of the risk of flooding and the fear of being refused home insurance, could mean that future residential developments in the Thames Gateway could be blighted (Towell, 2005).

“It is important to maintain a sense of proportion concerning the apparent flood-risk, and ensure the correct balance between technical solutions, flood-mitigation and public perception.”

(*ibid.*: 64)

The construction or refurbishment of dwellings which are flood resistant, increased housing density in low-risk areas and the potential for pooling contributions by a number of developers to pay for regional flooding infrastructure where required, are all proposed solutions (*ibid.*), although there is little recognition that the pressure to develop on flood-plains exists because of the paucity of other suitable sites.

“We are all at risk from the impacts of climate change. Our vulnerability to it will depend on the infrastructure of our lives, the buildings we live in and the investments we make. Our exposure to that risk will depend on where that infrastructure is in relation to the hazards perpetuated on us by the changing climate.”

(Roaf *et al.*, 2005: 80)

It has been argued (*ibid.*: 168) that there is an ethical issue involved, with a choice to either take a precautionary view and deny permission to a development which would result in devastating consequences for the existing community, or recognise the opportunities for increased wealth and quality of life both to the existing community and to the newcomers by approving “*fashionable development*”. They argue that,

“...there is a moral onus on ensuring that both groups properly understand the calculations on each side of the argument so they can best decide on their own future.”

(*ibid.*)

However, there is a perception that the focus of flood defences is on the South-East of England. There needs to be a higher level of equity between the national policy and its outcomes as applied across the country and not

“ ... excessively encourage the protection of the rich in the south rather than the poor in the north of Britain ... [I]t is true that economic efficiency in flood

defence favours protecting those locations where wealth is greatest and economic activity is most vibrant ...”

(Penning-Rowse, 2001: 110; see also Crichton, 2003)

4.9 Summary

This section has highlighted the issues of flood defence in relation to existing communities and for new development.

In the UK a large number of organisations are involved in the provision and management of flood defences, owing to the division of responsibility between national policy strategy and regional and local delivery. Flood defence and coastal protection are also treated separately from one another.

The DCLG sets national policy on development and flood defence for England, in conjunction with DEFRA, which is responsible for flood and coastal defence policy. Most funding for flood defences is via the revenue support grant from DCLG.

The Environment Agency is the main body responsible for implementing government policy on flooding, having supervisory duties as well as strategic and operational responsibilities for flood defence delivery and maintenance. It also has the lead role for the issue of flood warnings and for flood-risk mapping. Other responsible bodies include regional and local flood defence committees, water plcs, local authorities and some private landowners (such as Railtrack).

The powers available to these operating authorities are discretionary or permissive. There is no statutory duty to carry out flood defence works. Hence, failure to provide flood defences does not give rise to a right to compensation on the part of property owners and occupiers. The primary responsibility for protecting land and property against flooding therefore rests with the landowner. Owners can defend their land against flooding, providing they do not alter an established watercourse, even if diverting floodwater would damage someone else's land. But if the owner's land is already flooded or known to be flood-prone, the damage cannot be exported. Flood defences that involve building or engineering operations will also be subject to planning permission. Therefore although a landowner is responsible for defending his own land, there could well be restrictions on the extent to which he can do so.

The public at large appears ill informed about flood-risk. For example, there are an estimated 1.7 million homes currently located on flood-plains, although 25% of these homeowners are unaware of the fact and 13% of homeowners would not know who to turn to for help and advice in a flood situation.

The current division of responsibility is confusing and that there is a need to identify a single authority capable of delivering a sustainable and integrated approach to flood-risk management. Much well founded research funded by government also points to an urgent need for effective strategic action. Yet the government response has been disappointingly limited to a review of PPG 25; raising the status of the Environment Agency from a consultee on planning applications to a statutory consultee for development on flood-plains; encouraging provision of Flood-risk Assessments on planning applications; and developing a more strategic and integrated approach to coastal flooding and erosion risks.

The susceptibility of land to flooding is a material planning consideration and PPG 25 requires LPAs to adopt a risk-based approach to development applications in flood-prone areas. The ABI has published advice for planners and developers on behalf of the insurance industry about mitigation measures that may result in the continuation

of insurance cover for properties subject to flood-risk, relevant, for example, to the Thames Gateway area where public perceptions of flood-risk and fear of being refused insurance could blight proposed new housing development.

Developers must satisfy LPAs that their schemes appropriately reflect flood-risk and take responsibility for the provision and maintenance of any necessary flood control measures, avoiding the need for additional flood defences. However, the current planning approach is criticised as unreliable, and around 27% by value of new homes in England are built in flood hazard areas against the advice of the Environment Agency. It would appear that many planning officers and members of committees do not properly understand the issues nor have access to methodologies for evaluating the risks to local communities.

The design approach to flood defences has concentrated on providing certainty through keeping flood-risk at a 1% annual probability. Nevertheless, floods are dynamic and variations must be anticipated over the design life of defences. Estimates suggest that the impact of climate change and the need to protect existing communities could require a 20% upsizing of the capacity of existing flood defence schemes. Therefore, given that it is not possible to eliminate all floods, the approach to flood defences must be to 'manage the risk best'. Whilst responsible authorities have no control over the source of floods (precipitation) and only limited control over rivers, they potentially have greatest control over buildings and infrastructure, including defence measures and the location, design and materials involved in new development.

Decisions to construct flood defences should therefore be based on the social, economic and environmental aspects of each case, rather than political imperatives, funding opportunities or impact mitigation assessment. There are also issues of equity, for example there is a perception that the focus of flood defences is on the prosperous South-East of England to the detriment of the poorer north. It is unfortunately true that economic efficiency in flood defences is greater when protecting wealthier and economically vibrant locations, at least in part because human health and related social costs are not factored into the analysis.

In recent years, funding has been concentrated on the maintenance of existing flood defences and investment in new provision has declined. Defences are not in place in all areas at risk of flooding, existing defences are of varying standards and some defences are failing. It also seems that routine maintenance is not always a priority and defences may be allowed to decay to a point of requiring emergency repair, the funds for which come from a different budget.

Settlements along the South and East coasts of England are at the greatest risk of coast erosion, yet the cost of new coastal defences to protect relatively few properties or agricultural land is increasingly hard to justify. Shoreline management plans implemented in 1995 are non-statutory plans, but represented a significant step forward, in that coastal defence strategies are considered for relevant sections of coasts spanning local administrative boundaries. However, barriers to implementing integrated coastal management include uncertainty about climate change impacts, lack of resources, lack of strong political will, inadequate public awareness and complex conflicts of interest.

It is apparent that, in the longer term, engineering solutions to raising the level of flood defences is the least sustainable option. The emphasis must shift to management solutions, which includes allowing rivers space in urban areas and 'managed realignment' of coast areas, even though the policy is likely to be controversial, not least because there is no means of compensating those affected.

Nevertheless, improving flood management will still depend on overcoming the current skills shortage in appropriately qualified and experienced engineers.

5. FLOODING AND INSURANCE

5.1 Introduction

“Insurance is designed to provide protection against damage due to occasional, unexpected events. It cannot replace fundamental flood-risk and water resource management.”

(ABI, 2004a: 7)

It is speculated (Graves and Phillipson, 2000) that if storms (and therefore the resulting floods) are seen to be climate-change driven, and therefore predictable, insurance companies (which only cover unpredictable events) could withdraw cover. This would put pressure on new development and refurbishment plans to increase the specification for both the buildings and any flood defences to avoid a flooding event or to minimise the damage it might cause. Similarly, there would be pressure to locate buildings in areas not prone to flooding if insurance cover was to be denied in areas at high risk of regular flooding.

The underlying principle of commercial insurance is that the losses suffered by the few are covered by the premiums paid by the many (Clark, 1998: 337). However, this is only possible if:

- the damage sustained is measurable;
- premiums are payable from policyholders in both hazard and non-hazard locations;
- the amount of damage is limited; and
- the hazard is capable of definition in probability terms (*ibid.*).

Insurance is not, therefore, designed for frequent and predictable events and has been criticised by some as being “*an essentially elitist device*” (Clark, 1998: 335) available only to those who can afford it. However, insurance, of both buildings and contents against damage from flooding, makes also an important social contribution (*ibid.*: 333-4) following a flood, by aiding speeding recovery, as well as focusing attention on the risk of locating or occupying buildings within a hazard zone. In addition, without building insurance, it is unlikely that purchasers of property will be able to secure funding for their purchase.

Insurance, therefore, is fundamental to the efficient operation of the property market (ABI, 2004a: 21). Thus, there are wider cultural, social and political issues involved in having insurance cover, which affect the ability of people both to live and work within recognised (and potentially damaging) flood-risk areas in the UK.

5.2 Flood insurance worldwide

The global insurance market is complex and multilayered (Gloyn, 2005), and with the losses from the 2005 hurricanes in the USA estimated at \$60 billion (Katrina alone has generated 1.6 million in claims) and the terrorist-related losses, it is predicted that, as in the USA, where property insurance premiums have risen by 20%, such premiums will also rise in Europe. This state of affairs has led to concern from credit

rating agencies that some insurers' exposure to claims may damage their financial security (*ibid.*).

One group that is taking climate change very seriously indeed is the insurance industry, and their deliberations and decisions in the immediate future could put millions, who can no longer get insurance for their homes, at the greatest economic risk of their lives (Roaf *et al.*, 2005: 70).

Insurance density is increasing all over the world, faster in some countries than others, and the insurance against floods presents a particular challenge (Loster, 1999). There is a trend towards multiple-risk and all-risk cover, particularly in industrial countries, and in many countries the principle of 'solidarity' or 'mutuality' does not function because the transfer of losses from those affected to the community at large is not feasible at a realistic premium.

Reinsurance, which allows insurers to protect themselves against catastrophic claims, operates on a global scale and is increasingly constrained by such events as 9/11 and the growing number of natural disasters throughout the world. It is likely that climate change will mean that re-insurers are increasingly selective in the portfolios they are prepared to cover (ABI, 2004a: 7 – 8).

Munich Re has analysed data on major natural hazard disasters for more than 25 years. The figures show that while floods cause the largest number of deaths in poor and heavily populated countries, economic loss shows little regional distinction because of increasing values. But, as might be expected, the largest insured losses are encountered in the industrial countries where insurance density is generally at its highest.

"Part of the observed increases in losses are due to socio-economic trends such as population growth, increased wealth, ..."

(European Environment Agency, 2004: 70)

Although of the natural hazards, floods, are responsible for a third of all economic losses worldwide, their share of insured losses is relatively small, with an average of just under 10%, because cover for flood-risk is very conservative in many markets or does not exist at all. Nevertheless, the amount insured for flood loss has increased significantly due to:

- population increases globally and in the exposed regions;
- the increase in insured values in these regions;
- the increase in the vulnerability of structures (infrastructure, buildings) and of goods (stock, furnishings);
- construction in flood-prone areas;
- often limited trust in flood protection systems; and
- changes in environmental conditions.

Curiously:

“The financial services section as a whole is expected to be able to cope with the impacts of future climate change ... [with] increasing size of companies, greater diversification, greater integration of insurance with other financial services, and improved tools to transfer risk, potentially [contributing] to this robustness ...”

(European Environment Agency, 2004: 71-2)

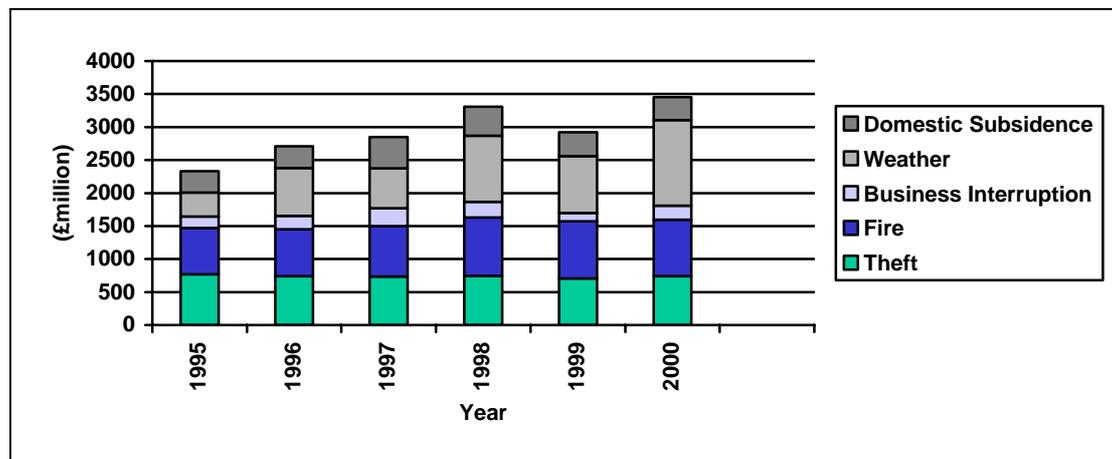
The insurance industry is three times bigger than the fossil fuel industry and controls 30% of the World's stocks and shares, so it could have a strong influence on large companies and in the climate change debate (Crichton, 2003: 24).

5.3 Flood insurance in the UK

Recent studies into coastal flooding (reported by Clark, 1998: 337) demonstrate that the total exposure of insurers to claims is considered to be acceptable, despite the long-standing tendency of British institutional response to be prompted by periodic extreme events.

Following major flood events in 2000 the UK, ABI (2001a) reported an increase in gross incurred claims due to weather events between 1995 and 2000 and stated that increasing flood risk in some areas may render additional properties uninsurable in future.

Figure 3 Gross Incurred Claims – Domestic and Commercial Property



Source: (ABI, 2001a)

The report points out that the functioning of the insurance market in flood-risk areas is dependent on flood defences providing reasonable levels of protection, to the “Government’s own Indicative Standards as an absolute minimum, but to higher standards if the cost of insurance is to be contained”, (ABI, 2001a: 6) and that the impact of climate change needs to be taken into account in designing these defences. However, in many areas, defences have not been enhanced, and remained below DEFRA’s standards for densely populated urban areas which would suggest there is a significant problem being created in terms of the insurability of certain areas.

In January 2003 the British insurers published a statement of principles on the provision of flood cover, which amounted to an agreement with government to

continue flood insurance for existing domestic properties and small business policyholders, while work was undertaken to improve flood defences up to 2007. This statement of principles was renewed in January 2006 (ABI, 2006a) with the provision of cover being extended for a further five years on the following basis:

- Flood cover will continue to be offered as a standard feature of household and small business policies where properties are protected by flood defences to a standard of 1.3% annual probability (1 in 75 year return event). Premiums will reflect the degree of risk.
- Insurers will continue to offer flood insurance to existing customers whose properties are currently at significant risk but where improvements in flood defences bringing them up to the 1.3% annual probability standard (1 in 75 year return event) will be completed within five years.
- Insurers will work with existing customers on a case-by-case basis in those areas of significant flood-risk where there are no plans to reduce the risk, and look at ways that flood cover can be continued.

The above commitment by the insurance industry is offered on the basis of that the following points are progressed by the government:

- Reducing the flood-risk for 100,000 homes in areas of flood-risk over the next three years;
- Sustaining an adequate investment programme for flood defences that takes account of climate change;
- Strengthening land use planning to limit new development in flood-risk areas;
- Providing more detailed information on flood-risk and flood defence schemes; and
- Alleviating the risk of sewer flooding and flash-flooding.

However, some non-UK insurers have withdrawn from underwriting flood cover in areas perceived as presenting high risk (Clark, 1998: 337).

The ABI therefore recommended that government priorities should lie in:

- greater investment in defences;
- radical curtailment of development in flood-risk areas; and
- faster and more consistent decisions on flood defences.

There is however a clear indication (ABI, 2004a) that insurance cover cannot be assumed for new properties in low lying flood-risk areas and that insurers are looking to at least maintain their level of risk.

“Insurers would be able to continue to offer flood cover if there is no net increase in flood-risk after development has taken place.”

(ibid.: 1)

However in August 2006, DEFRA cut the budget of the Environment Agency by £200 million. This means in England spending on flood defences will be reduced by £14.9 million, which would be cut from the maintenance budgets (BBC News Online, 2006). Although the government has said it would not be cutting the capital funding of defences, this was already under funded, with the Chief Executive of the Environment Agency saying that capital defence funding should rise by 50%. An ABI spokesman said *“The government must get back on track and give this issue sufficient priority and resources. The challenge we face from flooding is greater than ever before.”* (Neale, 2006). There have also been claims that the reduced funding will hamper planning decisions where schemes are dependent on the presence of flood defences.

In November 2006, the ABI published its report on ‘Coastal Flood Risk’ (ABI, 2006b) reaffirming the need for a *“sustained additional programme of investment”* in flood defences and again calling for more effort to *“ensure that regional planning strategies take account of climate change risks”* (*ibid.*: 5). The report asserts that longer-term strategies are needed that look 50 to 100 years ahead and that investment appraisals need to *“incorporate realistic long-term flood risk assessments”* (*ibid.*). However, while the British insurance industry would prefer to continue offering flood risk insurance as standard to UK households and businesses, the report warns that such insurance availability *“...will inevitably come under pressure as a result of climate change”* and that *“Insurers will continue to signal to government and customers where the pressures are becoming unsustainable”* (*ibid.*). In other words, if flood risk insurance has to be withdrawn it will be for reasons outside insurers’ control, but government could help prolong insurability by strategic investment in flood defences and tightening planning controls in flood risk areas.

In supporting the government’s message to planners and developers outlined in PPG25, the ABI (2004a) has set out ‘key considerations’ which it considers vital if insurance is to be available for the development proposed by the ODPM’s Sustainable Communities Plan for 200,000 new homes in the South-East by 2016. These cover:

- the standard of defence over time – which should not fall below current levels of defence, taking both the rate of deterioration in the condition of the defence and climate change into account;
- the design of flood defences – advocating ‘creative solutions’ to reducing overall risks and limiting the consequences of any flood;
- location of new developments – recommending that the most vulnerable areas should not be developed, but that there could be a trade-off between developing greenfield sites, if a corresponding area of low lying brownfield land were devoted to flood storage;
- flood resilient construction – recognising the advantages of designing and constructing so that likely flooding causes minimal damage; and
- drainage considerations – which should be designed to cope with a larger volume of rainfall, in the light of both increased development and climate change.

There are, however, central and local government (specifically planners) interests which are also involved in insurance for flood-prone locations, over and above those of individual property owners/occupiers and the commercial insurers, (Clark, 1998: 334). Thus, for the wider economic and social well being of the UK, if and when

private sector insurers and re-insurers are unable to bear the burden on environmental hazards which occur regularly in the same location, it is necessary for governments to provide an ultimate safety net (*ibid.*: 341).

5.4 The requirement for insurance

There is no absolute need or right to have insurance cover and not all risks are insurable. It seems likely that the desire of the British to have full insurance cover for all eventualities stems as much from a cultural as a financial driver. Indeed, it is recognised (ABI, 2004a: 7) that “*insurance plays a critical role in the operation of the property market.*” In the UK, insurance cover provided by a commercial insurer for the replacement of buildings and their contents is traditionally the norm, and a prerequisite for market-based lending.

This is not apparently so in other countries. In the USA, for example, insurance cover is available through the government-run National Flood Insurance Program (NFIP) where the general approach is to require mandatory risk mitigation from communities in exchange for insurance cover. Clark (1998: 340) reports that the NFIP has yielded an annual reduction in flood damages of some \$569 million. It will be interesting to see to how the NFIP is perceived as coping with the insurance claims following the damage caused to the southern USA during the summer of 2005.

However, for assets of high value and in countries where the population is highly risk-averse (such as for buildings, and in particular dwellings, in the UK), it is likely that risk aversion would be a major driving force for disaster mitigation. Thus, if insurance cover is not available for a building constructed in a flood-plain, the developer is unlikely to proceed (Roaf *et al.*, 2005: 78) because of the limited interest of potential purchasers in an uninsurable asset.

Clark (1998: 335) opines that the safeguarding of a viable natural perils insurance market should be a significant national priority, partly because of the role insurance plays both in recoverability (resilience) and promoting risk minimisation of events such as flooding.

Market research commissioned by UK insurers AXA in late 2002 (Vanson Bourne, 2003) investigated attitudes to flood and fire risk amongst small and medium sized enterprises (SMEs) based on 700 interviews with people responsible for their organisations’ insurance. The research found that although the risk of seasonal flooding is increasing in the UK, 76% of SMEs do not see flooding or fire as significant risks to their business and 89% feel their businesses are adequately insured. However, they may not fully appreciate the true costs of such an incident and only 57% believed flooding would have a major impact on their business. In South-East England, just 13% of SMEs viewed flood and fire as significant threats to their business. The study concludes that businesses threatened by flood need to focus on:

- effective risk management – identifying and planning for all possible flood-risks;
- business continuity planning – to ensure the business avoids the worst effects and can get back on its feet with minimum disruption; and,
- adequate insurance cover – to include business interruption insurance to help ease the effects of short-term closure on cash flow.

5.5 Managing risk

Risk is a combination of hazard (the probable frequency and severity of an event), vulnerability (the extent to which a flood would affect a property because of, for example, its services, construction, materials), and exposure (within an insurance context – the function of the value of the property at risk and the consequential cost of its damage or destruction) (Clark, 1998; 334).

From the insurers' perspective, risk mitigation is the most effective way to reduce costs, ideally by controlling pre-disaster vulnerability. Thus:

“Discouraging exposed development, insisting on high standards of flood-proofing, encouraging what are deemed to be effective flood defences and supporting the provision and utilization of flood warnings have long been seen as vital steps towards the control of overall flood-risk.”

(*ibid.*: 340)

Insurance is at the heart of the strategies to transfer risk and plays a major role in risk avoidance, prevention, control and mitigation, by imposing or encouraging measures which could reduce the occurrence, severity or impact of such events as flooding (Clark, 1998: 335). Thus, the insurance industry plays a significant role in risk evaluation.

Roaf *et al.* (2005) discuss how insurance companies might manage risk. Thus, as risk increases, insurers move from a passive system in which they pay for the damage incurred, to a reactive system, in which the industry collects information and commissions research, and then into a planning system, demanding risk mitigation or withdrawal of cover. A similar conclusion is arrived at by Loster (1999), that reducing the number and scale of insured losses will only be possible if insurers can impose conditions requiring preventative measures, or better, incorporate a substantial reduction in the insured loss if prevention measures are not taken. Realistically, however, “...insurers face market competition and the introduction of ‘deductibles’ is only likely to succeed ‘when the loss burden explodes’” (*ibid.*: 7).

Therefore if risk cannot be managed through controlling exposure and vulnerability, rising hazard could result in increased risk, which will be translated within the marketplace as increased prices and/or less cover.

“... premiums have been rising rapidly and across the board to pre-empt catastrophic payments that may actually bring the industry to its knees. The fear is that if allowance is made for a £15 billion event ... a £25 billion event will occur.”

(Roaf *et al.*, 2005: 71).

For example, 2003 was a year marked by a series of severe natural hazard events, as well as terrorist attacks, losses involving two satellites, and a leak of poison gas in China. It was the worst year on record for payouts from the insurance industry¹, reinforcing the need for transparency and a limitation of the risks. The insurance industry has, therefore, little choice but to adopt a rigorous policy of limiting its liabilities and ensuring that premiums adequately reflect the risk.

¹ Munich Re found that although the wind storms and severe weather in 2003 accounted for about one third of the 700 events recorded, they were responsible for 75% of all of the insured losses caused by natural disasters (Roaf, *et al.*, 2005:73).

It remains to be seen what changes will occur to the global insurance industry as a result of the claims made following more recent events, including the damage caused in and around New Orleans in August 2005.

The insurance industry has the skills necessary to map and quantify risk and, moreover, is well placed to motivate its clients (both domestic and commercial), to modify their behaviour (Roaf *et al.*, 2005: 73). The industry also needs to measure and manage its exposure and reduce the vulnerability of the assets it insures if it is to be able to continue to provide protection at a price which is affordable (*ibid.*: 76). The potential development of an 'insurance underclass' would put pressure on national governments to enter the insurance business as the ultimate insurer of otherwise uninsurable risk – a role which the UK government seems loathe to adopt.

5.6 Flood-risk mapping

In October 2004, the Environment Agency announced:

“ the publication of the most comprehensive, up-to-date and easily accessible map of flood-risk from rivers and sea across England and Wales ... [and] the start of the Environment Agency’s annual awareness campaign to alert the public to the risk of flooding and help people to prepare in advance to minimise the damage.”

(Environment Agency, 2004a)

The maps show 2.2 million properties at risk (either 'low', 'moderate' or 'significant') reflecting their proximity to rivers and coasts, but ignoring flood defences which were constructed over five years ago or which were not built to a specific standard (*ibid.*). Future initiatives are proposed as:

- showing speed and depth of flood water;
- identifying vulnerable groups (such as elderly people);
- updates every three months; and
- support for emergency action, such as turn off gas.

However, despite the details, there are significant gaps in the information provided. For example, the flood maps do not provide information on any of the following matters, all of which can make a significant difference to the flood-risk for a particular location:

- all flood defences (only those built in the last five years to a certain standard);
- flood depth, speed or volume of flow or flooding from other sources, such as ground water, direct runoff from fields, or overflowing sewers; nor
- information for certain locations (unspecified) which was not available at the time of the production of the likelihood of flooding.

In addition, flood probability data reflects the fact that defences could be breached or fail in a major event. The Agency recognises that:

“Flood mapping is a complex, detailed and extensive process which will never be completely accurate ... it cannot provide detail on individual properties.”

(*ibid.*)

Nevertheless, the public could be forgiven for having the impression that not only are the maps accurate, comprehensive and up-to-date, but that the risk of all kinds of flooding events are included.

Insurers have been understandably interested in the national-scale mapping of environmental hazards (Institution of Civil Engineers, 2001: 49), and Norwich Union, is one of the insurers who has developed its own flood map of the UK (Norwich Union, 2004). This shows whether a property is at risk, how often a flood is likely to occur as well as the depth of the flooding event. As a result insurance premiums can be calculated on individual addresses rather than postcodes, and this should mean premiums which more accurately reflect the risk.

It seems, however, that the insurance industry itself may be at risk in the light of recent events. There are powerful competitive pressures on insurers for higher resolution spatial and temporal data, to enhance the management of risk (Clark, 1998: 338).

But relationship between risk and insurance is fundamentally altered as flood data and prediction increase in precision (*ibid.*: 334). It can be argued that the efficacy of insurance as a management tool rests largely on there being a significant element of uncertainty in the prediction of such events as floods.

“The quest for greater certainty in environmental insurance (often articulated as a trend towards greater precision in risk evaluation) could, therefore dramatically reduce the management effectiveness of insurance, seriously damage this sector of the industry, and raise complex ethical questions.”

(*ibid.*: 335)

Clark (1998) discusses a case of apparent misperception of data precision of the Land-Form PROFILE™ of the Ordnance Survey. This product was promoted by the public media as being capable of showing “*which houses are likely to flood in a given street*” (The Sunday Times, 1997, quoted in Clark, 1998: 338). In fact, the Ordnance Survey itself pointed out that the product was accurate to heights of $>\pm 3.75$ metres – a very significant error envelope, which challenges its potential to predict flood damage precisely. In addition,

“Precision generates huge data sets in which very high at-risk asset precision (e.g. property location in three dimensions) may not be matched by process accuracy (e.g. definition of flood water level or behaviour) and past experience may not in any way reflect future exposure.”

(Clark, 1998: 338)

This may be particularly true where flood defence measures or property development has taken place since the last flooding event on which the data has been based.

The availability of improved data sets has direct implications for the insurance industry itself. Thus:

“If individual [property] hazard is known with great precision in space and time, low risks will become apparent and although some insurers may be tempted to ‘cherry pick’ these attractive clients, they will increasingly withdraw themselves from insurance cover, thus reducing the loss-bearing potential of premiums from outside the risk zone. While for a short time the evidence of

risk may be known to the insurer but not to the insured, this situation is unlikely to be sustainable. ... if the greater access to high precision data was to lead to an unravelling of the 'package' approach to domestic property insurance in the UK, then ... the ability of the insurers to fund the claims of the few by revenue from the many would decline and market viability would be rendered marginal. ... Once a spiral of market decline is initiated ... it is extremely difficult to reverse ..."

(Clark, 1998: 341)

It is not only within the insurance industry that there is a danger associated with an increased availability of data. With the evidence of the temporal effect of flood-risk on the attitude of purchasers, there is an increased burden placed on professional advisors, including mortgage lenders.

"... [T]he increasing availability of accurate and perhaps precise information on hazard and vulnerability will increase the liability to provide properly-informed decisions and advice. On the other hand, at the individual level the likely decrease in property value and increase in difficulty of acquiring property finance prompted by insurance loading or non-availability could in the future represent increasingly heavy burdens ..."

(*ibid.*: 338)

Should protection of the investment in residential and commercial property cease to be economically sustainable in any particular location, there is a real threat of blight reducing both the saleable and investment value of individual assets, and adversely affecting the environmental, economic and social sustainability of the larger affected area (*ibid.*).

Thus, while there are clear advantages in having made public more accurate and transparent information regarding flooding hazard, complex repercussions could arise, including adverse effects on the property market and the insurance industry as well as increased litigation against those deemed responsible.

5.7 Insurance availability

"Arscott foreshadows the emergence of a widespread class of householder who have no insurance and no legal recourse in the event of flooding."

(Dowden, 2004: 147)

The decision in the *Arscott* case (refer 4.5) has limited the potential activities of a landowner seeking to protect property during a flooding event. This increases the traditional and widespread reliance on insurance protection as the main vehicle for landowners to manage the risk of flooding attaching to their properties.

However, recent reports raise doubt over whether insurers would be able to continue to provide flood cover in the UK in the light of climate change (Roaf *et al.*, 2005: 74).

Insurance cover relies on volume and coverage in order to protect against specific and limited risks (that is, the majority of the premiums pay for the claims of the minority of insured). In the UK, therefore, the aim of the insurance industry is to provide cover for as many individuals as possible, although only 70 – 80% of the population is insured against flood damage.

Of the uninsured, only very few have been refused cover, with the majority being those who choose not to buy or who cannot afford flood insurance.

Much of the pressure to hold flood insurance comes from lending institutions, so cash purchasers (such as those who have previously paid off a mortgage) are able to choose whether or not to purchase such cover. Given the apparent ignorance of members of the public of their individual risk, it seems likely that it is the elderly and the economically worse off who are most vulnerable to losses resulting from an absence of cover, assuming such cover to be otherwise available.

If insurance companies begin to refuse cover in flood-prone areas on a large scale, there will be increasing social and political pressure for the national government to underwrite the losses itself. This would be particularly so, given the fact that much of the pressure for the proposed residential development in flood-prone areas in the South-East of England stems from the government's Sustainable Communities policies.

"There are already indications of a global shortfall in catastrophe insurance, and ultimately society (government) has to pick up the liability if commercial insurers turn away."

(Clark, 1998: 342)

5.8 Impact on land use decisions

According to Loster (1999: 6) flood hazard does not appear to impact greatly on land use decisions. This applies:

"...just as much to those affected, who seldom move out of exposed areas even after a loss has occurred, as it does to political powers, who are unprepared or hesitant when it comes to land-use recommendations or restrictions".

Industrial and residential areas are therefore located behind supposedly safe flood defences, and trust placed in the area's safety allows the concentrations of values to rise.

It remains to be seen whether the revised PPG 25 alters the past trend of development on flood-prone land in the face of Environmental Agency opposition and, potentially, in the absence of insurance cover.

Flood insurance also exerts an indirect influence on state obligations for the protection of citizens and resources and Loster (*ibid.*) questions whether flood protection and land use can be channelled in the right way if the public, industry and commerce are fully insured. However, if insurance cover in such locations is refused and developers therefore cease to view such sites as attractive, some local authorities may be hard pressed to meet government house-building targets.

5.9 Insurance and homeowners

One response of insurers to perceived risk is to vary the cost of cover by linking premiums to their perception of hazard and vulnerability in that location. This, it is argued (*ibid.*: 337-8), would be socially beneficial, because it highlights the trade-off between the cost and the benefit of occupation within an area of hazard and vulnerability. It would also increase the sensitivity of insurers (and therefore, heighten

the awareness of owners, occupiers, developers, lenders and potentially planners and other relevant institutions) to providing cover for:

- new flood-plain development undertaken against the advice of the Environment Agency;
- new development undertaken without adequate flood defence provisions;
- properties for which residents have declined flood defence on aesthetic grounds; and
- properties purchased cheaply because of a history of flooding. (Clark, 1998: 338).

A fact sheet for homeowners issued by the ABI (2004b) confirms that insurers who are ABI members will be willing to work with customers to reinstate their homes to flood-resilient standards *“provided this does not cost more than the repairs covered in the insurance contract”*. However, if the cost of flood proofing is substantially greater than standard repairs, the insurers will only provide funds equivalent to the standard repair. This does not demonstrate a willingness on the part of the insurance industry to support homeowners who are anxious to reduce their vulnerability and therefore any future losses. To fund the balance, homeowners may be able to extend their mortgage loan, provided they have sufficient equity in the property and can afford the additional repayments. The Council of Mortgage Lenders has confirmed that mortgage companies would normally be willing to consider such loans.

The document provides tables of indicative costs for reinstating a range of house types with and without flood resilient measures, and gives indicative cost savings for future deep (to 1m) and shallow (to 5cm) floods.

“... the forthcoming Homebuyer’s Inspections (Sellers’ pack) may well focus greater attention on the identification of flood-risk during the sale of residential property.”

(Wordsworth and Bithell, 2004: 109)

It is of course interesting to speculate that if flood-risk affects the value of a home. it consequently reduces the homeowners equity. This may in turn hamper the ability of those who wish to borrow for the purpose of installing flood protection measures. Again, interested financial institutions may not be sending the right signals to home owners who are keen to protect both their own and other investors’ assets.

5.9.1 Insurance and development decisions

Risk aversion should be a major driving force for disaster mitigation: thus, if insurance cover is not available for a building constructed in a flood-plain, the developer is unlikely to proceed (Roaf *et al.*, 2005: 78).

Clark (1998: 333) opines that those who occupy property in floodplains should carry the risk of that occupancy, as a device for discouraging unwarranted development within the hazard zone. Thus, insurance (the absence or increased costs of cover) could play a vital role within the property market in focusing attention on risk, in so far as there is a rational and informed choice about property location.

The ABI (2004a: 9 -10) recommends that developers should assess their proposals by calculating the Estimated Maximum Loss and expected flooding frequency in

order to quantify the financial consequences of a flood, and an integrated measure of capital at risk. The ABI (*ibid.*) provides a template for this, see Table 3.

The ABI supports the policy of development on brownfield land, but argues that this should be balanced against factors such as flood-risk. It recommends that where development is required on brownfield floodplain land, the area at lowest risk should be developed first. The ABI has warned that the residual risk of new housing developments in East London which are behind defences could be £26 million per year, but using a sequential approach to development could reduce losses in the Thames Gateway by up to 52% (ABI, 2005a).

Table 3 Template for calculating property-level Estimated Maximum Loss

Step	Action
1	Develop a detailed site map for the new development (including existing properties) setting out: <ul style="list-style-type: none"> ▪ Site topography ▪ Locations of existing and proposed properties (by construction and type) ▪ Locations of existing and proposed flood alleviation schemes, including hard defences, flood storage, sustainable drainage systems, and property-level flood-mitigation.
2	Divide development into Flood Impact Zones, based on: <ul style="list-style-type: none"> ▪ Entry points into the site from different sources of flooding – river, sea, sewer/overland ▪ Estimate spread and depth of floodwater from each entry point ▪ Probability of flooding from each point.
3	Within each Flood Impact Zone, establish: <ul style="list-style-type: none"> ▪ Total number of properties at risk, split by construction type ▪ The per-property rebuilding cost for these properties
4	Within each Flood Impact Zone, based on the depth of water, estimate: <ul style="list-style-type: none"> ▪ Potential extent of flood damage within each property type and the cost of replacing/repairing damage ▪ Multiply these costs by the number of properties (for each type) at risk ▪ Represent this cost as a proportion of total value at risk on whole site
5	The estimates for the Flood Impact Zone producing the greatest potential cost (<i>'worst case scenario'</i>) should be used as the Estimated Maximum Loss.
6	Repeat with different development and flood management options to look at how Estimate Maximum Loss could be minimised.

Source: ABI (2004a: 10)

5.9.1.1 USA Experience

In the USA, a National Flood Insurance Program (NFIP), which has been in operation since 1968, makes insurance against flood damage available to landowners in flood-prone locations at subsidised rates (Shilling *et al.*, 1989: 45) as well as controlling the use of land in such areas. All properties financed by government or government-regulated sources within those communities which were identified as being within flood-prone areas were required to participate in the scheme or risk losing their funding. The NFIP was overhauled following the floods in the Midwest during 1993, as a result of which home insurance cover must be documented during the period of any loan and penalties for non-compliance were strengthened. (Harrison *et al.*, 2001:

5-6). Thus, in the USA, flood insurance is not required by law (unless a loan secured on the property is outstanding) nor does it seem that there is any risk of flood insurance being withdrawn because of increased risk due to climate change.

Thus, there is no requirement on those property owners who receive no government loans or funding to purchase their properties to have any form of flood insurance, regardless of where their properties are located. According to Harrison *et al.* (2001: 6) there are 4.12 million NFIP policyholders. It is unclear the level of take-up of flood insurance outside of recognised flood-prone areas in the USA. However, the public perception within the USA of flood-risk and home insurance cover may well be affected by the devastation caused by hurricane Katrina on New Orleans in August 2005.

In research involving the risk of earthquakes in California, property owners 'self-insured' by purchasing houses in areas where the expected earthquake damage is relatively low. Given sufficient information on the hazard, a market for safe housing was created where one did not previously exist. Such research demonstrates how appropriate information given to the home purchasing public can alter buyer behaviour, but presumably, only if alternative locations to buy or build exist at similar or only marginally increased prices. In over-developed locations or those where the current planning system offers limited opportunities to develop away from a hazard, the additional expense of 'self insuring' may be prohibitive (Brookshire *et al.*, 1985).

5.10 Summary

This section illustrates how the UK insurance market is unusual in the world in the availability of private flood insurance for property and suggests a real danger that increased flood-risk due to climate change could undermine the future availability of such insurance.

Of the natural hazards, floods are responsible for a third of all economic losses worldwide, but their share of insured losses is relatively small, averaging just under 10%, because in many markets flood-risk cover tends to be conservative or does not exist at all. Nevertheless the amount of insured loss has increased significantly in flood-prone areas due to increases in population, property values, the vulnerability of structures and new development.

The insurance industry plays a significant role in risk evaluation and is taking climate change very seriously. Reinsurance, offering protection to insurers against catastrophic risks, operates globally and climate change means re-insurers are likely to become increasingly selective about the risk portfolios that they cover. The significant size of the insurance sector, which controls about 30% of the World's stocks and shares, means it could have strong influence in the climate change debate and on the behaviour of large companies and governments.

Moves toward a reactive system of risk management, whereby insurers demand risk mitigation as a condition of continued cover, will only work if it evokes an appropriate response from other stakeholders, particularly governments, property occupiers and developers. Otherwise increased risk will translate into higher premiums and / or reduced insurance cover. The issue of availability and affordability of insurance will then become more important, with the danger that an insurance underclass will develop.

Insurance of buildings and their contents against damage from flooding can certainly help speed recovery. While the need for flood insurance may focus attention on the

risk of occupying or developing property in a flood hazard zone, it does not appear to impact greatly on land use decisions. The presence of flood defences and the availability of insurance tend to allow property values to rise rather than provide incentive to relocate to a less hazardous area or to reduce vulnerability in other ways.

Insurance against environmental hazards, including floods, has become traditional in the UK and is fundamental to the efficient operation of the property market. However, there is no absolute need or right to have insurance cover and not all risks are insurable. It therefore seems likely that the British desire for full insurance stems as much from a cultural as a financial driver.

Things are different in many other countries where the principle of 'solidarity' or 'mutuality' generally does not function, because the transfer of losses from those affected by flood hazard to the wider community is not feasible at an economic premium. For example, in the USA the government run National Flood Insurance Programme requires mandatory risk mitigation from communities in exchange for cover. Mitigation includes controls on the location of development.

The UK experienced an increase in insurance claims due to weather events between 1995 and 2000, with flood-risk becoming uninsurable in some areas. As a result the Association of British Insurers published a statement of principles, renewed in 2006, concerning the basis for the continuation of flood insurance. This amounts to a conditional arrangement with government that cover will be offered to households and businesses where flood defences are in place, or proposals exist for their enhancement, providing government prioritises greater investment in flood defences, radically curtails development in flood-prone areas and introduces faster and more effective decision-making on flood defences.

The ABI has also given a clear indication that insurance cover cannot be assumed for new properties in flood-prone areas and has set out key considerations deemed vital for insurance to be available to the 200,000 new homes proposed by the ODPM's Sustainable Communities Plan by 2016. In particular the ABI has warned that the residual risk of new housing behind flood defences in East London could be £26 million per year, although adopting a sequential approach to developing the lowest risk areas first could reduce losses in the Thames Gateway by up to 52%.

Despite the cut in flood defence spending announced by DEFRA in August 2006, the ABI report on coastal flood risk in November 2006 continues to stress the need for sustained long-term investment in defences and tighter controls on development. However, while British insurers wish to continue offering flood risk insurance as standard, the ABI clearly believes that their ability to do so will come under pressure as the result of climate change, some of which will become unsustainable. Therefore government actions on flood defences and development control are crucial to insurers continuing to play a positive role in providing cover for households and businesses.

Flood-risk maps first published by the Environment Agency in 2004 show 2.2 million UK properties at risk of flooding, although there are significant gaps in the information, which is admitted not to be completely accurate. Major UK insurer Norwich Union has therefore developed its own maps to enable it to assess insurance premiums for individual addresses.

However, insurance is not designed for frequent and predictable events and the relationship between risk and insurance is fundamentally altered as flood data and prediction increase in precision. The effectiveness of insurance as a management tool rests on there being a significant element of uncertainty and the system of 'mutuality' could unravel in the UK, as policyholders occupying property outside of

flood-risk areas become aware of this fact and withdraw from policies that package this element of cover. The reduced loss-bearing potential of premiums could leave insurers unable to fund flood damage claims. Therefore, whilst more accurate and transparent information has certain advantages, it could also produce complex repercussions for the property sector and for government. If and when insurers and re-insurers are unable to bear the burden of insuring property in areas subject to regular flooding, the ultimate safety net can only be provided by the government, and to date, the UK government has been reluctant to get involved.

6. FLOOD-RISK, PROPERTY AND VALUES

6.1 Introduction

This section examines evidence of the extent of property in the UK potentially at risk of flooding, including the vulnerability of South-East England, being the location of case studies examined in sections 9 and 10 of this report. The possible impact on property values is discussed, in particular the response of insurers, lenders, surveyors and purchasers whose attitudes affect the function of property markets. Comparisons are also made with other jurisdictions, specifically Australia and the USA.

6.2 Extent of property affected in UK

Estimates of property affected by flood-risk in the UK vary. Sector (2000) estimates that up to 2m properties in England and Wales are located within flood-plains, worth around £214 billion. A report commissioned by DEFRA (Halcrow, 2001) estimates that in England and Wales property worth over £220 billion is potentially at risk from flooding or coastal erosion (see Table 4). The biggest risk, in terms of property value, is from sea and tidal flooding (59%), followed by fluvial flooding (34%). Potential coastal erosion losses represent about 3%.

About 50% by value or £110 billion of the property at risk is in the Thames region, dominated by London. When analysing flood-risks to property, the Thames region therefore needs separate consideration to avoid skewing the national picture.

However, the report recognises a number of limitations in identifying property assets at risk:

- The Ordnance Survey Address-Point database used as a surrogate to locate and count properties in the floodplain:
 - does not identify all buildings;
 - does not differentiate house types; and
 - could prove inaccurate for narrow coastal bands.
- Data do not identify:
 - the size and use of commercial properties;
 - high rise buildings;
 - individual property values; nor
 - wider impacts of flooding, for example, nor on local and national productivity.

Further, capital values of residential properties were determined using regional house price values, without differentiating house types, and rateable values (which represent a very specific kind of value as at a given date) were used for commercial properties.

The heavily populated nature of the UK coast is also highlighted as significant by de la Vega and Nicholls (2000). Over 30% of the population of England and Wales (17m people) live within 10km of the coast and 2.5 million people live below the 5m-ordnance datum (OD), 1 million concentrated behind the Thames Barrier.

The coastal zone is also highly important to the economy because it contains:

- 57% of grade 1 agricultural land for England and Wales which is below 5m OD, including particularly large areas in East Anglia and North Kent;
- 40% of manufacturing industry in England and Wales which is located in the coastal zone, and the total annual turnover of the British marine industry is estimated at £11 billion;
- Energy installations most of which are concentrated in coastal areas, particularly oil installations, specifically 70% of the UKs fossil fuel-powered generating plants and most nuclear plants;
- Important transport and communication networks, including the Channel Tunnel; and
- Major tourism facilities (45% of UK tourism by expenditure) and commercial property, including the City of London and Canary Wharf.

A third of the coast of England and Wales has some sort of coastal protection (over 1,200km). Around 160,000 domestic and commercial properties rely on tidal / sea defences and 1.5m people are protected from tidal flooding in England and Wales (de la Vega-Leinert and Nicholls, 2000).

The Halcrow report also examined the cost of maintaining defences and the economic impacts of flooding if defences do not keep pace with the effect of climate change (see Table 4). Although the study involved some broad-based assumptions, allowing scope to improve the accuracy of analysis, the authors conclude that there is a clear need to substantially increase expenditure on flood and coastal defence to maintain the same level of protection as that which currently exists and that failure to do so will lead to an increase in economic damage year by year. The report recommends that:

“... it is most likely that some combination of fluvial, tidal and coastal defence, concentrated upon urbanised areas, will yield the greatest return on investment ...” and that “... in individual cases some small-scale investments, which alleviate damage from the most frequently occurring events, often produce the highest returns ...”

(Halcrow, 2001: 36)

This emphasises the difficulty of defining broad national policy options and the importance of looking at each situation individually within appropriate policy and strategic planning frameworks.

Table 4 National assets at risk from flooding and coastal erosion in England and Wales

Assets at risk:
<ul style="list-style-type: none"> ▪ 10% of the population of England and Wales; ▪ property worth over £220 billion; ▪ 12% of the agricultural land, including 61% of Grade 1 agricultural land; ▪ agricultural land worth approximately £7 billion. <p>Represented by:</p> <ul style="list-style-type: none"> ▪ 4-5 million people; ▪ 1.8 million residences; ▪ 140,000 commercial properties; ▪ 1.4 million hectares of agricultural land.
Defence standards and economic impacts:
<ul style="list-style-type: none"> ▪ Without any flood and coastal defences for these areas, annual average economic damage from flooding and coastal erosion would be over £3.5 billion per year. ▪ To continue to provide and maintain present defence standards would require in excess of £0.3 billion per year in capital works and maintenance investment. ▪ Current defence standards reduce annual average damage to approximately £0.8 billion per year. ▪ Continuing current investment levels of approximately £0.24 billion per year would result in increasing annual damage of about £10-15 million per year. ▪ Accommodating climate change is likely to require additional investment of 10-20% over and above that required to meet '<i>indicative standards under present day conditions</i>'; ▪ The economic impacts of flooding could increase significantly if defences are not adapted to the predicted impacts of climate change, with average annual damage increasing by approximately 50% in fluvial areas and in excess of 200% on the coast by the year 2050.

Source: Halcrow (2001: 39)

6.3 Areas at risk

There is documentary evidence of the nature and frequency of extreme events along the British coastline.

“Historical synoptic analyses have shown that storminess is naturally variable over annual, decadal and longer periods. Since 1950, the UK has been subject to a phase of enhanced storm frequency ...”

(Bray *et al.*, 1997: 18)

The sorts of areas at risk are:

- developments (new and existing) within historic flood-plains and/or coastal areas;
- developments (new and existing) which are protected by aging and/or poorly maintained defences;
- developments (new and existing) which are protected by flood defences which may be topped by unusual flood events;
- unprotected developments in flood-plains and/or coastal areas which may be at risk from unusual flood events (however caused) and/or coastal erosion.

6.4 The vulnerability of South-East England

“... experts predict that there will be ... coastal flooding in the Southeast and more river and drainage flooding everywhere ... storm tracks will move south. This will mean more severe storms in the south of England where construction standards are lower than in the north.”

(Roaf *et al.*, 2005: 75)

The South-East of England is therefore at particular risk of flooding due to the interaction of:

- climate change;
- rising relative sea levels (RSL);
- relatively low standards of construction; and
- development pressure.

6.4.1 Rising Relative Sea Levels (RSL)

“rising sea levels are known to increase the frequency of extreme levels and thus reduce their return periods.”

(Bray *et al.*, 1997: 18)

The study by Bray *et al.* (1997) considered the effect of changes in RSL (and other related issues) on the South-East coast of England, where currently, there is a low probability of “*large extremes*” (*ibid.*: 18). The authors define an extreme condition in most open coasts as “*the combined action of high tides, storm surge and high waves*” with a potential outcome of either coastal erosion, overtopping of defences or both.

The South-East of England is suffering the combined effects of rising RSLs and land tilt. It is well recognised (see, for example, Bray *et al.*, 1997: 16; Roaf *et al.*, 2005: 169) that Scotland (and much of the northwest of Europe) is experiencing significant uplift caused by glacial isostasy (the shifting balance between the earth’s crust and the underlying upper mantle), while much of the South-East of England has been the subject of slow subsidence throughout the late Holocene period (the last 10,000 years (BBC News Online, 2005b), with the Thames estuary demonstrating the greatest pressure, possible due to the sediment loading. Such subsidence, together with rises in RSL, mean that this area is particularly vulnerable to increases in wave exposure and tidal surge.

“Sensitivity is site-specific but different coastal environments show characteristic responses to rising sea levels and form a basis for estimation of future impacts.”

(Bray *et al.*, 1997: 20)

According to Bray *et al.* (*ibid.*: 19) in their study area (covering the Dorset, Hampshire and West Sussex coasts), virtually all cliffs and most natural beaches are retreating and the majority of protected coasts suffer from declining beach levels and intertidal narrowing. They are, therefore, susceptible to storm damage. Such changes have major implications for future flooding and also for changing patterns of coastal forms.

The authors have used a modelling technique which seem to demonstrate that the various factors which impact on the coast covered by the study are likely to result in the shoreline receding landward and there are likely to be difficulties in retaining beaches in front of protective structures which will have implications both for the nature of the beaches (sand or gravel) and for the local tourist industry (*ibid.*: 21-22). In some locations:

“there are urgent needs for policy decisions that will make space available for a future managed retreat of such environments.”

(*ibid.*:22).

The potential strategies and policy options have been discussed in general terms above (refer 2.6). This section considers their applicability to the study area in the South-East of England, where:

“the high value of assets along the south coast precludes a ‘do nothing’ approach.”

(*ibid.*: 22)

6.4.2 Development pressure in the South-East

PPG 25 (ODPM, 2001: para. 23) recognises that development within flood-plains should be “*wholly exceptional and limited to essential transport and utilities infrastructure.*” The guidance goes on to require that such infrastructure should be

capable of remaining operational during a flood, and should not impede the storage capacity of the floodplain. Thus, there is no indication there of government policy supporting the development of residential properties within a floodplain.

A major study into the environmental impacts of increasing the supply of housing in the UK (DEFRA, 2004: 20), warns against siting new developments in flood-plains as well as the potential for such new developments to increase flood-risks to other areas. However, the three Regional Planning Bodies for the South-East of England have set out in an Inter-regional Planning Statement the broad allocation of 128,500 new homes in the Thames Gateway by 2016, 59,000 of which are to be located in the London Gateway, 43,000 in the Kent Gateway and 26,000 in the Essex Gateway (ODPM, 2004b). There is therefore huge potential for conflict as flood-plains come under increasing pressure to accommodate new residential developments for so-called affordable homes, which will need flood defence protection (refer for example, Graves and Phillipson, 2000: 42-3).

A study on behalf of the UK insurance industry (ABI, 2005c) examines the potential economic and financial costs of flooding arising from additional development in the government's four main designated growth areas in the South-East, and considers the most effective approaches to managing these risks. The four areas identified for development to address housing shortages are Thames Gateway, Ashford, the M11 corridor and the South Midlands. These areas face "... *differing levels of flood-risk, managed to varying degrees by defences of a range of standards and qualities*" (*ibid.*: 7).

In the report foreword, Nick Starling, Director of General Insurance, says:

"The study shows clearly that the new developments ... could increase the costs of flooding by more than £50 million each year if steps to manage potential losses are not taken – a figure that could increase tenfold once climate change effects are felt in full. But with some creative thinking and effective action, this additional flood-risk in the growth areas could be reduced substantially."

(*ibid.*: 3)

The government is urged to develop stronger and more strategic land-use planning policies and guidance to planning authorities, as the most cost-effective and sustainable solution for reducing flood losses and ensuring unnecessary risks are avoided. The report asserts that the right measures could reduce flood-risk to negligible levels in Ashford, the South Midlands and M11 Corridor. The risk could be halved in the Thames Gateway, but here planning measures alone will not be sufficient and increased investment in flood defences is needed to offset the 5% uplift in national flood-risk. Prudent steps to manage the risks of flooding are important to "... *enable insurers to offer flood cover for the new homes in the Government's targeted areas for growth ...*" (*ibid.*: 3).

Mitigation options deemed to be 'climate proofed', include:

- locating development off the floodplain;
- reducing ground-floor living;
- introducing flood resilience measures to construction;
- creating flood compartments;

- flood storage measures; and, potentially,
- SUDs

Options judged not to be climate proofed are:

- locating property to lower risk sites, because climate change could increase flood-risk in future;
- flood defence improvements, because climate change needs to be factored into defence design; and,
- land raising, because elevation cannot be changed after the initial development and could have negative impacts on nearby development.

6.5 Impacts on property values

There has been little research into the impact of climate change and specifically flooding on the value of property for institutional investors (Mansley and Dlugolecki, (2001) is a notable exception) so there is not much guidance as to its effect on either the policy or practice of such property owners. Mansley and Dlugolecki (2001), in a discussion paper to the London Investment Office of the Universities Superannuation Scheme, however, make a convincing case for large institutional (or ‘universal’) investors to engage with climate change.

“If climate change threatens the development of the economy and investee firms, it is in the direct interest of ‘universal investors’ and their beneficiaries to seek to avoid or reduce such threats.”

(ibid., 35)

While recognising that property prices reflect perceived risk of such events as floods, Clark (1998) opines that in practice, property purchasers display a restricted awareness of potential hazards even when this is made clear during the purchase process. This is somewhat supported by the research outlined below.

“It is difficult in such circumstances to evaluate the culpability of purchasers in placing their investment at risk. By extension, this attribution of responsibility might more properly be directed at those with a professional duty of care in this respect ...”

(ibid., 338)

The psychological reassurance of low cost insurance cover for those who have never personally been involved in a flood event may also be significant here.

There has been a little more evidence of academic research into the effect on property values of flood events in recent years. In addition, similar research has been undertaken in Australia and in the USA. This section summarises the relevant outcomes of the research that has been reported.

An academic study (Building Flooding Research Group: Liverpool John Moores University & University of Wolverhampton, 2004) concluded that, while a recent flood event affects the value of residential property (reflected in a range of discounts by valuers), the adverse effect on value of properties at risk of flooding but which have

not yet flooded is marginal. In addition, there is little consistent information available on flooding and flood-risk to valuers who rely most on local knowledge and personal experience. The study also concludes that the loss in value of previously flooded properties is recovered over a number of years, provided that there is no repeat of a flooding event and that the risk of flooding is reduced by preventative or defensive actions.

Regarding insurance, the study (*ibid.*) concludes that the availability of, and conditions attached to, building insurance cover are the key determinant of saleability and value of a recently flooded property. They also find that insurance and mortgage companies have generally responded positively to the increased risk of flooding by continuing cover to previously flooded properties, until December 2002. They also seem to be developing more finely-tuned risk assessment policies, working with local and drainage authorities, and owners on a case-by-case basis, although there was evidence that some still operate on a post code basis.

Eves and Brown (2002) questioned Chartered Surveyors regarding their perception of the effects of flooding on property values in 23 counties in England and Wales. They concluded that there is a direct and significant correlation between flood severity and the reduction in residential property values, although it was recognised that:

- Chartered Surveyors, financiers and insurers are more aware of the impact of flood damage on residential property than are purchasers;
- the reduction in property values is linked to the availability of both finance to purchase and to insurance cover; and
- flood defences (either existing or proposed) have a positive effect on the property market, particularly where flooding is rare.

In a later paper incorporating results of research in both England and Australia, Eves (2002) identifies a direct correlation between the severity of the flood and a reduction in residential property values, which diminishes over time for purchasers, but not for other stakeholders. In addition to those points made above, they conclude (Eves and Brown, 2002) that:

- Chartered Surveyors, insurers and financiers are more aware of the impact of flood damage on residential property than purchasers, who are more concerned about adequate warnings, than flood and clean-up costs, even where insurance is not available;
- the decline in property values is linked more to availability of finance than insurance; and
- whereas design and construction of a flood-resistant property is more important for purchasers, the cost of rectification is of greater concern to financiers and insurers.

However, part of their work (*ibid.*) specifically focused on counties in the South-East of England (Kent, Essex and West Sussex), where it was found that the floods in 2001 caused major inconvenience and that as a result, for example, in Maidstone, there was a 20% reduction in house prices as a result of flooding. In West Sussex, where the flooding was less severe during 2000-01, there was a minimal effect on purchasers, Chartered Surveyors and financiers. Their research also uncovered the

extent to which purchasers pay a premium or require a discount for proximity to rivers, thus balancing the aesthetic advantage with the perceived risk of flooding.

Work by Proverbs and Soetanto (2004) indicates that a recent flood event can adversely affect residential property values and other research has shown this can typically involve a discount to open market of 12% (Wordsworth and Bithell, 2004), depending on the local property market and characteristics of individual properties. The availability of building insurance and the conditions attached to it are also key issues affecting the saleability and value of residential property, since mortgage lending is usually conditional on insurance cover. Insurance and mortgage companies have generally responded positively to increased flood-risk. In the case of the autumn 2000 floods in the UK, insurers agreed to continue cover to affected properties based on government assurances of significant investment in improving flood defences.

In a report based on the UKCIP98 study, Graves and Phillipson (2000) consider the attitude of mortgage lenders to flooding and opine that:

“Few, if any, mortgage lenders would refuse a loan based on the likelihood of the property being affected by climatic change impacts, unless the risk was highlighted in the surveyor’s report.”

(ibid., 39)

However, this could mean that subsequent damage and losses suffered by the lending institutions may imply negligence on the part of surveyors in the same way that losses suffered during the falling market in 1998 were blamed on the valuation profession.

6.6 Comparison from other jurisdictions

It should be recognised that evidence from other countries of the effect on property values following either a flooding event or the withdrawal of insurance cover may be of limited value, largely because of the different social and financial systems affecting house purchase conditions imposed on and asset protection by either state or lending institutions, social and cultural attitudes to risk in general and the perception of the specific risk of flooding in particular. It is relevant to note that the UK is one of the few countries where private insurance schemes have existed for more than half a century and that, for most countries, private insurance is in addition to a state system (Huber, 2004: 1).

6.6.1 Scotland

Since devolution in Scotland, flood defences are the responsibility of the local council, *“which is democratically and legally accountable if it fails to act properly”* (Crichton, 2003: 26). In 1993, storms over Scotland exceeded the severity of storms over the South-East of England, however little damage resulted. This is because the Building (Scotland) Act, 2003 has introduced tougher building standards, thus buildings in Scotland are constructed to reflect the harsher conditions: and thus damage and subsequent insurance claims are significantly reduced. Thus, it seems that altering the construction methods for the South-East of England would improve the resilience of new dwellings and thereby reduce the damage from storms. *“Very simple traditional measures might add only one or two percent to the cost of construction, but would significantly reduce windstorm damage.”* (Crichton, 2003: 24).

As far as flood protection is concerned, unlike in England, the 1 in 200 year standard of protection is 'universal' for all new buildings, with a 1,000 year standard for such vulnerable uses as old people's homes, schools, hospitals etc.. In addition, construction in flood hazard areas has almost completely ended. Critchon (2003: 26) estimates that *"the active flood management programme currently in progress will result in almost all high risk properties being protected against the 200-year flood within the next three years, taking climate change into account."* It is also interesting to note that the Scottish Executive grants for flood defences have never been refused on the grounds of budget restraints and there is no rationing of flood defence spending.

6.6.2 United States of America

In the USA, where insurance cover is underwritten by the state, legislation passed in 1998, requires vendors to inform potential buyers of several types of natural hazards which may affect the property, including flood (Troy, 2001).

Research in the USA into sale prices of houses indicates that comparable dwellings located within a flood-plain sell on average for less than those located outside the flood-plain. However, the price differential is less than the present value of the future flood insurance premiums (Harrison *et al.*, 2001).

In another study, it was suggested that house owners in a 500-year floodplain who are not required by law to purchase flood insurance may not even be aware that their homes are in a flood-plain (Fridgen and Shultz, 1999). However, additional depreciation of residential property values is associated with the increased awareness of purchasers of the risks associated with flooding (*ibid.*).

It seems, however, that research in the USA (Tobin & Montz, 1997) demonstrates that the time taken for a flooded property to recover to full market value depends on the depth of flooding, and in some cases, it can be as long as ten years. In extreme cases, dwellings in the worst areas are abandoned but their continued visible presence has a blighting effect on surrounding properties.

6.6.3 Australia

According to Eves (2002), in Australia, it is not possible to insure a property (building or contents) against flood damage. Any such risk must therefore be reflected in the long-term financial management undertaken by a purchaser. However, because of the extent of the advanced flood warnings issued, the effect is mitigated, at least as far as personal property is concerned.

In Australia, lending institutions will not finance property which is subjected to severe flooding, and funds are not generally available to residential properties where the building floor level is below the 1-in-100-year flood level for over-floor (as opposed to over-land) flooding, as identified by the local authority (*ibid.*).

It seems that, in the face of government resistance to toughen building standards in Australia, the finance sector has produced its own set of building standards appropriate for mortgages and insurance (the Blue Book) for certain types of properties. *"Builders have learnt to ignore the government standards and use the Blue Book instead."* (Crichton, 2003: 25). This is clearly a potential solution for England, particularly given the application of more stringent regulations in Scotland and the apparent enhanced storm protection achieved.

Eves' (*ibid.*) research concludes that not only are flood-labile properties less valuable than comparable flood-free properties, but that the reduction in value varies

according to the time which has elapsed after the latest flooding event. Also, in times of strong buyer demand and limited supply, the market does not consider flood-risk to be a major factor in the decision to invest.

6.7 Summary

Estimates suggest that in England and Wales over £220 billion worth of property is potentially at risk of flooding or coastal erosion. The greatest risk is from sea and tidal flooding (59%), followed by river flooding (34%). Potential losses from coastal erosion are relatively small (3%). About 50% of the property at risk by value is in the Thames region, dominated by London. However, estimates of property at risk vary because the data is not comprehensive and, while it is possible to obtain an indication of the number and the order of value of property potentially affected, lack of information about the size and use of commercial properties means that impacts on local and regional economies are not identified.

The coastal zone is highly important to the economy in England. It is occupied by 10 million people (within 10km of the coast), accounts for 40% of manufacturing industry, 40% of tourism expenditure and contains a concentration of energy installations. About a third of the coast has some sort of defences protecting around 160,000 domestic and commercial properties and 1.5m people. Unless the quality and level of protection of existing coastal defences keep pace with the effects of climate change and they continue to afford the same level of protection, then an increase in economic damage from flood events year-on-year is to be expected. However, small-scale investments to alleviate the most frequently occurring flood events can produce the highest returns, emphasising the difficulty of defining broad national policies and the importance of considering situations individually.

In South-East England, the combined effects of rising sea level and land subsidence make coastal areas particularly vulnerable to wave exposure and tidal surges. Evidence from the West Sussex, Hampshire and Dorset coasts shows that virtually all cliffs and most natural beaches are retreating. Where coasts are unprotected, it is anticipated that sediment eroded in one area will be deposited elsewhere. The concept of sacrificial coasts is therefore likely to become a major factor in future coastal management. However, protected coasts controlled by artificial defences cannot adjust naturally and can neither retreat nor supply sediment to shore up adjoining areas. It therefore seems that the south coast can be expected to retreat landward and that there will be difficulties retaining beaches in front of protective structures, increasing the risk of overtopping, structural damage and losses to local tourism.

Despite warnings against placing new developments in flood-plains, regional plans for the South-East include 128,500 new homes allocated to the Thames Gateway by 2016, particularly to provide much needed 'affordable' housing. The Association of British Insurers has urged the government to develop stronger and more strategic land-use planning policies and guidance to planning authorities, as the most cost effective and sustainable means of reducing flood losses and avoiding unnecessary risks. However, in the Thames Gateway planning measures alone are judged insufficient and increased investment in flood defences will be needed, although any actions must be fully 'climate-proofed'. The potential for conflict resulting from development pressure and increasing flood-risk is therefore clearly significant.

There has been little research into the impact of climate change, and specifically flooding, on the value of institutional investment property. This study identifies one discussion paper by Mansley and Dlugolecki (2001) for the Universities Superannuation Scheme. There has been more research in recent years into

flooding impacts on the value of residential property, including studies from Australia and USA.

UK-based research has shown that, although recent flood events affected property values, the effect on properties at risk, but which have not yet flooded, is marginal. There is also a significant correlation between flood severity and reduction in residential property values. Whereas a recent flood event can typically result in a discount to open market value of about 12%, severe floods in 2001 resulted in a 20% reduction in house prices in Maidstone, Kent, whereas less severe flooding in Sussex had a minimal effect.

Previously flooded properties recover their value over a number of years, provided there is no repeat event and preventive or defensive actions are taken. Flood defences, existing or proposed, are shown to have a positive effect on property values.

In the UK, the availability of building insurance and the conditions attached are key to the saleability and enduring value of residential property, since mortgage lending is usually conditional on insurance cover. Although research indicates there is little consistent information available to valuers on flooding and flood-risk, most rely on personal knowledge and local experience. Chartered Surveyors, lenders and insurers also tend to be more aware of the impact of flood damage on property than do purchasers. It is also suggested that few mortgage lenders would refuse a loan based on the likelihood of the property being adversely affected by climate change impacts unless this risk was highlighted in the surveyors report. This could mean that, in the event of subsequent damage and losses lenders may seek to imply negligence on the part of surveyors.

It is clear, however, that the more stringent building standards which are applied in Scotland ensure that severe storms result in much less property damage than comparable events in England. Also the level of flood protection and the commitment of funding to achieve flood protection are higher in Scotland than in England.

Evidence from other countries about the impact of flooding on property values should be treated with caution, because of the different conditions attaching to house purchase, lending, asset protection and risk perception. The UK is one of the few countries where private insurance schemes have existed for over 50 years and in most countries private insurance is in addition to a state system. That said, some examples from other jurisdictions are relevant.

In the USA, where insurance is underwritten by the state and legislation requires vendors to inform buyers of potential natural hazards, houses in flood-plains tend to sell for less than those located outside flood-plains. In extreme cases, abandonment of flood-damaged homes has also blighted surrounding properties. In Australia, government resistance to tougher building standards has led the finance sector to produce its own standards applied when applications are made for mortgages and insurance for certain property types, and which builders have learned to adopt. This is clearly a potential lesson for the UK.

7. QUESTIONNAIRE RESULTS AND ANALYSIS

7.1 Introduction

This chapter discusses the results from the postal questionnaire undertaken in June and July 2005. The questionnaire was designed to gather perceptions of flood-risk amongst stakeholders in the property sector and was sent to developers, lenders, occupiers, investors and valuers covering the residential and commercial sectors.

Of the 1,231 questionnaires sent, 121 were completed, a 9.8% response rate. A non-response follow-up to investigate the reasons for non-response sent to 1,108 produced 231 replies (20.8%). This showed that the main reason for non-response was lack of experience of flooding (43%). Non-respondents to the first questionnaire were also asked to complete one of the common questions about their perception of flood-risk, which boosted replies to this question.

A full discussion of the questionnaire methodology can be found in Appendix 1.

The analysis has been divided up into the following sections:

- a description of respondents' characteristics;
- perceptions of flood-risk;
- strategies for dealing with flood-risk; and
- perceptions of flood-risk in London and the South-East.

7.2 About the respondents

Across every stakeholder group, the size of the firm respondents worked for included small, medium and large organisations.

Most of the occupiers, developers and investors believed that of the property in their portfolios the amount at risk from flooding was between 0 – 25%. Over half of all respondents had experience of dealing with flooding in relation to property - this is particularly true of investors (71%).

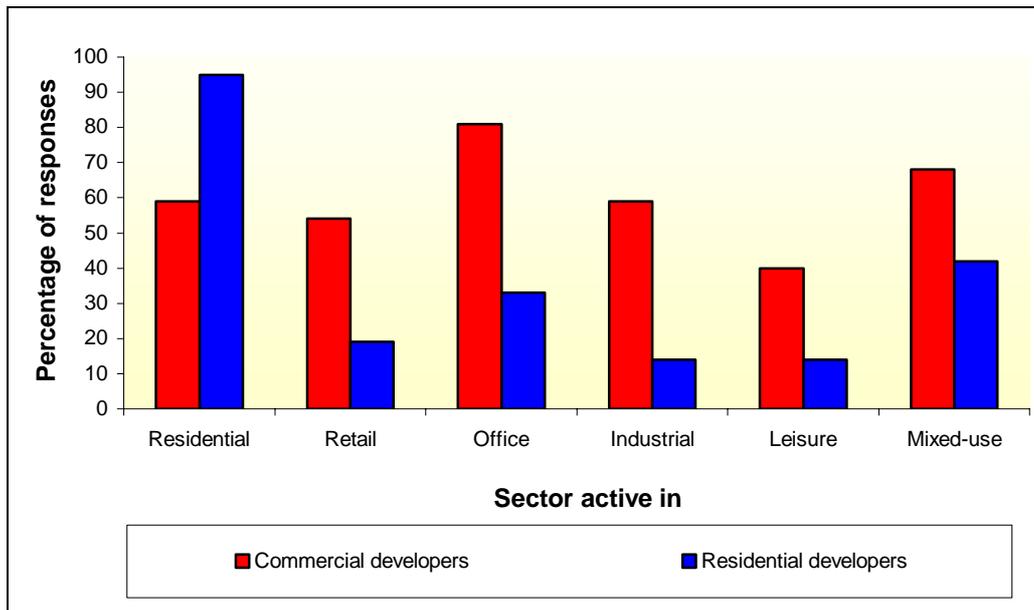
The nature of the respondents in each stakeholder group is now described in order to set the following data analysis in context.

7.2.1 *Developers*

The 43 responses from developers were almost equally split between commercial (22) and residential (21).

The commercial developers completed most of their development in the office market (81.8%) followed by mixed-use schemes (68.2%). Almost 60% of commercial developers also undertook residential development and about 31% had completed housing schemes in 2004/05 (see Figure 4). 13% of the commercial developers had not completed any developments in 2004/05.

Figure 4 The sectors in which the commercial and residential developers are active



Of the 17 commercial developers who reported the size of projects they were involved with during the previous year, respondents had completed over 1,092,477.04 sq m (11,759,325 sq ft) of development (retail, office, industrial and leisure), built 553 housing units and acquired sites totalling 931.91 hectares (2 302 acres). Schemes ranged from small retail projects of 278.7 sq m (3,000 sq ft) to large industrial schemes of 557,418.24 sq m (6,000,000 sq ft). Site acquisitions ranged from one to 647 hectares (2.471 - 1,598 acres).

Almost two-thirds of the commercial developers said 0% – 25% of their sites were subject to flood-risk, and the remaining third said 26% – 50% of their sites were at risk. Further, some 68% had some experience of flooding.

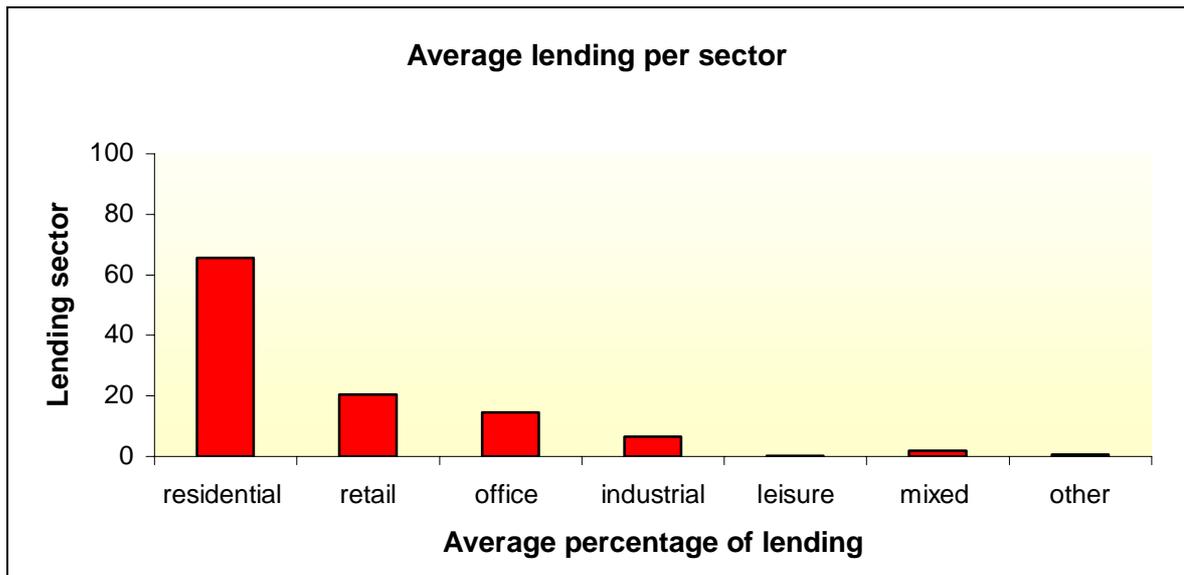
Amongst the residential developers, 95% had completed residential schemes during the previous year. The total number of units completed by all the respondents during the previous year was 5,681 and site acquisitions totalled 1,152 hectares (2,846 acres). Scheme size ranged from 5 units to 3,805 units and site acquisitions from one to 809 hectares (1,999 acres). Over 57% of residential developers had also been involved in commercial development, mostly mixed use schemes (42.9%).

On the issue of flood-risk, 86% of the residential developers said 0% – 25% of their sites were at risk of flooding and 5% said that a high proportion of their sites were at risk, that is 76% – 100%. Just over 71% of the residential developers had experience of flooding on a development site in the past five years.

7.2.2 Lenders

The 14 responses from lenders showed that they had been involved in a total of approximately £39 billion of lending in the previous year, ranging by company from £40 million to £25 billion. Most lenders were involved in the residential, retail and office sectors. By value of lending, the most important sector was residential (see Figure 5).

Figure 5 Lending per sector



7.2.3 Occupiers

Of the 21 occupier respondents, around 42% had over 5,000 employees. The response was therefore characterized by large employers and may therefore be more reflective of the perception and strategies of large firms, rather than SMEs and micro-companies.

The occupiers came from a wide range of sectors, with the largest group working in retail (38%) (see Figure 6). Amongst the occupiers, 81% believed that 0-25% of their properties were at risk of flooding. There was an almost even split between the number of occupiers who had and had not been affected by a flood event.

7.2.4 Property investors

The majority of the investor respondents (about 67%) worked in property companies, as shown in Figure 7, and most (over 97%) held 100% of their assets in property, so they had extensive experience in property-related issues. Over 71% of the property investors believed that 0-25% of the property in their portfolios was located in at-risk areas and about 39% had experienced a flood at one of their properties in the past five years. The respondent investment companies ranged greatly in size and during the previous year had invested between £105,000 to £800 million in property.

Figure 6 Occupier respondents by industry sector

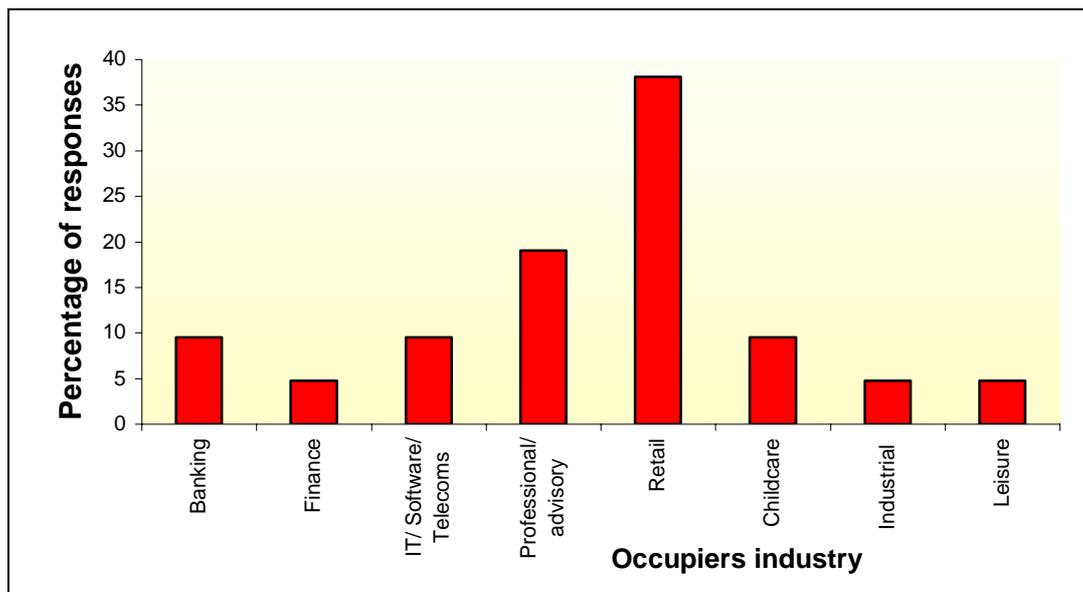
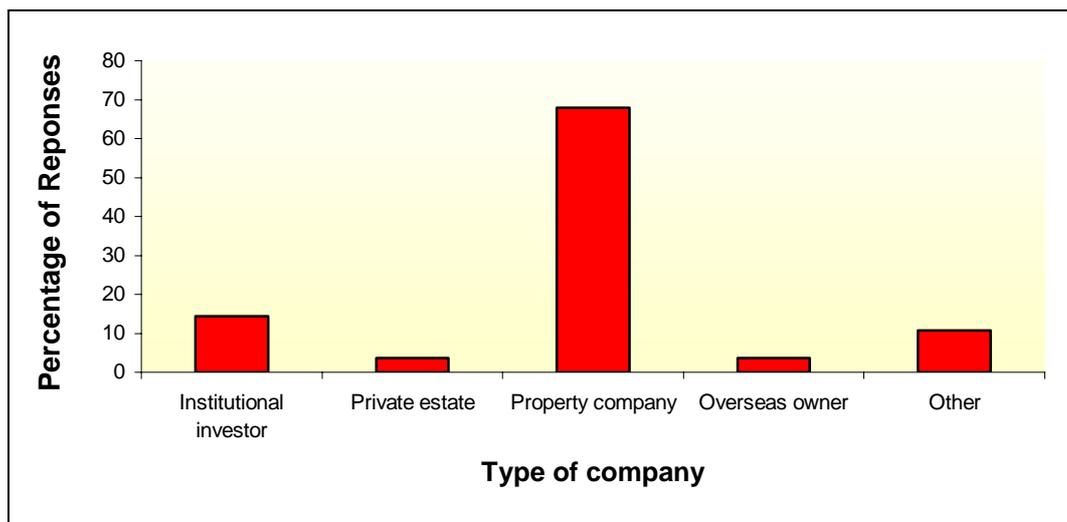


Figure 7 Investor respondents by company type



7.2.5 Valuers

Of the 15 valuers who responded, most had experience of valuing in all property sectors, having conducted 1-10 valuations by sector during the previous year. One valuer reported undertaking 50-100 valuations in the mixed-use sector (see Figure 8). The respondents therefore had a breadth of experience in valuing properties in different commercial categories.

In terms of flood-risk, 60% of the valuers had experience of valuing property located in flood-risk areas, which means the responses are based largely on knowledge rather than simply a perceived understanding of the flood-risk issues. The valuers worked for a range of clients, including institutional investors, private estates, property companies, overseas owners and banks. The majority of valuations were

undertaken for banks or lenders. None of the valuers conducted valuations for overseas owners. Most were involved in valuations for loans or sale advice, but a few of the valuers had been asked to undertake valuations for performance measurement purposes (Figure 9).

Figure 8 Number of valuations undertaken in each sector.

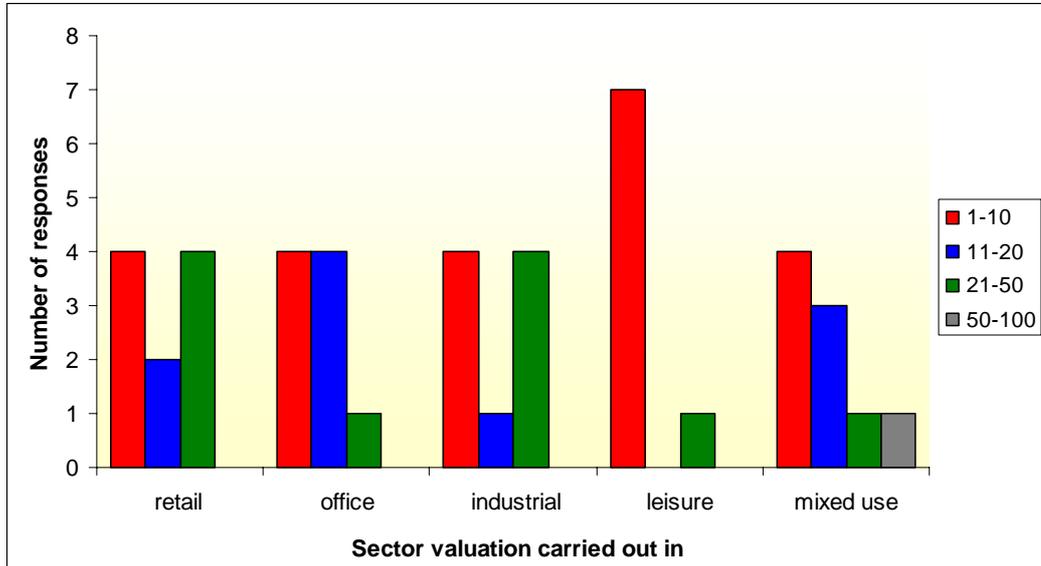
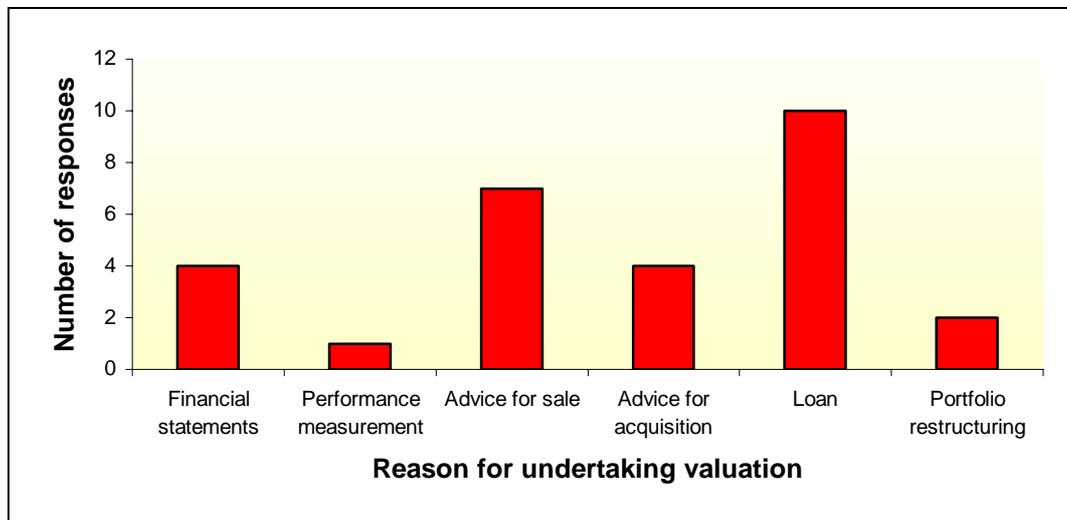


Figure 9 Reason why valuation undertaken



7.3 Perceptions of flood-risk

This section discusses the responses to common questions to all the stakeholder groups, which sought to measure their perception of flood-risk compared to other environmental perils and to identify issues which may influence their perception of flood-risk.

7.3.1 Ranking flood-risk against other environmental perils

Respondents were asked to rank the relative importance of flood-risk, contamination, storm damage and subsidence. The response to this common question was boosted by the follow-up questionnaire to 'non-respondents', giving a total of 352 responses to this question (a 28.6% response rate).

Figure 10 shows how the different stakeholders ranked each peril, whilst Figure 11 shows the average for all the stakeholder groups and compares the original response with the fax-back non-response follow-up, which also explored reasons for non-response.

As can be seen, taking an average score, all the stakeholder groups attached greatest importance to contamination risk, especially the investor group. The emphasis on contamination is interesting because this factor is more highly regulated through existing legislation and may indicate that environmental factors are considered in terms not just of their physical impact on a property, but also in terms of their secondary impact resulting from legal liabilities, regulatory obligations, or duties, which can have a significant impact on investment value. Also the issue of contamination has been widely covered in the professional and the industry press in recent years, giving it a relatively high profile.

All stakeholder groups ranked storm damage the least important of the perils, except for the occupiers group, where approximately 23% ranked it as a very important issue. Overall, the average scores for the occupier group show the least differential between the four perils, suggesting that they view their level of exposure or opportunity to mitigate these risks as more evenly spread.

The average ranking by the valuers and lenders groups show a similar pattern, which is consistent with the fact that property lending valuation is an important area of business for the valuer respondents and that they might be expected to be in tune with their clients attitude to risk.

The commercial, residential developers and property investors all followed a similar pattern of ranking the different perils, with contamination, flood-risk, subsidence and storm damage in that order.

The comparison between responses to the original questionnaire and to the non-response follow-up illustrated in Figure 11 shows a similar ranking for contamination and flood-risk, but differences in the ranking of subsidence and storm damage. Whilst this comparison is limited, because it is based on the analysis of just one question, it suggests that the perception of flood-risk was not greatly different amongst the original respondents, more of whom had experience flooding, as against the 'non-respondents', many of whom (43%) did not complete the full questionnaire because they said that they lacked of experience of flooding.

Figure 10 Respondents' ranking of environmental perils

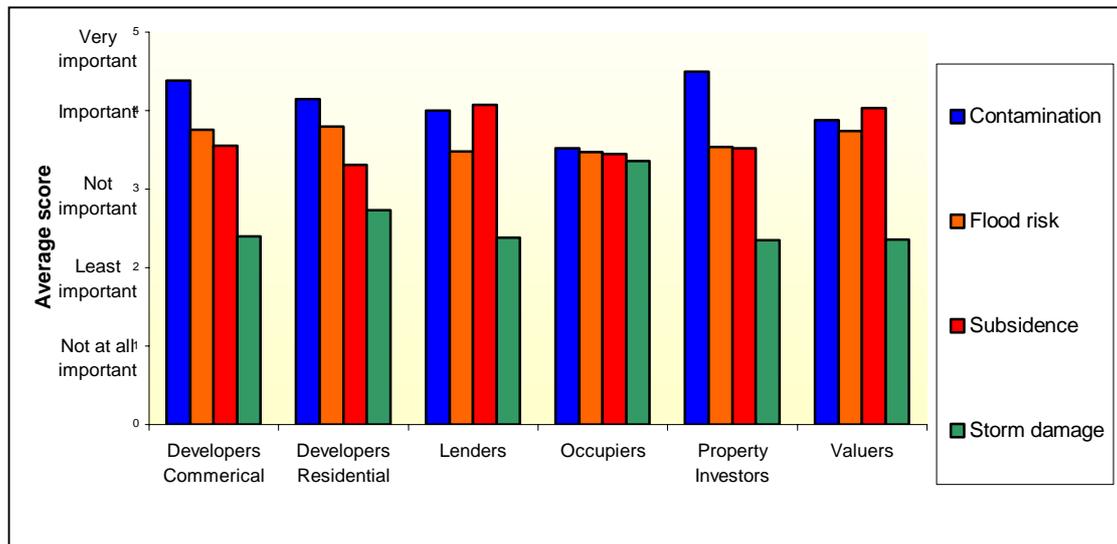
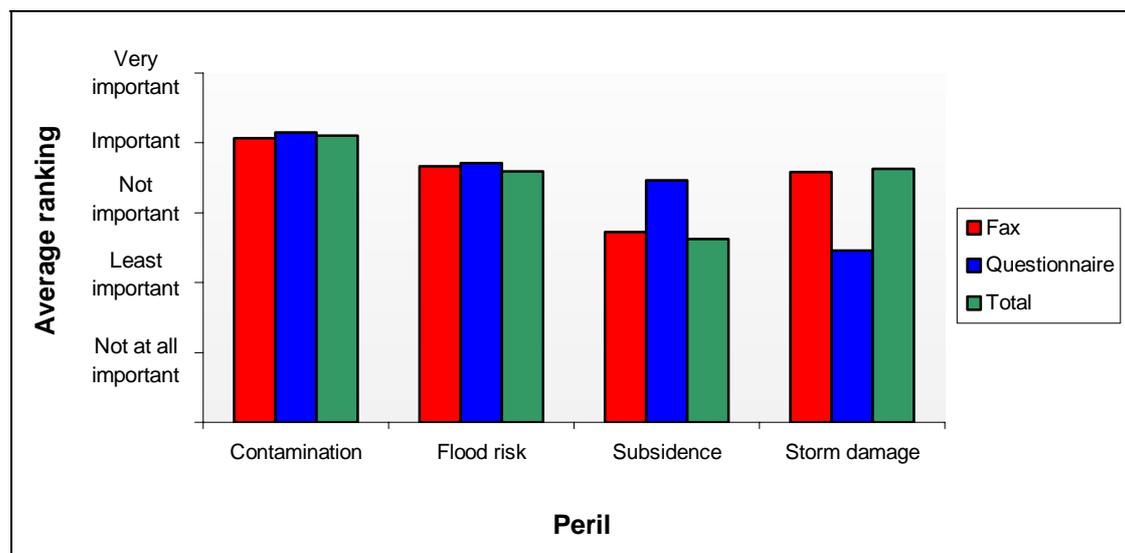


Figure 11 Ranking of perils comparing questionnaire responses with 'non-response' follow-up



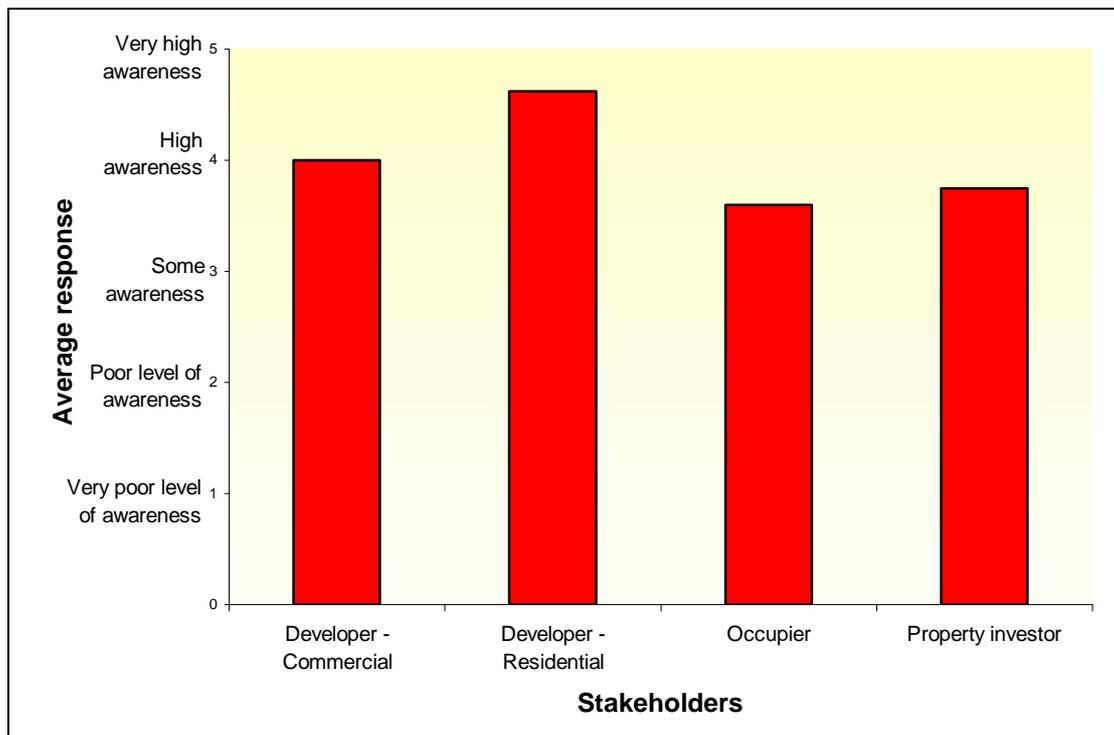
7.3.2 Flood-risk awareness

Developers, occupiers and investors were asked about the level of awareness of flood-risk within their company, given that the primary responsibility for safeguarding property against flooding rests with land owners (see section 4.5).

Largely, these stakeholders felt that there was a high level of awareness about flood-risk issues within their company (see Figure 12), especially the residential developers. Developers' awareness might be expected to be raised following recent changes to planning policy guidance on flood-risk (PPG25) and the role of the Environment Agency as a statutory consultee on planning applications (see section 4).

The only respondents to say they felt that there was very poor awareness of the issues within their company were some of the occupiers. This is interesting because it could be argued that businesses in occupation should be the most physically affected by a flood event and therefore could be expected to be more mindful of the potential risk.

Figure 12 Awareness of flood-risk within respondent's company



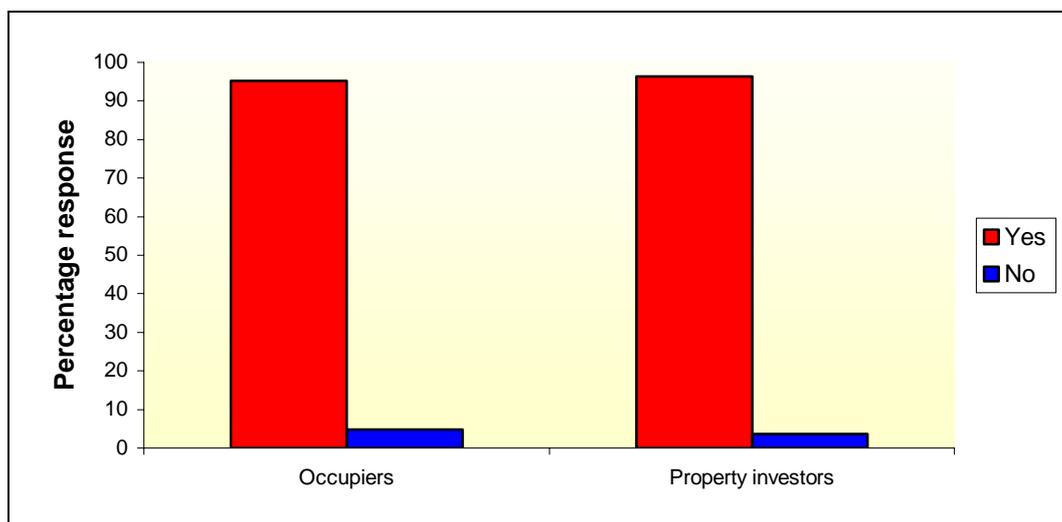
7.3.3 Flood-risk insurance

Most occupiers (95%) and property investors (98%) felt they were adequately insured against flood-risk (see Figure 13).

However, recent events suggest that firms tend to over-estimate the amount of cover provided by their policy. For example, a report on the aftermath of the Buncefield Oil Depot blast (Hodgekiss, 2006) showed that the micro and small companies in the vicinity of the oil depot had been worst hit, with many experiencing uninsured losses, such as relocation fees. Small firms tend to suffer from poorer contingency planning

and less comprehensive insurance cover, leaving them more vulnerable to major disasters. A report by AXA (2003) also showed that despite insurance, 80% of businesses affected by a major incident either never re-open or close within 18 months. The ability to re-open quickly is crucial as even a short interruption to normal business can damage customer relations. Following a flood event, it can take many months to reinstate property, therefore an alternative location can be vital to continued trading.

Figure 13 Whether occupier and property investors feel adequately insured



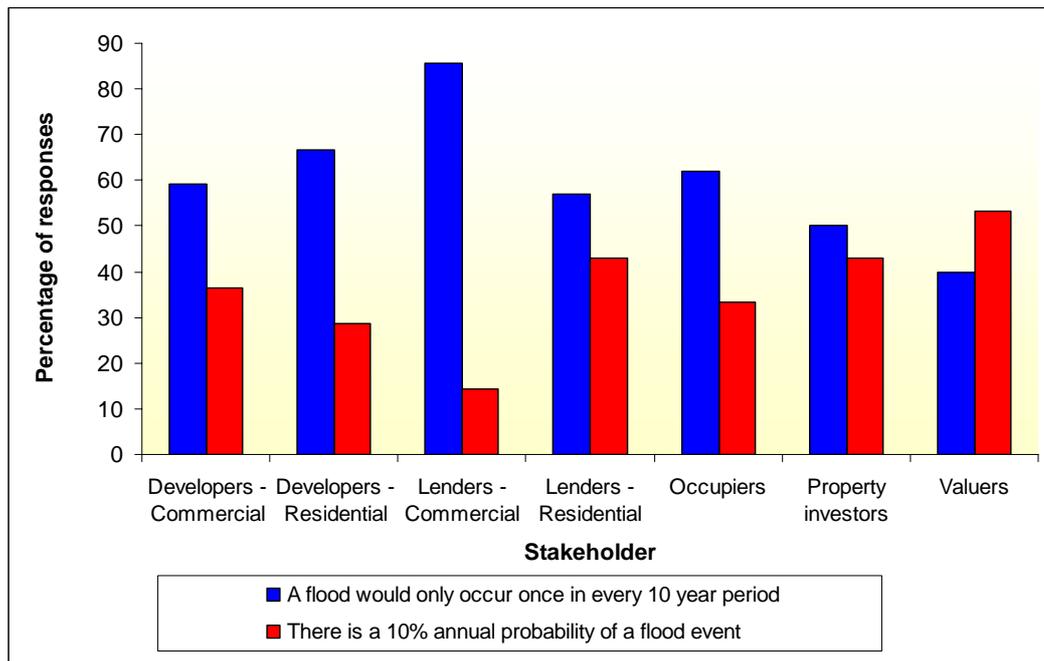
7.3.4 Understanding flood-risk

Flood-risk has tended to be expressed as a ratio, for example an area might be identified at risk of a '1 in 100 year return flood'. However, the terminology is now being changed to a '1% annual flood-risk', to avoid the perception that after a major flood there is unlikely to be another for the next 99 years and to recognise that the odds are the same each year. Some documents still contain the old terminology and the research questionnaire tested respondents understanding by asking them to choose between two different definitions of the term '1 in 10 year return flood'; the options were:

- A flood would only occur once in every 10 year period; or
- There is a 10% annual probability of a flood event.

While the correct answer is the second option, most respondents did not correctly interpret the term, and this was especially so for the residential developers. This calls into question the belief amongst most of the residential respondents that their company had good awareness of flood-risk issues. and shows that the language used in describing flood-risk has not been well understood. The response therefore supports the need to change the terminology and improve understanding, because understanding the probability of a flood occurring is crucial to devising an appropriate response and to managing the risk.

Figure 14 Comparison of how the different groups understood the term ‘1 in 10 year return flood’

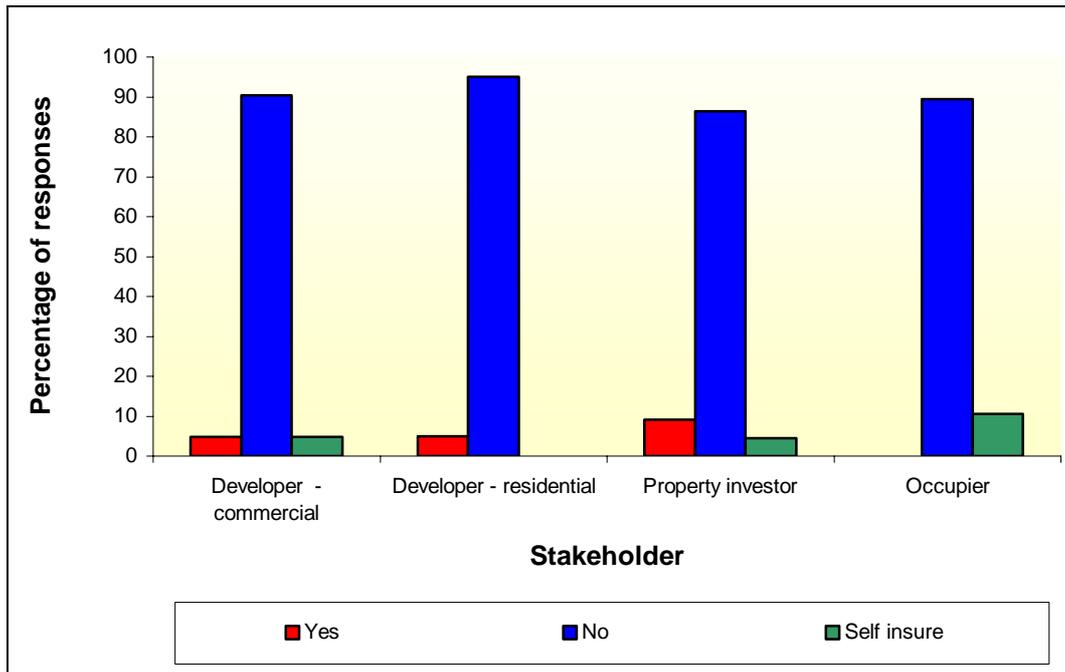


7.3.5 Obtaining insurance

Amongst the developers, occupiers and investors, 90% said that they had not experienced any difficulty in obtaining insurance because a site or property was located in a flood-risk area. Of the 4.9% who had experienced difficulty, this had resulted either in higher premiums or in a higher excess being placed on the policy, with no one having been refused cover, nor had flood damage been totally excluded from the policy. A small proportion of respondents (but not residential developers) self-insured. Self-insurance was most common amongst occupiers (10.9%).

As suggested by findings from the literature review (see section 5) it is possible that the ability to obtain flood insurance without difficulty has influenced respondents' perception of flooding, in that this risk is not then considered a threat to the financial security of the existing or future stakeholders.

Figure 15 Difficulty obtaining insurance for property in flood-risk area



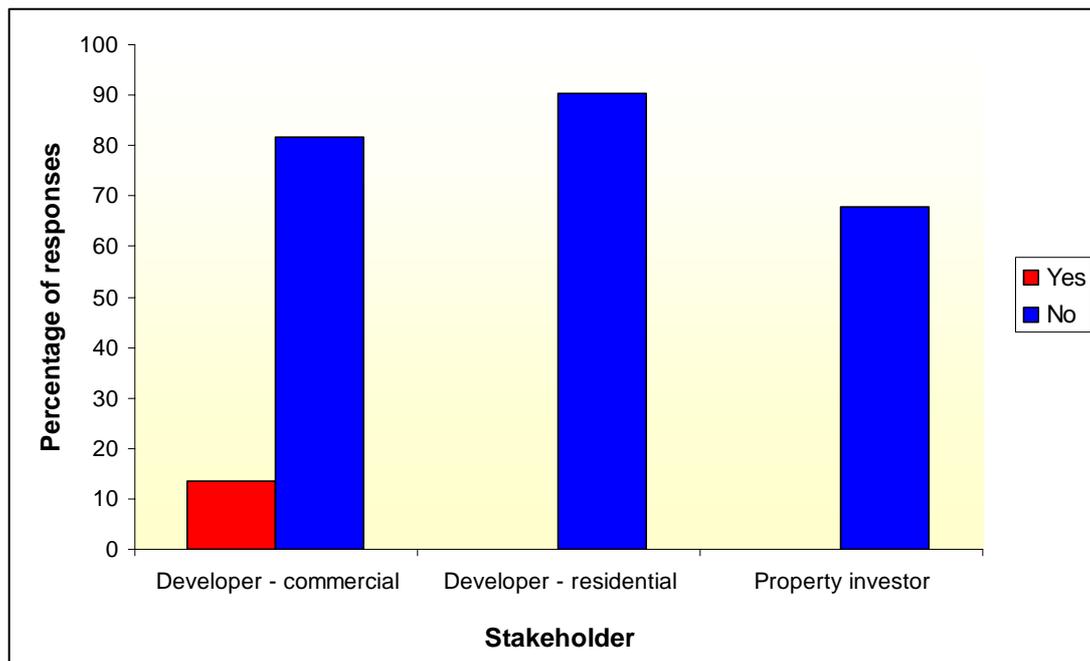
7.3.6 Obtaining finance

Amongst developers and investors, 94% had not experienced any difficulties with obtaining finance for development projects located in flood-risk areas (see Figure 16).

Only three of the commercial developers had experienced any problems obtaining funding and just one had been refused a loan.

As with insurance, the ease of obtaining finance may have an influence on respondents' perception of flood-risk.

Figure 16 Difficulty obtaining finance for property in flood-risk areas



7.4 Stakeholders' strategies

To identify how flood-risk might influence the strategies of different stakeholders, each group was asked how they would respond to a series of different flooding scenarios. This section discusses the findings for each group.

7.4.1 Developers

1. Flood-risk assessments

All commercial developers in this research would conduct a flood-risk assessment (FRAs) on a site as soon as it was under consideration for development (see Figure 17). Almost three-quarters of residential developers would take similar steps. However about 19% would wait until after the site acquisition, although this may include those who take options on sites which last for a number of years, where the financial commitment and exposure is considerably less until the option to purchase is exercised. A small percentage of residential developers would only conduct an FRA if requested to by the Local Planning Authority (LPA).

The information source for the FRA most relied on by both developer groups was the Environment Agency guidance (commercial developers 81.8% and residential developers 95.2%), followed by information from the planning authorities. They also used historical data about sites and relied on local knowledge (locals, estate agents, etc.) to aid their flood-risk assessments.

2. Flood-risk scenarios and development strategy

The developers were asked how they would adjust their company's strategy to developing a site based upon six different flood-risk scenarios (see Figure 18).

Both the commercial and residential developers were likely to abandon their development plans if flood insurance was not available for their project or if the site

had experienced flooding in the past five years and had been subject to an insurance claim for damage. This shows the important relationship between flood-risk, insurance cover and development strategies.

The results also show how the presence of defences can impact on the strategy of both commercial and residential developers. Where the level of flood-risk was 1%, but no flood defences were in place, most developers would be more cautious and develop for a less sensitive use. Also as the level of flood-risk increases from 0.5% to 1% then most developers become more cautious about undertaking development. Interestingly, the strategy responses were similar whether the risk of flooding was 0.5% and with no defences or 1% and with defences in place.

Figure 17 The stage at which developers undertake a flood-risk assessment

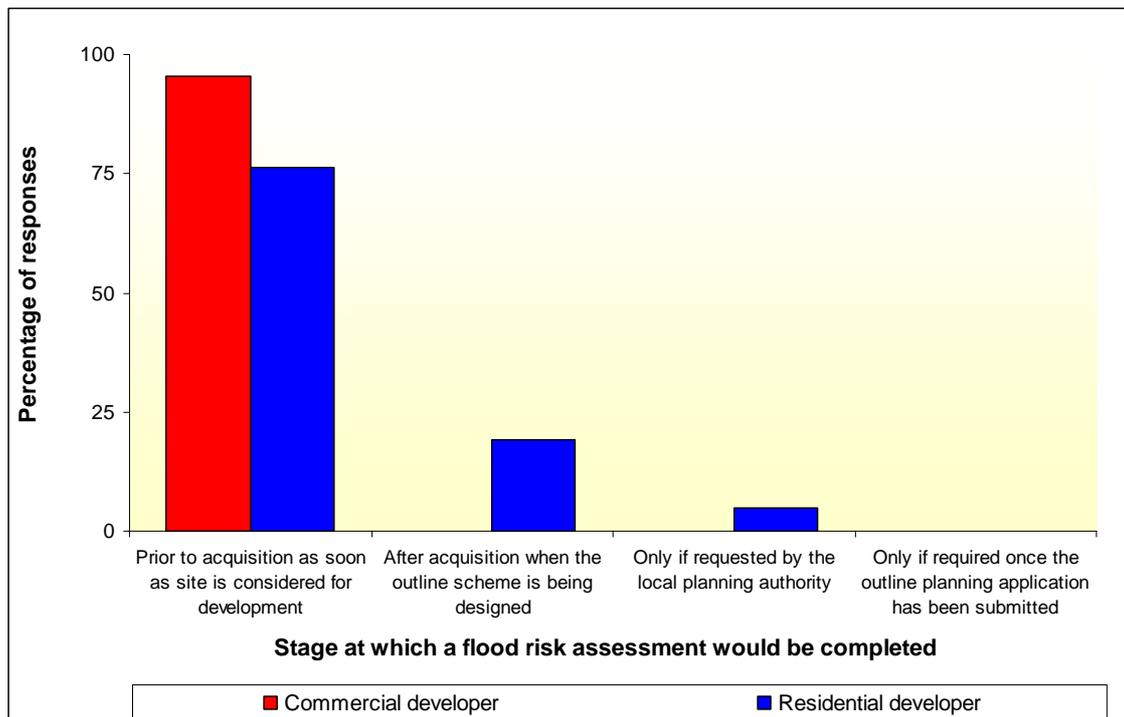


Figure 18 The impact of different flood-risk scenarios on commercial developers strategies

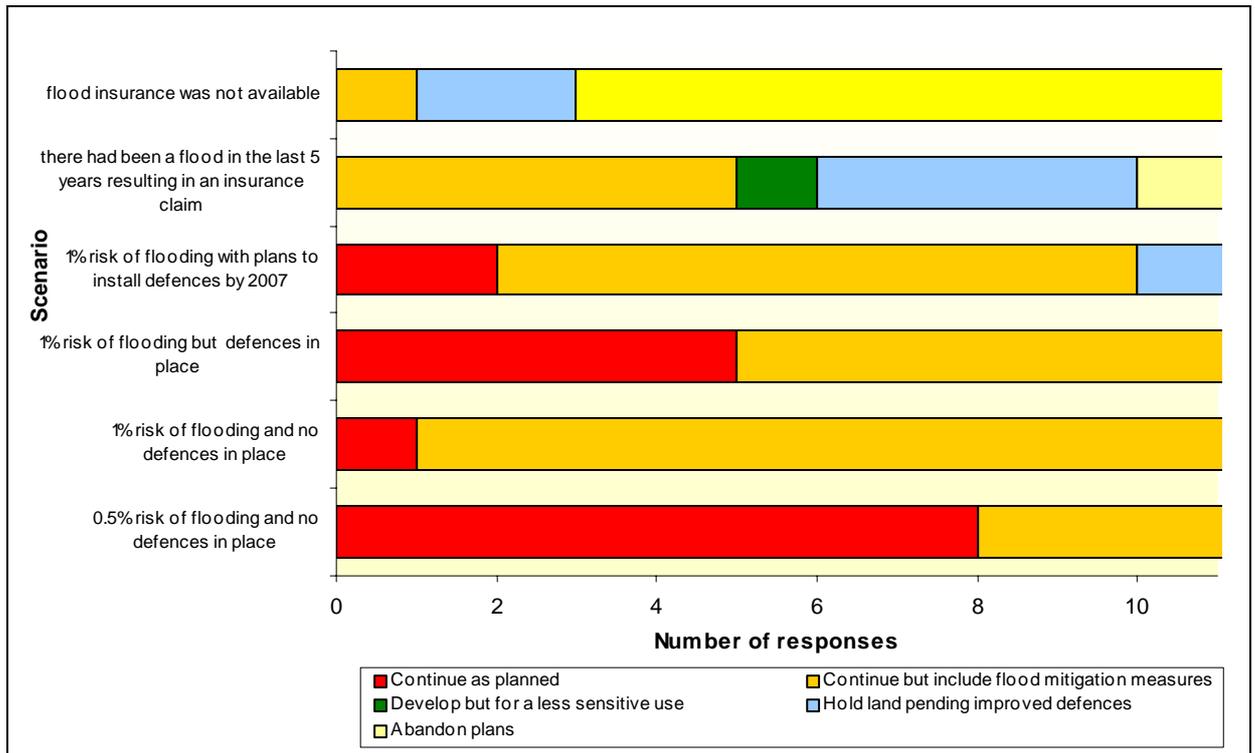
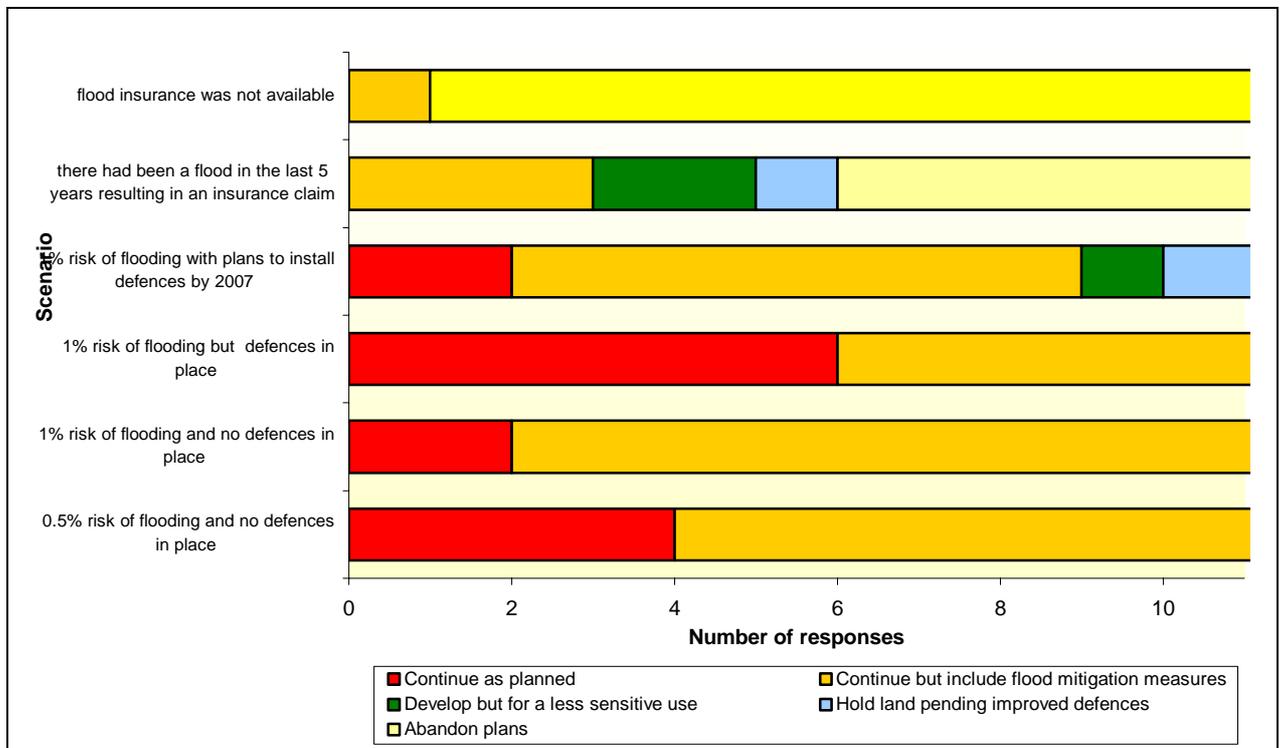


Figure 19 The impact of different flood-risk scenarios on residential developers strategies



3. Environment Agency objections

Where a proposed development is on a floodplain the LPA will normally consult with the Environment Agency. However if the Environment Agency objects to a scheme on the basis of flood-risk the LPA may still grant planning permission, contrary to the Environment Agency's advice, because of other material considerations which LPA deems to be more significant.

The Environment Agency periodically produces a report on planning applications to assess the impact of their advice on planning decisions made in England (Environment Agency, 2006a). The most recent edition showed that the majority of decisions (92%) were in line with their advice.

However, the research questionnaire sought to understand what developers would do if planning permission was granted contrary to Environment Agency advice. This is significant because the insurance industry has indicated that insurance cover for home purchasers may have to be more closely monitored on schemes built against the Environment Agency's advice.

The response showed that where permission is granted contrary to the Environment Agency's advice, most commercial and residential developers would proceed with their schemes, but modifications would be made to accommodate the concerns raised. However, a small proportion of residential developers would opt for abandoning the scheme altogether, whilst about one-fifth of all the developer respondents would proceed with their schemes as planned, which could be of concern to future owners, occupiers and insurers.

4. Use of flood-mitigation measures

Developers were asked how often flood-mitigation measures were used on development sites and within buildings at risk of flooding. The mitigation options are different for commercial and residential schemes with regard to the use of space, floor levels and services installations (see Figure 22 and Figure 23).

When implementing flood-mitigation measures across development sites, the most popular option was to raise the ground level of the development. The residential developers were more likely than the commercial developers to install a Sustainable Urban Drainage System (SUDs) in their development schemes, whereas more commercial developers installed flood-water stores.

In relation to mitigating flood-risk for individual buildings, residential developers generally made greater use of building specific measures than commercial developers and were particularly inclined towards raising the ground floor level of buildings. Both residential and commercial developers sometimes implemented wet proofing of buildings and installed anti-flooding devices into the building's foul drainage system.

Figure 20 Developers' response in case of planning permission granted contrary to Environment Agency advice

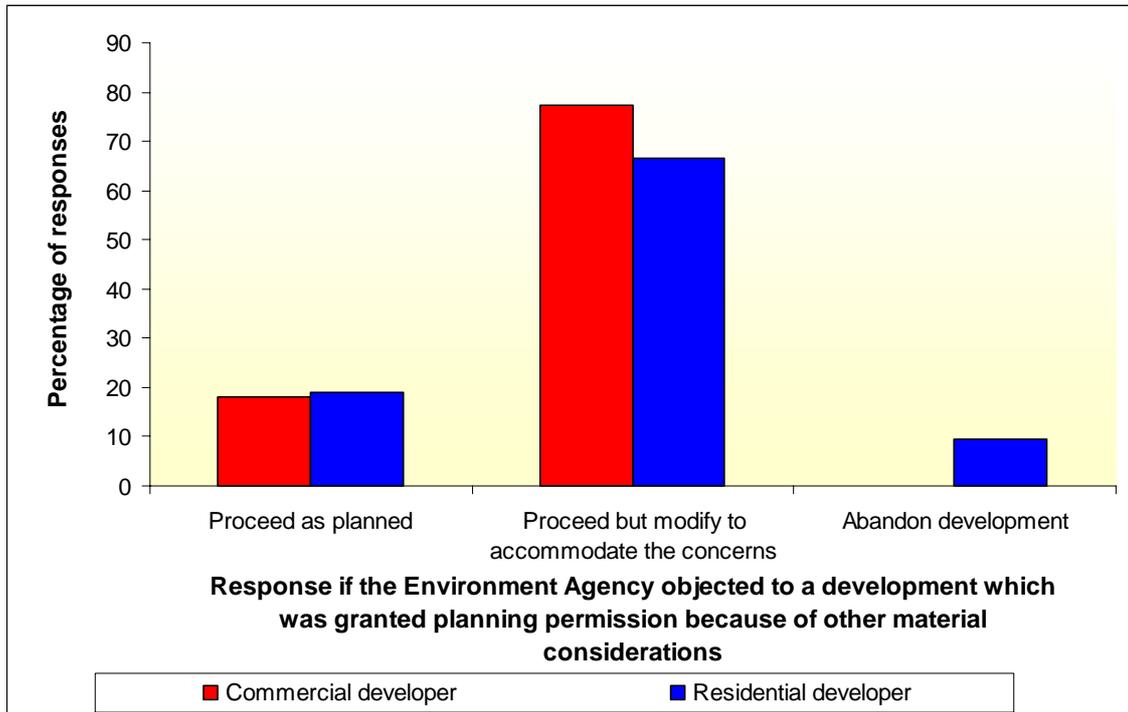


Figure 21 The use of flood-mitigation measures by developers across whole development schemes

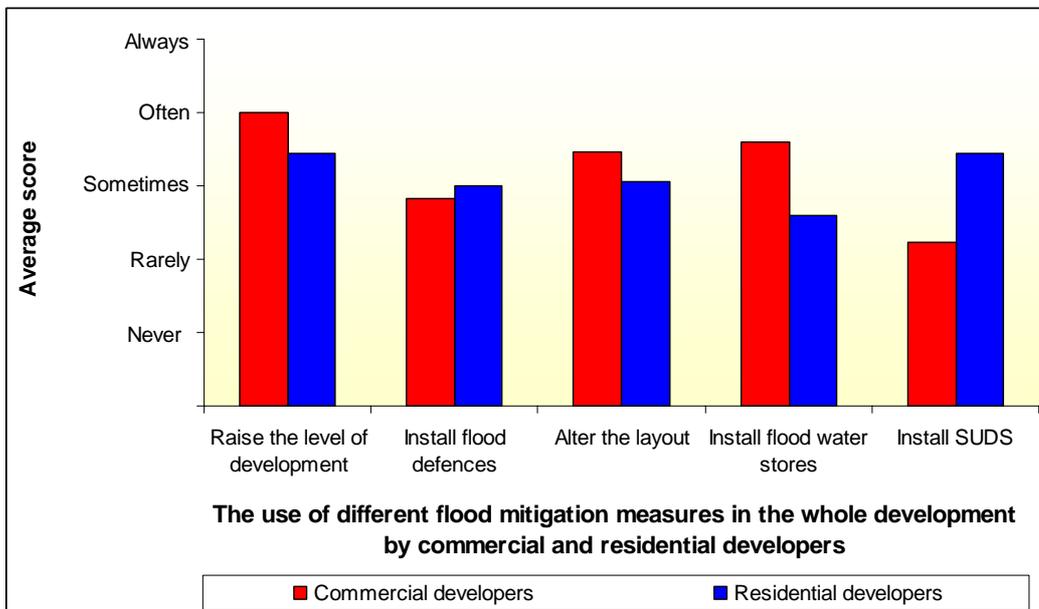


Figure 22 The use of building specific flood-mitigation measures by commercial developers

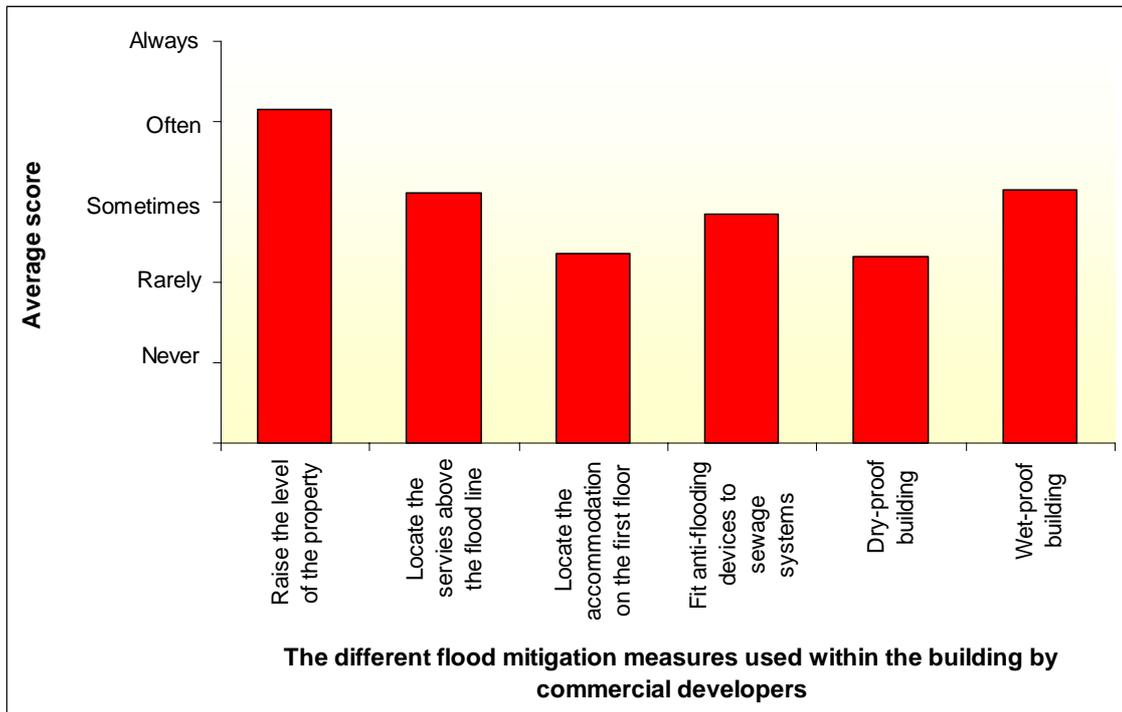
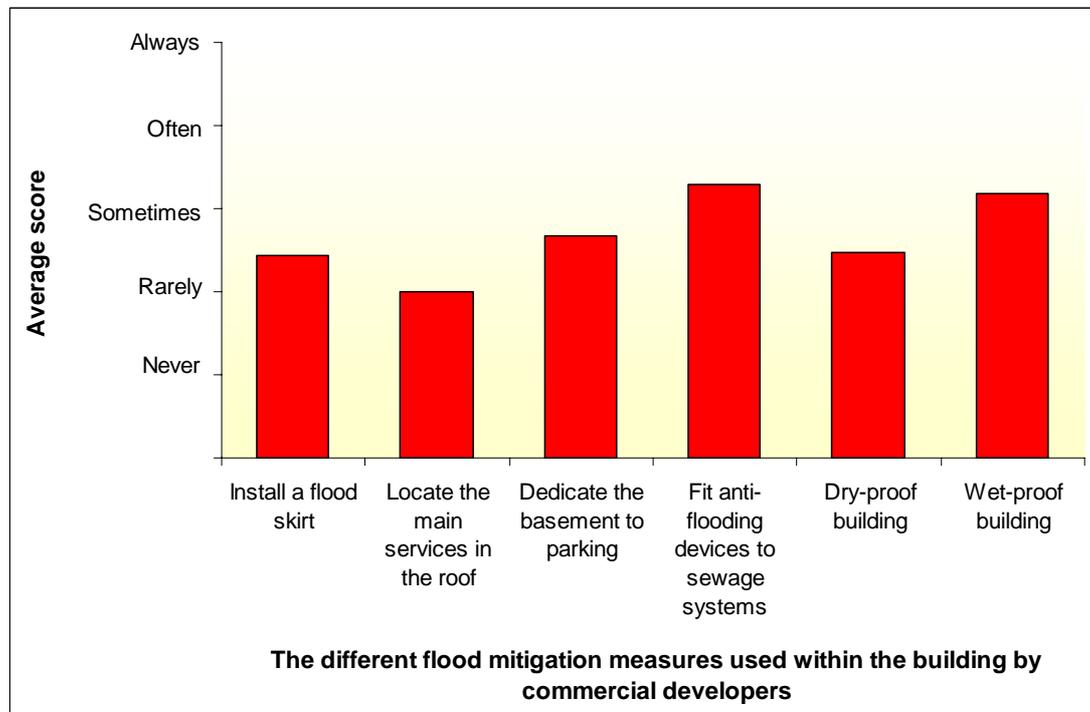


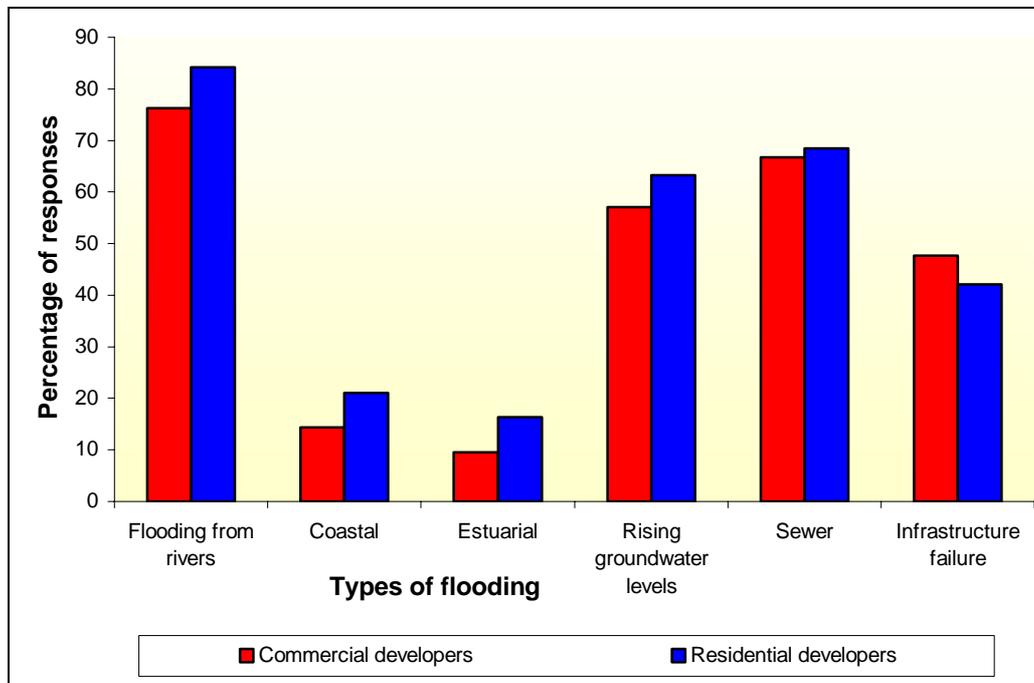
Figure 23 The use of building specific flood-mitigation measures by residential developers



5. The success of flood-mitigation

Developers were asked which types of flooding they felt could successfully be mitigated against. As can be seen from Figure 24, most believed they could successfully deal with flooding from rivers, followed by problems from sewers, rising ground water and infrastructure failure. Less than 20% believed they could successfully counter coastal and estuarial-related flooding.

Figure 24 Perceived success of flood-mitigation measures



About 27% of commercial developers and 19% of residential developers were investigating new methods of mitigating against the threat and damage of flooding. Of those who were looking into new techniques, the main measures being examined were ways to provide more floodplain capacity, new flood defence structures and raised floor designs for buildings.

However, most of the respondent developers were not investigating new methods of flood-mitigation, possibly because they were choosing not to undertake developments in flood-risk areas, since 22% of the commercial developers and 19% of the residential developers in this research had abandoned site acquisitions in a flood-risk area during the last five years.

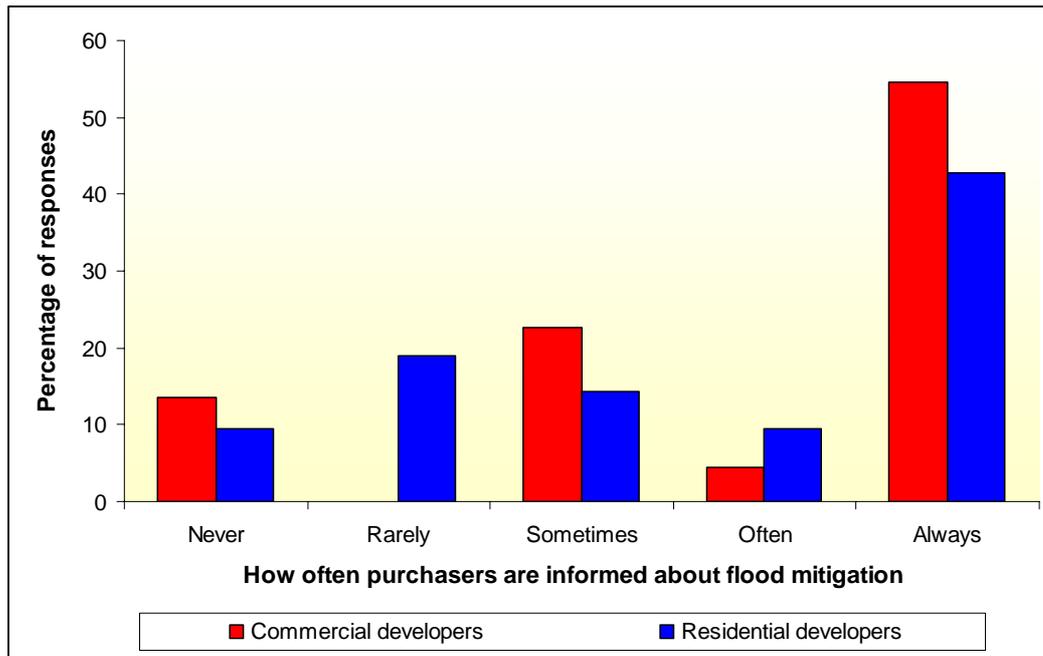
6. Informing purchasers about flood-mitigation

Almost half of residential developers in this research always informed their purchasers about flood-mitigation measures they had installed on the site, compared with the majority of commercial developers, who did this as standard.

This is possibly because the due diligence² carried out by commercial property purchasers is more rigorous than the enquiries made by residential purchasers, making it more important for commercial developers to be up front and address these issues before they are raised by the purchasers' solicitors.

The proposed Home Condition Report, originally due to be introduced in 2007, but now deferred, is to include information about flood-risk and could therefore raise awareness amongst residential purchasers.

Figure 25 Whether developers inform purchasers about flood-mitigation measures installed on a site



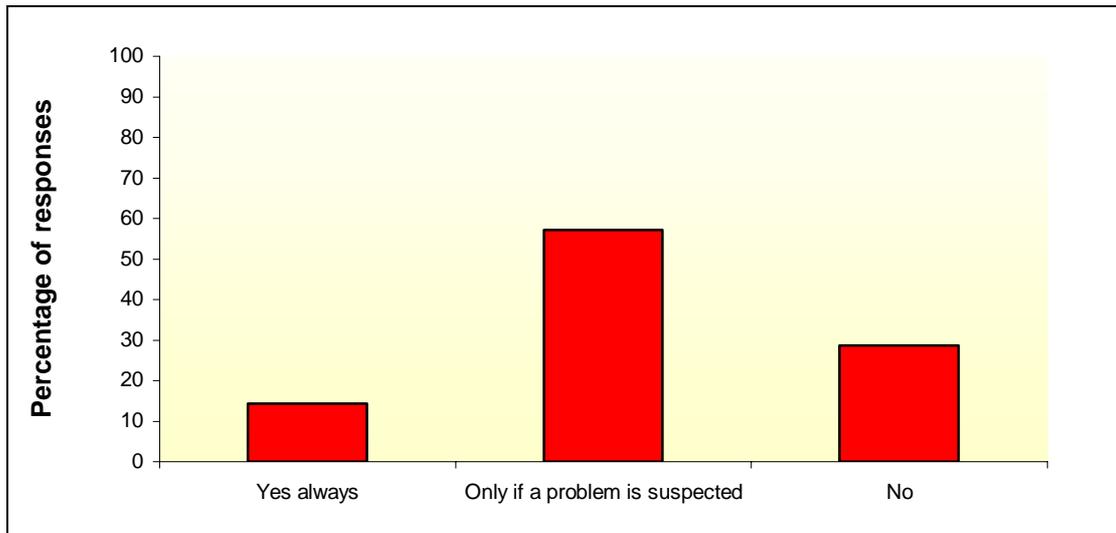
7.4.2 Lenders

Approximately 69% of lenders said they did not have a policy to avoid lending in flood-risk areas, but 66% said they would not offer a loan or mortgage if insurance for flooding was not available. This is interesting because it again shows how the availability of insurance underpins property transactions and because the findings also suggest that some lenders may still be willing to risk a loan against a property that is not covered by flood insurance.

Most lenders would only undertake a flood-risk assessment on a site if a problem were expected (see Figure 26) and most tended to get their information from local knowledge (75%).

² Abbot (2000: 345) defines "due diligence" as: "Reasonable inquiries, surveys, searches and investigations made to ascertain information relating to a property prior to entering into a contract or purchase."

Figure 26 Comparison of whether lenders undertook a flood-risk assessment prior to lending

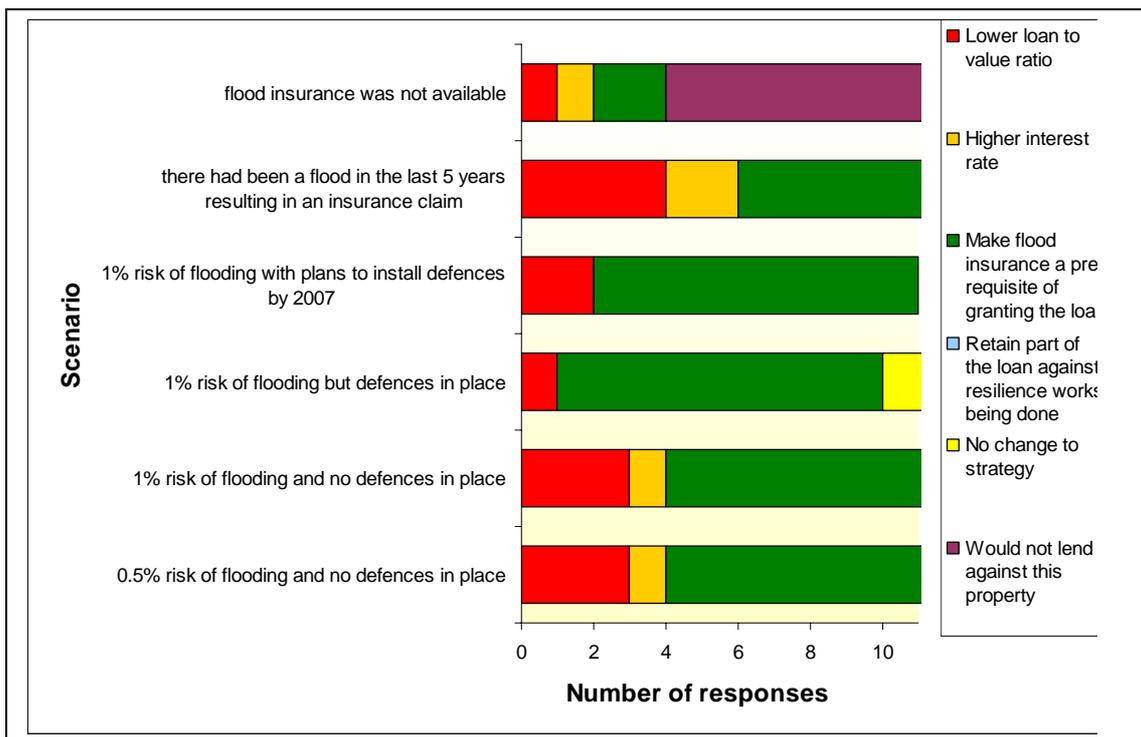


1. Flood-risk scenarios and lending strategy

The lenders were asked how they would adjust their company's strategy to granting a mortgage or loan based on six different flood-risk scenarios.

The results, illustrated in Figure 27, show that not only would most lenders not lend on property where flood insurance was not available, but that a high proportion would make flood insurance a prerequisite of granting a loan, even where flood defences are in place. Some would reduce their level of risk exposure by lowering the loan-to-value ratio, or seek a higher rate of interest to compensate for the increased risk. Only two lenders had refused funding because of the flood-risk (as against lack of insurance), for values of £2 million and £5 million.

Figure 27 Flood-risk scenario and lending strategy



7.4.3 Occupiers

Amongst the occupier respondents, 61% said they would only undertake a flood-risk assessment prior to taking a business tenancy if they suspected a problem, with the remaining split between undertaking it on every occasion and not undertaking it at all (see Figure 28). They would mostly rely on information from planning authorities (62%), followed by guidance from the Environment Agency (57%), historical data and local knowledge.

The occupiers were asked about the importance of various factors in either persuading or dissuading them from taking a new lease, as illustrated in Figure 29 and Figure 30.

Of the persuasive factors, strategic location scored most highly amongst all respondents. Flood insurance and the presence of flood defences were also relatively important (see Figure 29). In relation to dissuasive factors, the average scores show less differential between the factors, all of which occupiers considered important reasons that would discourage them from taking a new tenancy in a commercial building. Landlords seeking a higher rent was cited as the major negative factor, followed by the inability to obtain flood insurance and the premium the occupiers would need to pay for this type of insurance. The occupiers were also asked how their company strategy would change towards taking a new tenancy based on six different flood-risk scenarios (see Figure 31).

The results show that if flood insurance were not available most of the occupiers would abandon tenancy negotiations. Only one of the occupiers had abandoned taking a new tenancy in the past five years because of the risk of flooding.

Figure 28 Occupiers undertaking a flood-risk assessment



Figure 29 Factors important in persuading a company to take a new tenancy

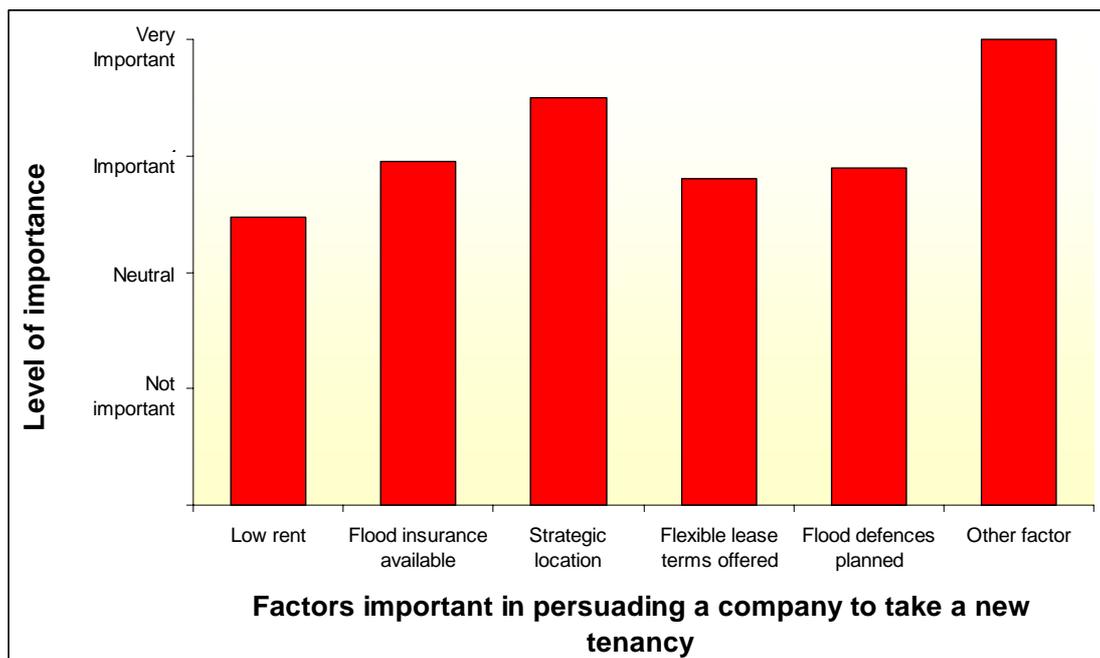


Figure 30 The importance of different factors in dissuading an occupier from taking a new tenancy

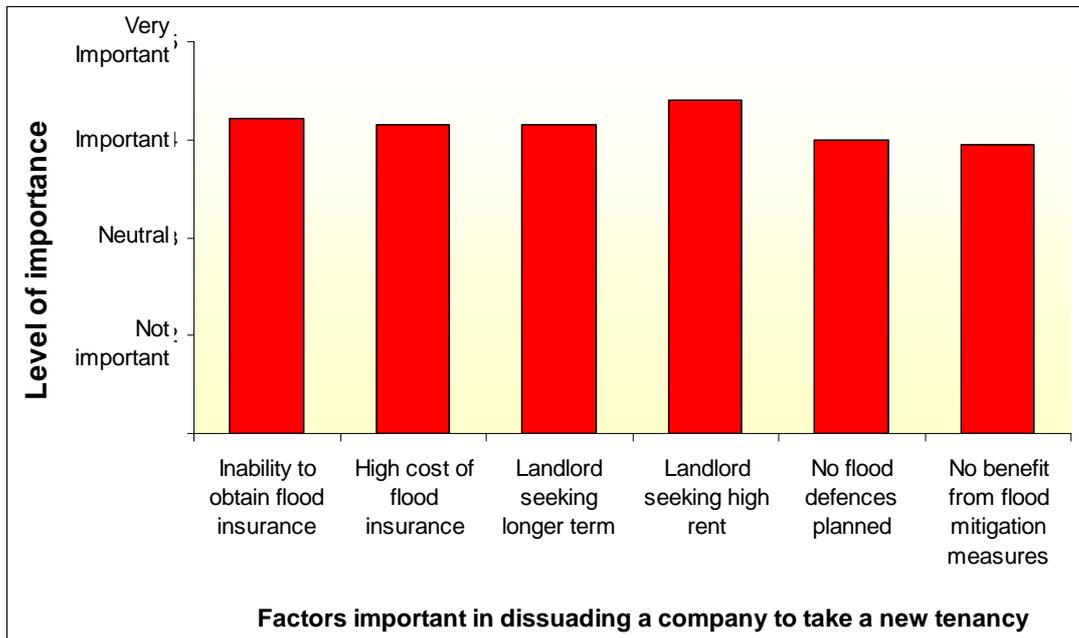
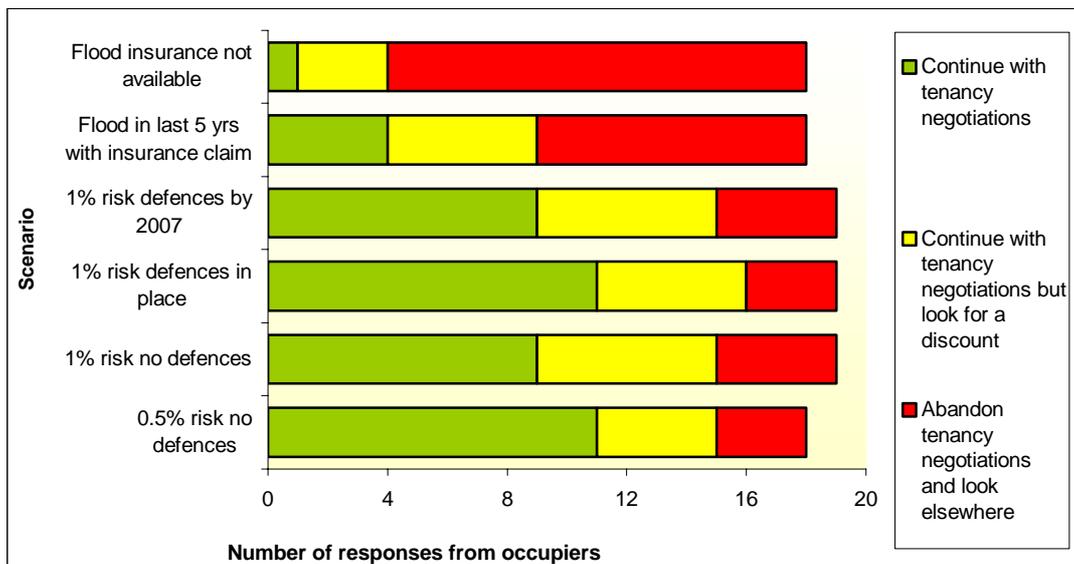


Figure 31 Impact of different flood-risk scenarios on occupiers' strategies



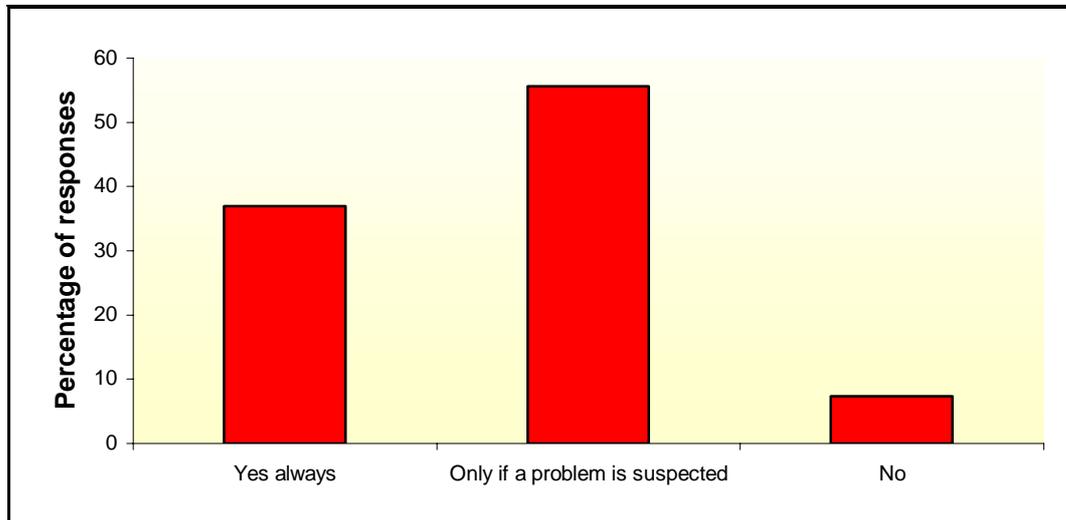
7.4.4 Property investors

1. Flood-risk assessments

About 35% of property investors would always undertake a flood-risk assessment prior to purchasing a property, whereas 55% said they would only commission an assessment if a problem was suspected and less than 10% did not undertake one at all (see Figure 32).

Those investors who considered that they had a very high level of awareness of flood-risk issues were those who undertook a flood-risk assessment as standard before acquiring a property. Most property investors would base the flood-risk assessment on the Environment Agency's guidance (67%), followed by investigating local knowledge and historical data of the site, and information from the local planning authority.

Figure 32 Property investors undertaking a flood-risk assessment



2. Investment decisions

Property investors were asked how important various factors would be in persuading or dissuading them from making a property investment.

The responses show that investors attached a similar level of importance to all the persuasive factors (see Figure 33), indicating that the ability to obtain flood insurance and planned flood defences could be as important in investment decisions as location or market strength. In terms of factors that would dissuade investment, the inability of tenants to obtain flood insurance is shown as the second most important factors (after difficulty in letting the property) followed by the high cost of flood insurance. This finding therefore suggests that inability to obtain insurance could act as a barrier to investment.

Figure 33 The importance of different factors in persuading property investors' to acquire a building

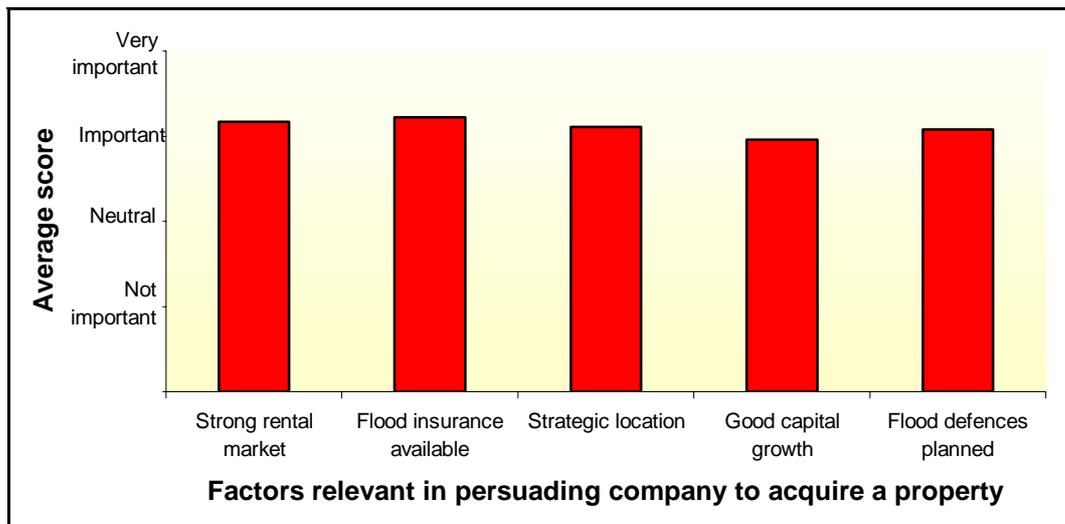
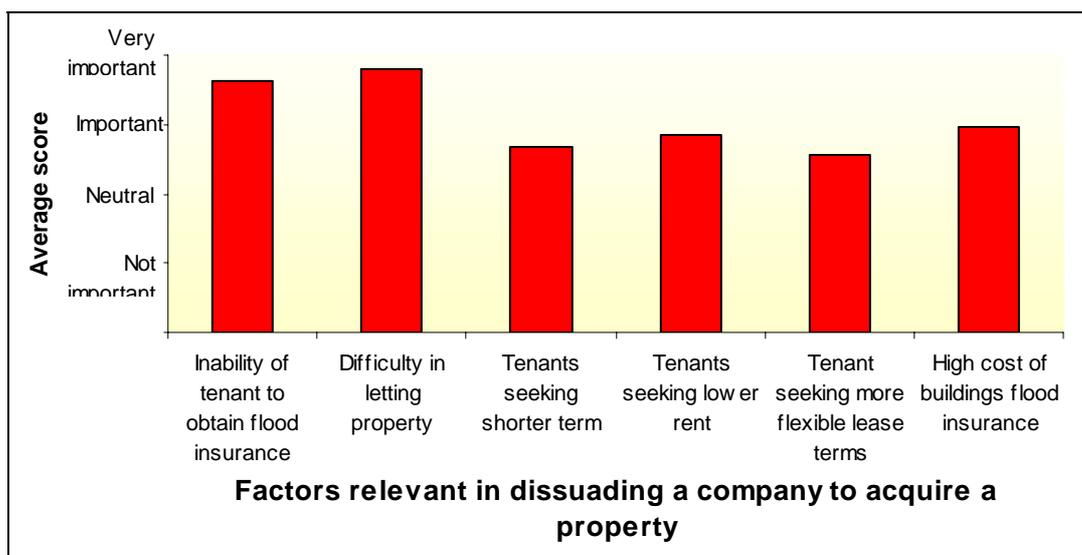


Figure 34 The importance of different factors in dissuading property investors' from acquiring building



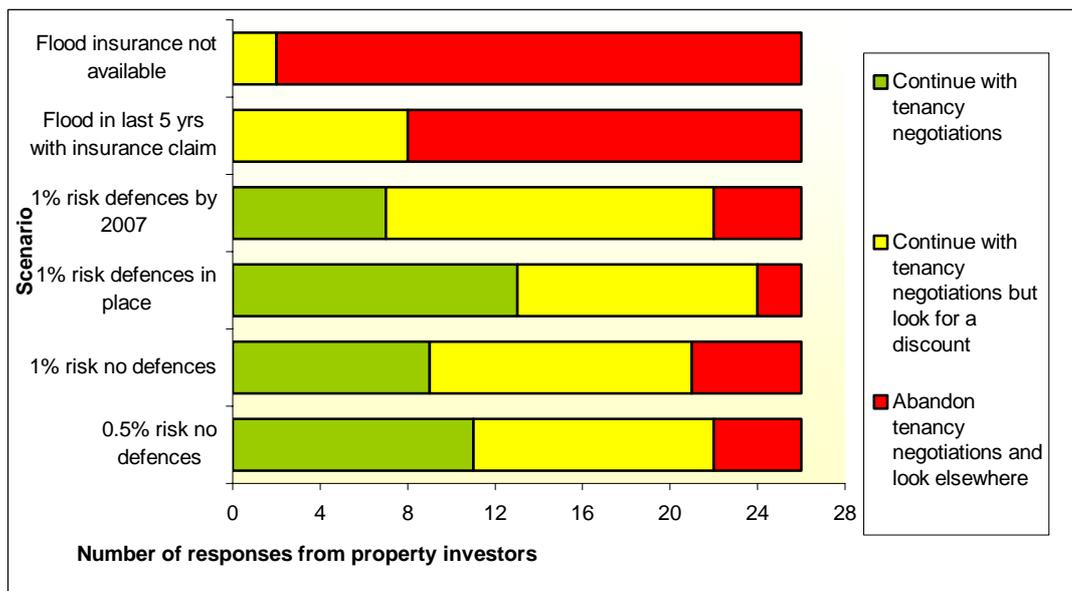
3. Flood-risk scenarios and property investment strategy

The property investors were asked how they would adjust their company's acquisition strategy based on six different flood-risk scenarios. Their responses are illustrated in Figure 35. If flood insurance was not available, most of the investors (85%) said they would abandon the acquisition, while just two (7%) said they would seek a discount in the price. Where there had been a flood in the last five years resulting in an insurance claim, most would again abandon the acquisition, although a greater number (8) would instead seek a price discount. With a 1% flood-risk where flood defences are installed, 46% of the investors said they would continue with the acquisition, whereas fewer would continue if defences were planned by 2007 (7) or not present (9). Most of the rest said they would seek a price discount rather than

abandon the purchase altogether. The response is similar in the scenario of a 0.5% flood-risk where there are no defences.

Overall these findings suggest that the availability of insurance is a more important determinant of investor strategies than flood-risk in itself. Also, the presence of flood defences would tend to encourage investment in property. This again highlights how property investors consider it very important to be able to cover flood-risk with insurance.

Figure 35 Impact of different flood-risk scenarios on property investors' strategies



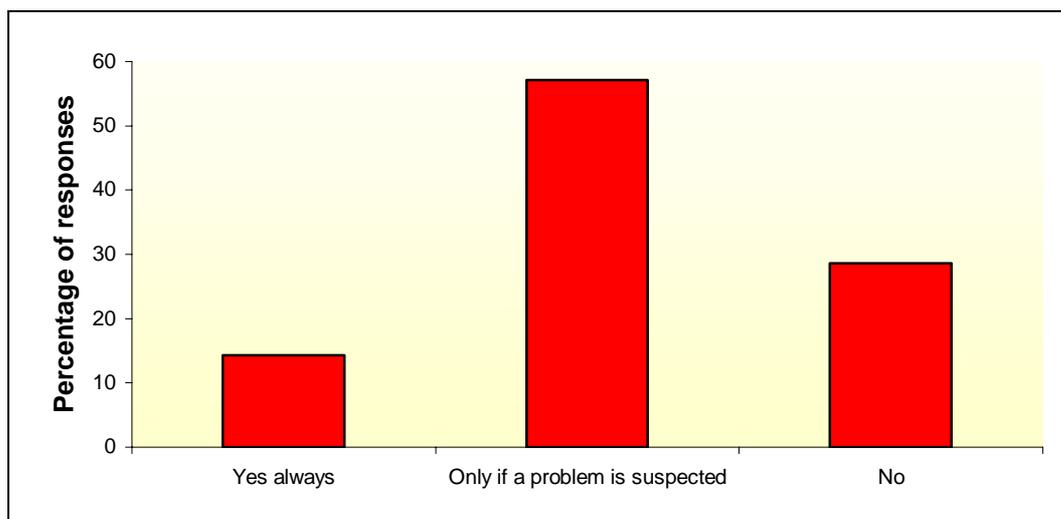
7.4.5 Valuers

1. Flood-risk assessments

Amongst the valuers, 53% said they would only undertake a flood-risk assessment prior to undertaking a valuation if a problem was expected rather than as a routine exercise.

Of those who do not undertake a flood-risk assessment as standard, 40% said they would place a caveat to this effect in their valuation report. However, when they do undertake a flood-risk assessment, most would rely on their local market knowledge of the area as well as the Environment Agency's published data. Most of the valuer respondents did not use information from local authorities, historical data or enquire into the insurance status of the property.

Figure 36 Percentage of Valuers undertaking a flood-risk assessment when undertaking a valuation



2. Professional guidance on flooding

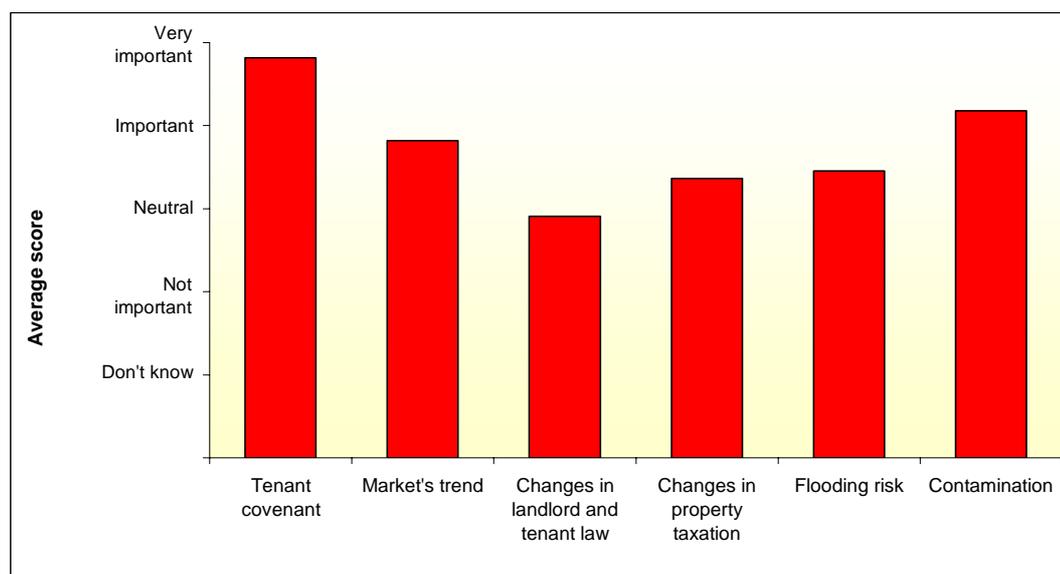
Most of the valuers (60%) said they felt that the current professional guidance for valuations, which applies to property in flood-risk areas, was adequate, but could benefit from improvement in terms of:

- access to better flood maps and risk assessments that could assist surveyors undertaking valuations;
- a more precise definition of what it is 'reasonable' to include in the valuation report regarding flood-risk and
- specific guidance on the form of caveats for use in valuation reports, that qualify the extent to which flood-risk has or has not been addressed in the valuation.

Investment valuations

The valuers were asked about the level of importance that they perceived the property investment market attached to various risks associated with property. The response illustrated in Figure 37 shows that, based on the average scores, tenant covenant, contamination and market trends were placed ahead of flood-risk in terms of their importance to investment decisions. This result is consistent with the valuers' response to ranking flood-risk against other property perils discussed in section 7.3.1.

Figure 37 The factors valuers believe are most important to property investment decisions



3. Valuation and flood-risk scenarios

The valuers were given a valuation scenario for a property investment (see Figure 38) and asked what adjustments, if any, they would make to the 'all risks yield' and how their adjustments would be qualified, given six different flood-risk situations.

Comparing the first three flood scenarios, the valuers indicated that they would on average adjust the all risk yield is as follows:

Scenario	Probability of flooding	Yield adjustments
1	0.5% (1 in 200) no defences	0.5 - 1% increase
2	1% (1 in 100) no defences	0.5 - 1.5% increase
3	1% (1 in 100) defences	0.5 - 1% increase

To the non-valuer these yield adjustments might appear relatively small, but they result in a capital value reduction from £800,000 on a 10% yield down to around £695,000 on an 11.5% yield, that is a 15.7% drop in capital value. An increase in flood-risk driven by climate change could therefore have a significant impact on property values in affected areas.

Just one of the valuers said that he would not adjust the all risk yield but would in all the scenarios advise the client not to purchase the property.

In the case where flood defences would not be in place until 2007, one valuer said he would "possibly apply a deferred yield of 10% in 2007", in other words, the yield would return to 'normal' once the flood defences were installed. This is interesting since flood defences do not guarantee a 100% protection against a flood, because there is a risk that they can be breached or fail, but the perception on the part of this

respondent would appear to be that the risk is so low as to have no effect on the investment value.

In the situation where a flood had occurred in the last five years, resulting in an insurance claim for damage, several valuers stated that their yield adjustments would *“depend on the severity of flood”* and also on *“the risk the investor is prepared to accept.”* Others would not recommend a purchase of the property or *“not recommend [it] as suitable security for loan”*. One valuer said he would refer this matter to an expert for assessment.

In Scenario 6, where flood insurance is not available due to the risk of flooding, some valuers said they would make a significant adjustment taking the yield to 12.5% – 25%. This wide range of opinion suggests that the ‘no-insurance’ situation is not only viewed as seriously high risk, but also indicates lack of information on which to base the valuation. A yield of 25% would result in a reduction in capital value to £320,000, that is a 60% reduction in value. Half the valuers would simply advise the client against purchase.

One valuer said he would not make any adjustment to the all risk yield based on the first four scenarios because the *“market does not appear to perceive this [flood-risk] to be a problem as long as insurance is available”*. Another valuer with institutional investors as clients explained that insurance is paid for by the property occupiers and:

“The investment market would have a very different approach if flood insurance became unavailable. At the present time investors would not consider adjusting the yield. If the flood-risk insurance was not available for a specific property, they would simply just not purchase.”

It is apparent from the valuation scenario that the availability of flood insurance is critical in the property market, and its absence has a dramatic impact on the all risk yield, capital values and on advice to clients.

Figure 38 Valuation investment scenario

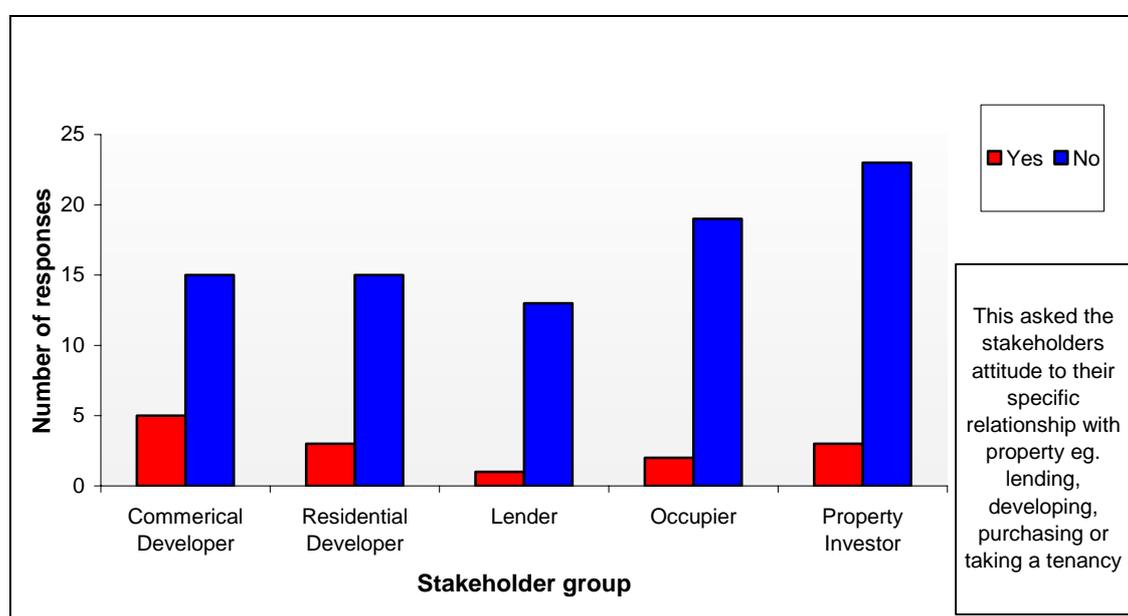
<p>You have been instructed by a client to undertake a market valuation for the acquisition of an office investment in Reading. The details of the investment are as follows</p> <ul style="list-style-type: none"> ▪ The net passing rent on the property is £80,000 p.a. (This is a full market rent based on comparables of other properties in the location, which are not at risk of flooding); ▪ All risks yield on similar properties is 10% (but these properties are not at risk of flooding); ▪ There are 18 years unexpired on a 20 year lease, let on FRI (full repairing and insuring) terms; and, ▪ 5 yearly rent reviews. 	
Response	Number of respondents
Scenario 1: 0.5 % risk of flooding and there are no flood defences	
Would adjust the all risks yield by 0.5 – 1%, to 10.5% – 11%	6
Would not make an adjustment to the all risk yield	3
Advise not to purchase	0
No response	6
Scenario 2: 1 % risk of flooding and there are no flood defences	
Would adjust the all risks yield by 0.5 – 1%, to 10.5% – 11.5%	5
Would not make an adjustment to the all risk yield	3
Advise not to purchase	1
No response	6
Scenario 3: 1 % risk of flooding and flood defences are in place	
Would adjust the all risks yield by 0.5 – 1%, to 10.5% – 11%	4
Would not make an adjustment to the all risk yield	4
Advise not to purchase	1
No response	6
Scenario 4: 1 % risk of flooding with flood defences would be in place by 2007	
Would make an adjustment to the all risk yield	4
Would not make an adjustment to the all risk yield	4
Advise not to purchase	1
No response	6
Scenario 5: Flood occurred in the last 5 years resulting in an insurance claim for damage	
Would adjust the all risk yield	8
Would not make an adjustment to the all risk yield	0
Advise not to purchase	1
Refer to an expert	1
No response	5
Scenario 6: Flood insurance not available due to the risk of flooding	
Would adjust the all risk yield (some significantly 12.5% to 25% up)	7
Would not make an adjustment to the all risk yield	0
Advise not to purchase	2
Refer to an expert	1
No response	5

7.4.6 Perceptions of flood-risk in London and South-East England

The questionnaires also looked at whether the increased flood-risk in London and the South-East of England had altered respondents' attitude to the region (see Figure 39).

Only 14 of the respondents had changed their policy to locating, developing or lending on property in London and the South-East. More commercial developers said they had changed development policy than respondents from other stakeholder groups, although the response is relatively small. Amongst all those who had changed their policies, most (about 66%) now carried out more due diligence on property acquisitions. Just one lender now required further information before deciding to lend and three respondents said they now avoid the region.

Figure 39 Have respondents' attitudes changed toward London and the South-East due to perceived increased flood-risk?



7.5 Summary

The main issues to emerge from the questionnaire survey show that:

- The availability of flood-risk insurance is central to property development and investment strategies.
- Increasing flood-risk could have a significant impact on property values in affected areas.
- Many respondents believe that their organisations have a good understanding of flood-risk, but the terminology for expressing flood-risk is often wrongly interpreted.
- Flood-risk assessments on property acquisitions are more likely to be undertaken if a problem is suspected than as a matter of course.

- The presence of flood defences appears to be interpreted as lowering the risk of flooding, even where the stated risk is still greater than in areas that do not have defences.

Flood-risk insurance

Most of the commercial and residential developers said they would abandon development plans if flood insurance was not available, or if the site had flooded in the last five years and been subject to claims for damage.

Although most lenders said they did not have a policy to avoid lending in flood-risk areas, most said that they would not lend on property where flood insurance was unavailable and that flood insurance would be a prerequisite of granting a loan, even where flood defences are in place. Some would lend, but at a reduced loan-to-value ratio or at a higher rate of interest to compensate for the increased risk.

Most occupiers said they would abandon negotiations to lease business premises if flood insurance was not available. Occupiers' inability to obtain flood-risk insurance was also an important disincentive to investors.

The valuers who responded indicated that if insurance was not available, then they would either make a very significant adjustment to the yield on an investment valuation, considerably reducing the capital value, or simply advise the client not to purchase.

Most occupiers and investors believed that they were adequately insured against flood-risk, although other research indicates that firms tend to over-estimate the amount of cover provided by insurance.

Most developers, occupiers and investors had not experienced any difficulty in obtaining insurance because a site or property was located in a flood-risk area. Of the small number that had experienced difficulty, this had either resulted in higher premiums or higher excess on the policy. None of the respondents had been refused cover or had flood damage excluded from the policy.

Flood-risk and property values

Valuers indicated that given scenarios of 0.5 or 1% flood-risk, with or without flood defences, that they would make yield adjustments on investment valuations in the range 0.5–1.5% on a base yield of 10%. To the non-valuer these adjustments might appear small, but an increase in yield from say 10% to 11.5% would mean a 15% reduction in capital value. An increase in flood-risk driven by climate change could therefore have a significant impact on property values in affected areas.

In circumstances where flood-risk insurance was unavailable, yields from 12.5 – 25% were suggested. This wide range of opinion amongst valuers indicates that the 'no insurance' scenario is not only viewed as a serious risk to value but also suggests a lack of information on which to base a valuation. Several respondents felt more guidance was needed on valuing flood-risk property and it is possible that the relatively low response from valuers to the questionnaire was because many valuers simply do not know how to value in this situation.

Flood-risk awareness and perceptions

Most developers, investors and occupiers felt that there was a high level of awareness of flood-risk issues in their organisations, especially residential developers, although a few occupiers said the level of awareness was very poor.

However, most respondents, again especially residential developers, interpreted a '1 in 10 year return flood' to mean that a flood would only occur once in every 10 year period, rather than the correct interpretation of a 10% annual probability. This finding supports moves to change the terminology, because understanding the probability of a flood is crucial to managing the risk.

In comparing flood-risk against the perils of contamination, storm damage and subsidence, most respondents attached greatest importance to contamination risk, followed by flooding. Land contamination is the most highly regulated of the environmental factors and this finding suggests that the perils are considered not just in terms of their physical impact, but also in terms of the legal liabilities and regulatory obligations or duties that attach to them.

Flood-risk assessments

Most developers would conduct a flood-risk assessment as soon as a site was being considered for development and before acquisition, although about a fifth of residential developers would wait until after site acquisition, which may include those taking options on sites.

Most lenders and occupiers would only conduct a flood-risk assessment on a property if a problem were expected, as would just over half of investors. About a third of investors undertake a flood-risk assessment as standard, being those who believed that they had a high level of awareness of flood-risk issues. While about half of the property valuers said they would only undertake a flood-risk assessment if a problem were expected, about 40% these would place a caveat to this effect in their valuation report.

Generally, the increased level of flood-risk in London and the South-East had not changed respondents attitude to locating or investing in the area, although some now carry out greater due diligence on acquisitions.

Flood-risk and development

Developers appeared more willing to develop on sites with 1% flood-risk where flood defences are in place than where the flood-risk is lower at 0.5% but no flood defences are in place. This suggests that the presence of defences is interpreted as lowering the risk of flooding, and could therefore encourage development, even though the assessed risk is still greater than in areas that do not have defences.

It is currently unusual for planning permission to be granted against Environment Agency advice to refuse consent due to flood-risk. However, if planning permission were granted contrary to Environment Agency advice, while most developers said they would proceed with a modified scheme to reflect the concerns, a small number of house builders would abandon development plans.

Most developers and investors had not experienced any difficulties in obtaining finance for development projects or investments because they were located in flood-risk areas.

Developers largely believed that they could successfully mitigate against flooding from rivers, sewers and rising ground water, but less than 20% believed they could successfully counter coastal and estuarine flooding.

When implementing flood-mitigation measures across development sites, the most popular approach was to raise the ground level of the development. Residential developers were more likely than commercial developers to adopt building-specific measures, usually raising the ground floor of buildings.

Of the commercial developers (27%) and residential developers (19%) investigating new methods of flood-mitigation, most were looking at ways to provide more flood-plain capacity, new flood defence structures and raised floor designs for buildings.

8. INTERVIEW RESULTS AND ANALYSIS

8.1 Introduction

This section of the report presents our findings from the non-response follow-up questionnaire interviews.

8.2 Methodology

The survey invited questionnaire respondents to participate in non-response follow-up interviews. Table 5 details the stakeholder groups represented and also the number of interviewees. The objective of this survey was to obtain an in-depth examination of the themes emerging from the questionnaire results. In addition to interviewing representatives of the five main stakeholder groups, three interviews were also conducted with people from the insurance industry.

Table 5 Summary of the interviewees

Stakeholder group	Number of interviews
Developers	6
Insurance	3
Property investor	7
Lender	1
Occupier*	1
Valuer	1

* The occupier held about 35% of properties as freehold so had experience as a property owner as well as a tenant.

The interviews were conducted both face-to-face and over the phone and took place between October 2005 and April 2006.

The interview questions were based on the results from the questionnaires, focusing on key points highlighted from both the literature and questionnaire responses.

8.3 Experience of flooding

The interviewees were asked to describe their own experiences of flooding as this was likely to inform their approach to and perception of flooding.

There were 16 interviewees who had experience of flooding, however the accounts given by those interviewed was of minor scale flooding. There was however a greater difference amongst interviewees' views on how this had changed their perception of the risk of flooding and how it had influenced their strategy. For example the occupier interviewed has experienced flooding with, *"the odd property that has flooded"*;

however the interviewee stated that this experience had not significantly changed their approach to properties they currently occupy or are looking to occupy:

“I think the impact was quite minimal, obviously once you know [about flooding] then you have always got it in mind, but it doesn’t crop up terribly often.”

In contrast a property investor who had suffered minor flood damage in 2000 said they would be more cautious in the future as they were now more aware of the problems associated with flooding.

“I think now that I’m aware of flooding, I think that the flooding issue has become more apparent over the last few years particularly from that very wet winter we had in 2000 ... I don’t think, if I was looking at [the buildings] again, I don’t know whether I’d have bought them or no, anyway I am where I am and there we are.”

8.4 Perceived impact of flooding on property

8.4.1 Awareness

Interviewees were asked how they viewed the significance of flooding in relation to property.

There was a consensus of opinion amongst the interviewees that flooding as a property issue was becoming an increasingly significant consideration for those with property interests. This was demonstrated by the comment of one property investor:

“I think that the flooding issue has become more apparent ..., I think flooding is much more of an issue.”

However most interviewees felt that flooding was an issue which had only become a key consideration in the past 7 to 8 years as illustrated by the views of another property investor:

“I’d have said seven or eight years ago it wouldn’t have been on the radar.”

One valuer offered an explanation for the reason behind this change in emphasis as being a result of the changing weather which has resulted in more floods:

“the weather conditions are indeed changing ... there have been periods, late ‘90s and early 2000 where the weather conditions seemed to be more extreme, much more frequently.”

8.4.2 Views on significance of flooding

Whilst the majority of interviewees agreed that awareness of flooding as an issue had increase in recent years, there was a range of views on the significance of the topic to property.

There were those who felt it was a critical issue which should be given due consideration. This view was illustrated by the comments of one property investor:

“It’s pretty significant, you would definitely weigh it up as a factor; you know you’re looking at an investment transaction.”

However there were the contrary views of interviewees who felt that it was simply one issue, but did not view it as significant. This view was demonstrated by the views of another property investor who had a very unwary approach to flood-risk stating:

“Well it comes lowish down. If I’m prone to sleepless nights, which on the whole I’m not, I’m happy to say, but if I were prone to insomnia and worry, I think flooding would come pretty low actually after things like fire, things like that.”

Another property investor held a similar view:

“I think it’s one of a number of issues. I mean I help look after another building, the issues of Health & Safety have become very expensive to deal with apart from the DDA Act stuff and so I think flooding is just one issue when you look at a building.”

8.4.3 Views of the effect of flooding on property

In terms of the effect and impact on property, one of the main issues that arose from the interviews was the impact on value. However some interviewees highlighted specific elements, which would impact on value such as an increased selling time resulting from a poor flood history or a limitation on the redevelopment options available.

The majority of interviewees felt that an increased risk of flooding or a recent flood event would have a detrimental impact on a property’s value. The comments of one Developer illustrated these views.

“I think the impact could be quite profound, I mean I think it’s quite well known that residential properties which have suffered flooding are having quite a significant fall in value. So actually I have no doubt that the same principle would apply to all sectors of the market, so hence the need to make sure that actually your investment is protected from flooding, so that is important.”

As mentioned above some interviewees were specific on the problems that flooding could have on a property’s or site’s value. As the valuer interviewed explained, the risk of flooding could result in a longer selling period, which could influence value:

“Since the late ‘90s, early 2000s and with the focus on climate change and insurance problems, it is a much bigger issue now than it ever used to be and therefore more difficult to sell.”

However the valuer felt that the impact on value, would be limited to the immediate aftermath of a flood event and would lessen as time passed after a flood:

“diminishes after an event... as the memory fades the level of problem recedes if you can say to a buyer it’s five years, ten years, fifteen years since there was a problem then they make an assessment.”

Another issue highlighted was the effect that a high flood-risk status could have on the redevelopment potential of a site or building. As one property investor explained, a high flood-risk can limit the options available in the use of a building:

“if you’ve got a commercial property in a flood-risk area you’re perceived to be less likely to get change of use consent, particularly to residential.”

8.5 Flood-risk Assessment

Interviewees were asked whether they undertook a flood-risk assessment as standard when buying, renting, lending or valuing property, they were also asked their opinion on flood-risk assessments. The strategy with regards to undertaking a flood-risk assessment varied amongst the interviewees from those who conduct an evaluation as standard to those who worked on a case-by-case basis.

Many property investors felt that the flood-risk issues relating to a site were normally expressed explicitly in the investment particulars. As one property investor explained:

“Yes I mean to be fair, quite a lot of investment details that we look at will sort of flag up a problem, some of them will even try to address it.”

Whilst the opinion was given that vendors often highlighted flood issues, many interviewees still conducted a flood-risk assessment as part of their due diligence as one of many environmental issues considered, as the comment from one property investor highlighted:

“The risks we’re looking at are primarily in relation to the Environment Property Act, but their brief is quite wide, and they also look at flooding.”

As mentioned above there were a few interviewees who did not conduct a flood-risk assessment as standard when buying, renting or lending for property or land, with the view taken that it was better done on a case-by-case basis rather than as standard, as the comment of the occupier interviewed demonstrated:

“It’s not like every property you come across needs to be evaluated because of the potential flooding but it does crop up from time to time.”

Another example of this view was given by the Lender interviewed who did not undertake a flood-risk assessment as part of a mortgage or loan application assessment:

“No, we don’t, and it’s not something that we ask surveyors to do and it’s not something that they actually include in the survey report back to us. Normally they will, to protect themselves. They’ll say, well we haven’t looked at the ground conditions for contamination, but I’ve never seen anything in relation to flood.”

The explanation given by a lender for not undertaking a flood-risk assessment was that the locality they predominately worked in was not perceived to be at risk from flooding. This again highlights how experience influences strategy, as the perception that flooding is not an issue in that locality removes it from further consideration:

“Probably the area in which we operate there’s not a high risk. You know it’s not like the South-East of England for example where it’s much more of a

threat ... the reason is because it's not basically perceived to be much of a threat."

There were some specific ideas offered by the interviewees on undertaking a flood-risk assessment in terms of the detail and issues to consider. These are highlighted by the comments of the valuer, who mentioned that it was important to understand the characteristics of the flood-risk, such as the source of any flooding such as fluvial or coastal:

"I think it's also important to distinguish between different types of flooding. One tends to always think of a river rising above a certain level and certain properties within that area are automatically affected. There is a second case, certainly of flooding where local ground conditions can cause flooding to a property. This might be in the case of badly drained farmers, fields or the natural contours of the land means that if there's a downpour, the road system for example or the field system results in water coming down a field or a road it just can't deal with and it can end up in a particular property. That is harder to discern because there is likely to be less evidence of such an event."

With regard to the timing of undertaking a flood-risk assessment, there were some interesting comments on the issue. There were views that it gave a prospective purchaser an advantage to have a flood assessment in place early on as they would be able to make an unconditional offer to the vendors, putting them in a stronger position against other bidders, as highlighted by one developer interviewed:

"Yes, we do, because, increasingly, vendors are trying to get offers that are as unconditional as possible and very rarely have they actually done all the work to eliminate that kind of issue."

8.6 Information Used for Flood-risk Assessments

The interviewees were asked about the sources of information they used if they undertook a flood-risk assessment and how they felt about the quality and availability of the information.

Almost all interviewees used the flood maps produced by the Environment Agency as a primary source of information on the flood-risk status of a building or property. For many interviewees this information was considered a starting point when conducting a Flood-risk Assessment, as demonstrated by the views of one property investor interviewed:

"I would have thought the first port of call would be the Environment Agency."

However whilst the Environment Agency's flood maps formed a starting point for investigations into the risk of flooding, many interviewees supplemented this data with additional information which appeared to vary from historical data to information held by local authorities:

"Well, we gain all our information from various sources really, desk top surveys etc..."

However there was a degree of criticism of the information provided by the Environment Agency with many interviewees feeling that the information lacked detail and accuracy, as illustrated by the comments of one property investor:

“I think the Environment Agency’s web-site is great, it’s helpful that it’s not quite as specific as I’d like it to be, doesn’t record events to the extent that I’d like to see and with the degree of sort of accuracy and detail ... it’s fairly macro scale.”

Some interviewees believed errors or omissions in the data could lead to professional and financial risk and exposure where the flood status has been underestimated, as it meant the risk had not been fully accounted for. This was an issue highlighted by an insurer who had commented that it had meant insurance had been offered on the incorrect terms or premium. A representative from an insurance company had highlighted some of the deficiencies with the Environment Agency maps, as the reason why they had produced their own maps. This issue was also highlighted by comments from the valuer interviewed:

“There are problems with the Environment Agency’s website and there are problems with the data generally in that many records may not define a flood-risk area even if there been flood incident in the last forty of fifty years, that goes back a very long time and can blight a property.”

Other stakeholders felt there had been missed opportunities in terms of development where a developer may have felt the flood status has been overestimated.

8.6.1 Reviewing flood-risk assessments

The developers and property investors were asked whether they undertook periodic reviews of the flood status of property or land assets that they may hold in their portfolios.

Most of the developers interviewed did not hold sites in their land banks for long periods of time, but one developer who did, said their firm did not undertake an FRA review of the site prior to developing it:

“We don’t normally review that [flooding] in terms of our risk profile on a five yearly basis”

Whilst most property investors undertook some type of FRA prior to acquiring a property, none of the interviewees undertook an on-going review of properties held in a portfolio.

It appeared most checks made of property were to ensure compliance with legislation and regulations, as one property investor explained;

“A lot of what we check is also legislative, DDA being a good example, asbestos registers, that sort of thing, but I guess you know if there was a statutory requirement for property owners to do a similar review then we have to fall in to line, but at the moment we don’t.”

It appears however that whilst there is no formal process for reviewing the risk of flooding it is likely that as part of the general management of a property, any change to the property or local area, which would affect the flood-risk status would be picked up in the course of regular business, as one property investor explained:

“We’ve got Property Managers who walk round, look at the sites. We’re all Chartered Surveyors hopefully so we walk round, see if there are any issues you know. Every property we’ve got I’ll visit at least once a year or the Property Manager will visit two or three times a year at least. ... Something probably would get picked up just by visual inspection, I guess.”

The fact that flood-risk assessments are not periodically reviewed through a structured process means that Investors will be unaware of the flood-risk status of many properties acquired when flooding was not an issue considered in the due diligence.

8.7 The role of insurance in strategy

This question asked the stakeholders how insurance influenced their strategies in relation to dealing with sites at risk of flooding.

One developer confirmed it did play a role:

“yes, it does. We obviously will consult with our insurers”

“You’re not going to go ahead with a development unless, for example, the construction risk can be insured at the very least and if the construction risk can be insured then so can the occupiers’ risk, if indeed there is any, resulting from the construction.”

One developer explained how the insurance issues concerning a site did in fact put them off purchasing it:

“Insurance brokers the minute you know they started realising the scheme might be in the flood-plain, they weren’t happy and that put us off developing.”

Most property investors said that insurance was a key component in the value of a property. One property investor said:

“I think, obviously, if your building is either difficult or expensive to insure it’s bound to have an impact on the value.”

The lender interviewed felt that general building insurance was sufficient and would not require specific flood insurance. However flood coverage is a common element of most policies and is offered as standard so it may be that with general building insurance, stakeholders would assume flood protection was in place.

The valuer highlighted a problem for residential properties in relation to flooding, when insurers do an electronic search as a result of which it appears that the property is at risk, so they are not interested in providing insurance cover. However, unlike with obtaining commercial insurance, there is no process for speaking to an underwriter to explain how the physical situation is very different from the computer-modelled environment.

This point was also discussed by one of the Insurers interviewed, who recognised the shortcomings in terms of providing residential insurance, which is the result of the large number of policies administered. However, for commercial insurance this is different, as normally for medium to large companies, a broker is involved who can negotiate with the underwriters and explain the site- or property-specific issues and

flood-mitigation measures which can be factored into the insurance risk, premium and policy. So, commercial property is probably less susceptible to any blanket changes in insurance policy with regard to flooding. Commercial insurance provision could arguably be described as being less sensitive to insurance policies on flooding risk as the rules will not always be applied in the same way as they are for residential property or some SME insurance policies.

8.8 London and the South-East

The question was asked of the interviewees whether the perceived increase risk of flooding in London and the South-East had affected their attitudes to these areas, which was similar to the question asked in the questionnaires. Largely, the interviewees did not believe that there had been any change to their strategy resulting from a perceived increasing flood-risk.

The occupier interviewed felt the only change that had been made to their strategy was that they were more aware of the issues relating to flooding:

“Well, I think we’re just slightly more aware, you know.”

However, one developer did feel that the perceived increased flood-risk in London and South-East had made their company more cautious about developing in this area:

“I think it’s always been an issue that, as a business, we’ve been aware of.”

8.9 Strategy and approach to property at risk of flooding

This question asked the developers, occupiers and property investors about their strategy in respect of property which was at risk of flooding. As each stakeholder has a different relationship to property, the interviewees’ responses to this question have been separated out so the different strategy responses to flood-risk property can be discussed.

Property Investors

There was a difference in the approach amongst the investors interviewed. Some investors were very cautious in their approach to property investment, which has an obvious impact on their strategy to dealing with flood-risk property.

“I’ve always been very prudent and we’re very careful”

It was felt by another property investor that flooding would have a significant impact on property investment strategies and could result in them abandoning an investment acquisition:

“Yes, if we’ve got something under offer on the basis of, you know, great tenant, great building, great location, good lease and all the rest of it, then during the course of due diligence it came out that it was in a sort of Carlisle type situation and had been flooded last year, then we would dig in to it a lot more deeply and essentially walk away from the deal, if we could satisfy ourselves that it was worth buying.”

This approach seemed to be driven by the concern over letting a property if it was located in an area at risk of flooding, as one property investor explained.

"I say we're in to letting, we don't want tenants to query, question everything and we don't want to lose a tenant, because we're involved in good quality buildings"

Another property investor explained how one of the other issues taken into consideration with flooding is: *"essentially if we had to sell it tomorrow, could we do it easily?"*

One of the smaller investors interviewed appeared to have a different approach to their investment strategy in considering flood-risk:

"We do consider it; we don't have perhaps as institutional a strategy as some of the bigger, more research backed operators might have, but I guess we're more ad hoc in terms of our dealing with it."

This comment would appear to suggest that it is largely the bigger, more sophisticated, investors who are currently attaching greater significance to flooding.

One investor had purchased a property, which had been flooded prior to the acquisition. However their purchase strategy was that it did not dissuade them:

"it didn't put us off, I mean there was some impact [from the previous flood] but not major and, given that the statistics showed that the frequency of such floods were, you know tens of years ... we took the view that it was a reasonable risk to take."

This is of course interesting, as it goes against the questionnaire results where the strategy response of Investors to sites that had flooded was to walk away in about 64% of cases.

Occupier

The occupier interviewed confirmed that a property which had a high risk of flooding would not be an option for them with regards to taking a tenancy:

"We wouldn't go for a property, where we thought there was a really high risk [of flooding]."

However they felt this was likely to be a rare situation as they were unlikely to consider properties at risk of flooding;

"It is probably fairly rare that you would find yourself in a position whereby, you'd be forced to discontinue the transaction. I don't think there are that many instances that we would look at where properties are potentially at risk."

This comment suggests that any issues of flooding would be highlighted in the property search stage so that properties considered for occupation, either under a tenancy or via a purchase would not include those that had flooding as an issue, or any other factor such as contamination. This suggests that whilst transactions may not be halted because of flooding, it does not necessarily mean people would take a flood-risk property. It could simply be that 'at risk' properties are eliminated from the selection pool before the process reaches lease or contract negotiation stage.

Developers

Flooding seemed to be a significant consideration for the developers who were very aware of the issue, as explained by the comments of one interviewee:

"It is an issue we are certainly very conscious of."

Most developers were also very cautious of property at risk of flooding, as a comment from one interviewee highlighted:

"I personally would always rather build outside the floodplain."

One developer explained that flooding might be one of a number of other factors which may mean they walk away from a purchase.

"flooding might have been one of a number of issue that saw us abandon a site acquisition."

Another developer indicated that the issue with flooding was that *"it would be difficult in getting planning permission."* Problems with planning look like they will deter people from flood-plain sites. However as the demand for new sites continues to rise and as the availability of suitable sites diminishes, then developers will have to start looking at these difficult areas. However as another developer explained, currently some developers are walking away from site purchases because of the floodplain / planning issue.

"If you've got something which is designated flood-plain you can't develop it, so where we've looked at site where that look like it's going to become an issue we have not acquired it."

For some developers it appeared that their strategy was influenced by the knowledge that if any issues relating to flooding had not been addressed in the design of the site and/or property they would face difficulties when it came to sell or letting a building.

"we've done two quite significant leasing transactions. The flooding question has always been raised by the occupier and what we've said is that we've raised the ground level ... that's actually satisfied them."

Another developer also highlighted this view:

"Investors by and large don't like risks, if you know that there's an enhanced risk on a site then you've got to have a pretty robust way of dealing with that and ensuring that you don't have a problem with flooding. If we haven't got a robust programme of what we've done to mitigate those risks then it would, could have, a fundamental impact on whether you sell the site without a huge discount or whether you sell it at all."

Most developers said they would prefer to *"pay the money out"* for flood defences than have to undertake the work as part of a development. The reason given by one developer was related to the risk and liability associated defences:

"I'm not sure we'd want to concern ourselves with the risk that might be associated with actually undertaking a flood mediation scheme."

One of the most common solutions appeared to be raising the level of the development so it was no longer at risk within the floodplain. However as one developer explained, this is not without financial implications:

“If possible, the levels of the site will need to be raised and, if you’re talking about that it’s fantastically expensive because you’ve got to raise the level of site but you can’t build on soft ground so you’ve got to compact it as well or you know you’ve got to deep pile. It’s massively significant.”

The installation of SUDs seemed to be a very popular option with many developers and one interviewee explained the advantages which made them attractive:

“[SUDs] seems to work very well, yes. In fact we use them almost everywhere now because it is getting more and more difficult to get licences to discharge into small water courses and so on, on an unrestrictive basis and so SUDs obviously gives you the control discharge and it saves you taking out, space the balancing ponds, balancing ponds are fine but you need a lot of them, you need a fairly big site so you can stick them in the landscaping or something like that. SUDs are much more space efficient.”

The developers were asked what they felt were the most important factors in promoting a change in the way developers approached developing on sites at risk of flooding. One developer felt that it had to be a direction from the planning system *“I think it’s got to be planning-led.”* Another developer felt that better information on which areas are at risk of flooding would assist in effecting a change in the approach of developers.

“There has to be clear definition of areas liable to flooding and I’m not convinced yet that there is accurate enough information in relation to that.”

However the interviews also expressed the view that the drive for change would probably come from the market;

“in the end we’d always have in the back of our mind what an investor might think about it.”

With regard to commercial property, it was felt that as occupiers and investors became more aware of the issues and risks surrounding flooding, then this would change the approach of developers to meet these expectations. From other interviews, it is apparent that the perception of investors and occupiers is already being taken into consideration. Therefore, a developer interviewed felt that to drive change forward, more education was required to raise awareness.

“Well, I think it is a perception of occupiers and probably investors so you know the issue is sort of coming more to the fore, to be honest, and I suspect there needs to be more education on it.”

8.10 Government

This question asked the interviewees what they felt the government should focus on with regards to flooding, if they had the option of influencing policy. There was a wide range of possible considerations for the government.

One property investor commented that additional information should be supplied to help in identifying at risk areas.

“if there was a more detailed, you know, really accurate EA type resource for picking out at risk areas, that would be helpful too.”

The issue of raising awareness was common from some interviewees, a point illustrated by the view of a developer:

“Well, I suppose the awareness, really, and probably an understanding of the risk because I’m not sure. You know I’m a Chartered Surveyor and you know I don’t know all about it and I suspect you can ask anyone on the shop floor here, they’d simply be the same.”

However, the lender interviewed said that the government should focus on the insurance industry, with the objective of reducing the cost and restrictions on flood insurance policies:

“I don’t know, they’d probably have to assist the insurance industry in some way to cut down their policies.”

This point on supporting the insurance industry in providing cover was also mentioned by the valuer interviewed who felt that where cover could not be provided by the industry, additional central government assistance should come into effect:

“Well I think they’ve got to look very seriously at where roads and houses are built and they’ve got to define genuine flood-plain areas more accurately. I think the river authorities have got to take on their management responsibilities seriously and I’m not suggesting they don’t, but I think even they would accept that new events focused our attention in different ways and I think there needs to be some central fund to provide compensation if insurance companies are having difficulty insuring the properties. Somebody has got to accept responsibility.”

Another developer felt that there needed to be involvement from the government in the provision of strategic defences to facilitate the development of flood-prone areas, which may be ripe for regeneration, such as the Thames Gateway:

“I think the government has to accept its responsibilities for perhaps releasing areas that are prone to flooding, by doing its own mitigation works, as well as the developer doing his own mitigation works for the particular area he’s involved with.”

8.11 Summary and conclusions

The interview results show that the issues surrounding flooding have become more significant for property stakeholders in the last few years. The stakeholders’ experience of past flood events also had an influence upon their perception of the risk that flooding poses and how they should deal with this risk.

From the interviews, it was apparent that there is a great difference in the stakeholders’ approach to dealing with flood-risk, from the very cautious to those who are not so risk-averse. Whereas sophisticated investors and developers have well-

developed approaches to identifying and dealing with floodplain sites and properties, others operate on a more ad hoc basis.

There appeared to be a consensus of opinion that a property's exposure to the risk of flooding and / or flood history would have a detrimental impact upon its value. The reasons included a limitation on development options and increased difficulty in selling. Therefore the impact on value has not only a depreciating effect because of the potential damage to the physical building or contents, but also thereby a stigma effect in terms of discouraging buyers and blighting development.

Most stakeholders would undertake a flood-risk assessment in conjunction with a property acquisition. However even where property investors show a robust approach to identifying flooding issues at the acquisition stage, the long term management of properties does not seem to follow the same rules. None of the interviewees conducted periodic reviews of the flood status of property they own, even though they may monitor other aspects of the buildings' performance. This failure to undertake periodic reviews suggests stakeholders could be unaware of changes in the level of flood-risk to which their property is exposed, for example because of climate change generally or because the dynamics of a floodplain or river have been altered by a development either up or down stream of their site. This could have knock-on consequences in terms of:

- the validity or availability of insurance cover for the property, which could be out of date; and
- the periodic revaluation of property for investment and / or accounting purposes, because sites could be over-valued if the flood-risk status of property is not taken properly into account.

Therefore, although the interviewees, like the questionnaire respondents, said that the inability to obtain flood insurance would not only adversely impact on value but also on purchase decisions, they are apparently not keeping track of the flood-risk and insurance status of property they hold in terms of managing risk and developing and exit strategy.

The interviews also showed that the availability of flood insurance differs between the residential and commercial market. Whereas commercial firms and business occupiers will use a broker to secure their insurance and can negotiate directly with and inform underwriters about any flood-mitigation works, in the residential insurance market the volume of policies means that the underwriting decision is automated, with no room for consideration of other factors, or for the checking of the accuracy of data held. This means that in some locations, a commercial building may be insured for flooding but adjacent residential properties are not.

The interviewees who had property dealings in London and the South-East explained their reasons for not changing their property strategy due to a perceived increase in flood-risk, apart from being more cautious and applying greater due diligence to acquisitions. Their reasoning was that the area is an important economic region and they assumed, especially in the case of London, that the government would step in to ensure the area would not be adversely affected.

Many of the property stakeholders felt that the sources of information available for identifying flood-risk areas, were currently insufficient and in need of improvement. In some instances, the risk of flooding was underestimated, which could lead to problems for insurance companies in quoting premiums and policy conditions on terms that are viable for the insured as well as the insurer. Conversely, some

developers felt that there were problems with flood-risk being over-estimated, because current flood maps were too general, meaning that development was being prevented or sterilised in areas that could otherwise support viable development. This has consequences for land supply, particularly as brownfield sites become scarcer and in the face of continuing government pressure to build more houses.

9. COMMERCIAL CASE STUDIES

9.1 Introduction

The aim of this part of the research is to look at property investors' strategies in relation to commercial properties built on floodplains, the approach taken by investors to identifying flood-risk when purchasing property and how this is accounted for in an assessment of a property's price and value to a portfolio, to understand how the investment decision-making process is influenced by flood-risk and establishing how the flood status of a site is identified and by whom and what significance is attached to it.

The two case studies examined were London and Green Park in Reading. The two case studies are situated in the Thames Region, which has the highest value of commercial assets at risk of flooding (fluvial and coastal, than any other region, representing 23% of the total property assets in England and Wales that are at risk (Halcrow, 2001).

9.2 Commercial case study methodology

The background and context of the commercial case studies was established through a review of related reports and literature. Interviews were also carried out with property investors and associated professionals to establish the investment decision making process in relation to commercial properties at risk of flooding and their strategies for dealing with this.

9.3 London

"At White Hall I hear and find that there was the last night the greatest tide that ever was remembered in England to have been in this river: all White Hall having been drowned, of which there was great discourse."

(Samuel Pepys, London 7th December 1663)

9.3.1 Introduction

London is a major world city of great historical, cultural, political and economic importance. High population densities exert pressures on resources, systems and sectors. In addition, the urban heat island effect may exacerbate impacts of climate change, placing more strain on the city (London Climate Change Partnership, 2002).

As discussed in the literature review, one consequences of climate change is the increase in the RSL. Related, at least in part, to this, one of the identified environment impacts of climate change in the London area is flood-risk (*ibid.*).

Flood disasters in London have an established history: one of the worst occurrences was the tidal flooding of the East Coast and the Thames Estuary in 1953, which took a toll of 300 lives. That year huge waves caused a tidal surge that rushed up the Thames, bursting the banks of the river and the Lea, damaging over 1,100 homes in Silvertown and Canning Town. Although the flood did not reach central London, which was flooded last in 1928 (the City, Southwark, Westminster, Hammersmith), the incident indicated that the City was vulnerable to that type of natural disaster. The last severe flood recorded in London was in Autumn 2000, where 320 properties in

London were flooded by the river Roding and Salmons Brook (Flooding Investigative Committee, 2002).

The Mayor of London identified flood-risks as “a factor impinging on spatial development in many parts of the city”, (GLA, 2004d: 32). The Environment Agency stated that when these risks are ignored;

“a severe flood in London could paralyse the central part of the London Underground, cause damage to fresh water and sewer systems and disrupt power, gas, telephone and vital data services. Thousands of homes, shops, factories, businesses and buildings would be affected. It could take months to get London functioning again”

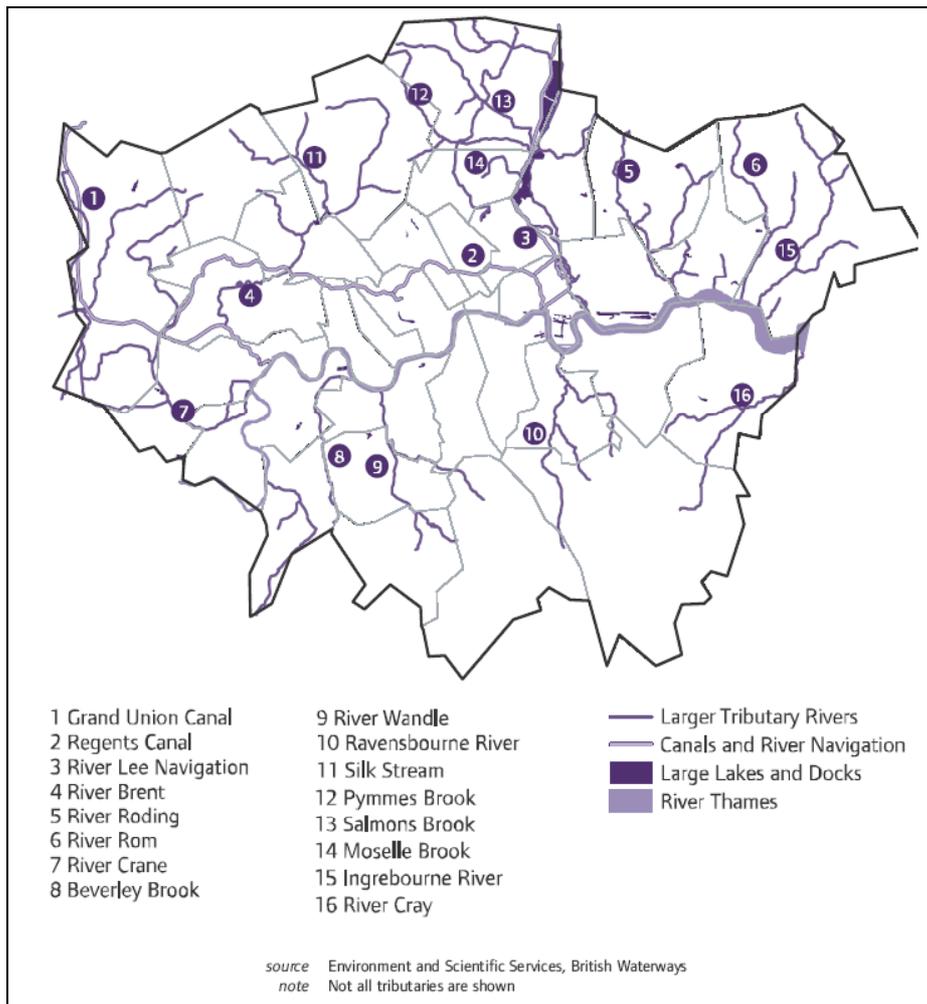
(Environment Agency, 2006b)

The same public body also estimated that insurance claims caused by severe flooding in London could reach over £30,000 million in losses.

9.3.2 London’s Blue Ribbon Network and main new development scheme

To gain an understanding of sources, this section briefly explains the London waterways network, namely the Blue Ribbon Network. London’s Blue Ribbon Network is the term used in the London Plan to include the Thames, the canal network, the other rivers and streams, and open water spaces such as docks, reservoirs and lakes within the city (GLA, 2004d). Figure 40 shows the main elements within the Network.

Figure 40 The Blue Ribbon Network



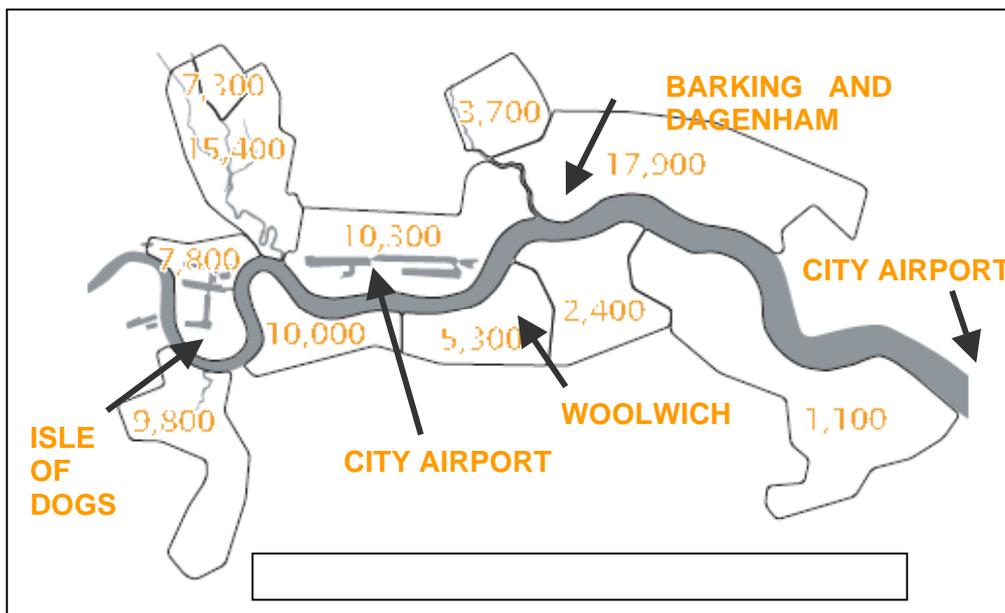
Source: taken from 'The London Plan' (GLA, 2004c)

This Network consists of semi-natural and man-made water systems. Related to the spatial development strategy for Greater London, the London Plan promotes sustainable use of this Network, such as for water transport, water recreation, waterside open space, natural habitats and flood storage or protection (*ibid.*). The Plan also acknowledges that the Network is subjected to tides, erosion and floods, which should be taken into account when using and developing waterside spaces.

Currently the proposed developments along the Thames Estuary consist mainly of large-scale housing development projects as part of the Thames Gateway scheme, and this covers areas of East London, South Essex, and Kent. A document published by the GLA states that by 2016, the London Thames Gateway would have the capacity to accommodate 91,000 additional homes and 180,000 jobs (GLA, 2004b). The Association of British Insurers estimates that about 91 per cent of new homes and 1 million m² of commercial property proposed for Thames Gateway in East

London are likely to be located within the floodplain (ABI, 2005c)³. Figure 41 indicates the new housing development capacity in the London Thames Gateway.

Figure 41 Capacity (in units) for new housing development in the London Thames Gateway



Source: taken from (GLA, 2004b).

9.3.3 Flood-risks in London

Published reports (including ABI, 2000; GLA, 2002a; London Climate Change Partnership, 2004b; GLA, 2005) suggest that flood-risks in London are mainly generated by the following:

- rising sea level and tidal surges;
- inundation of floodplains by river flows; and
- sewerage and drainage network overwhelmed by intense rain storms.

In addition, investigation conducted by the General Aquifer Research and Development Team (GARDIT, 2001) suggests that the rising groundwater in London also imposes severe flood-risks for the city.

These flood-risks in London will be further aggravated by the impacts of climate change. A report by the London Climate Partnership (GLA, 2002a: 6-7) predicts that as a result of climate change, the South-East of England can expect:

- heavy winter rainfall which could occur twice as frequently by the 2080s;
- winters wetter by up to 30 per cent by the 2080s;

³ This report used the figure of 96,000 new homes in the East London, which is the current volume used by the London Development Agency in their "areas with development potential" (ABI, 2005c).

- the number of storms each winter crossing the UK could increase from five (the 1961-90 average) to eight by the 2080s;
- relative sea level in the Thames Estuary will continue to rise by between 26 and 86cm by the 2080s and will rise further in the future; and
- extreme sea levels will be experienced more frequently.

The growing population in London also contributes to the increased risks of flooding. Meeting the demand for housing in London means there are more developments in floodplain areas removing the natural floodplain and the function they provided. Also, as more areas are being urbanised, the permeable earth is being replaced with concrete impermeable surfaces (the so called Tesco effect) (GLA, 2004c).

Information published by the Thames Gateway London Partnership summarises the flood-risks in London floodplain areas based on their sources:

Table 6 The source-pathway-receptor model of flood-risk

Source	Pathway	Receptor	Consequences
Tidal/fluvial flooding from the Thames	Breach, overtopping	Properties and people behind TTD*, civil infrastructure	Very large
Thames tributary fluvial flooding	Breach, overtopping, overbank flooding	Properties and people behind fluvial defences, civil infrastructure	Medium to large
Surface water flooding	Blockage, overflow. Failure of pumps or sluice outfalls	Property adjacent to surface water drains	Small to medium
Groundwater flooding	Raising groundwater level	Properties in low lying areas, civil infrastructure	Small to medium
Human error in operating tidal defences (Thames Barrier)	Raising groundwater level. Overtopping of defences	Properties and people behind TTD, civil infrastructure	Medium to large

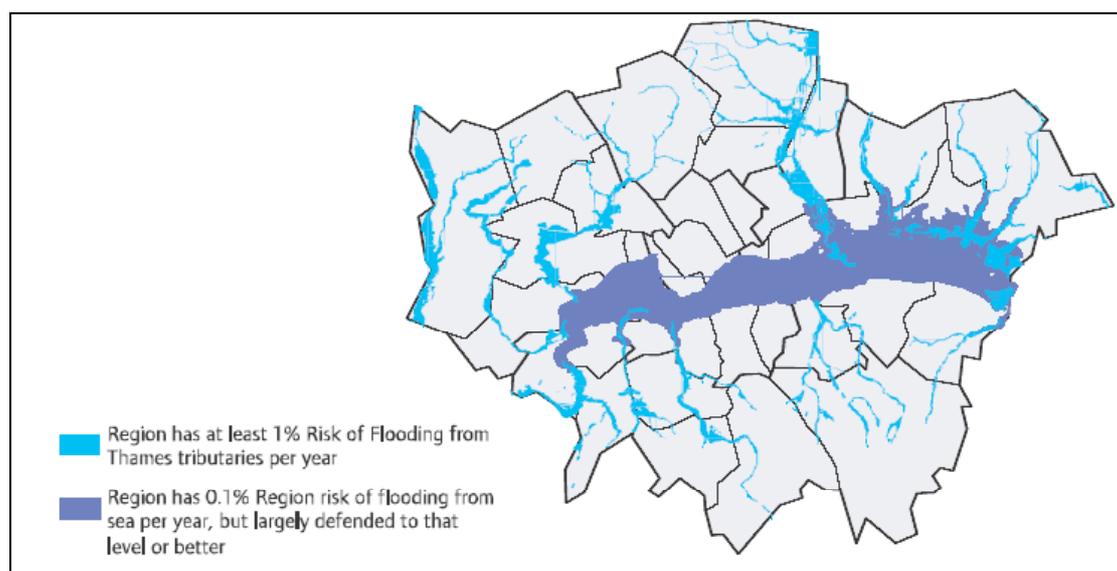
Source: taken from Entec, 2005b. Note: *TTD = Thames Tidal Defences

9.3.3.1 Floods generated by tidal surges

Tidal flooding has been seen as the main threat for London. Certainly, responding to memorandums from both the Environment Agency and the ABI highlighting the threat of storm surges for the city, the London Assembly (GLA 2002b) recognises this and highlights the events of 1953 when storm surge waters overwhelmed flood defences along the east coast of England.

The London Blue Ribbon Network map shows areas that are prone to flooding from tidal surges and flood from Thames tributaries (Figure 42).

Figure 42 Indicative flood-risk areas in London



Source: taken from *'The London Plan'* (GLA, 2004d)

Tidal surges which threaten London are generated by low air pressure travelling south or southwest over the North Sea and the funnelling of water from the southern North Sea into the Thames Estuary (GLA, 2004c). The closest tide gauges to London are at Tilbury, Southend and Sheerness (London Climate Change Partnership, 2002). Currently, about 150km² of land in London lies below the high tide level (Marsh, 2006).

A report published by the London Assembly (GLA 2005) indicates that the risks from tidal flooding are expected to increase as the results of:

- global warming, which is gradually raising the sea level; and
- possible increases in the height, intensity and unpredictability of the North Sea surge caused by meteorological depression, which funnels the surge of high water through the estuary.

Where there are no flood defences against tidal surge, about 420,000 properties on the Thames tidal floodplain would have a 0.1 per cent annual risk of flooding, which puts the value of property at risk at £80 billion (Flooding Investigative Committee, 2002).

The probability of tidal flooding has been significantly reduced since the completion of the Thames Barrier and other smaller barriers in the Thames tributaries (see section 9.3.5). The current standard of tidal flood defences in London protect to the 1 in 2,000 year event (GLA, 2005).

However, due to rising sea levels, the standard of flood defence provided by the Thames Barrier is estimated to decline by 2030, when the probability of tidal flooding will be doubled to 0.1 per cent chance (1 in 1,000 year event). By 2050, a 34cm sea level rise at Sheerness will increase that probability significantly to 0.5 per cent (1 in 200 year event) (London Climate Change Partnership, 2002).

9.3.3.2 Flood generated by Thames tributaries

Another flood threat from London is fluvial flooding from the Thames tributaries. This type of flooding is generated by heavy rainfall, which can cause rivers to rise to the point where they overtop the banks. When this happens, the excess water flows onto the low-lying areas on either side of the river (Environment Agency, 2006c).

Some areas in East London are at greater risk, as mentioned in the report published by the GLA (2005) which includes the following statement;

“In East London, there is also a problem with some of the tributaries into the Thames, and they are defended to quite a low standard. Actually, a lot of the significant flood-risk that you find in East London with a greater than one-in-75 chance comes from the tributaries, rather than the Thames itself – the Lea and those areas.”

(GLA, 2005, citing Dr Sebastian Catowski)

The probability of fluvial flooding could increase further due to the effect of climate change, which threatens increased rainfall in winter, both in volume and intensity (Flooding Investigative Committee, 2002).

9.3.3.3 Flood generated by overwhelmed sewerage and drainage system

London’s sewage and drainage system was designed and built in the mid-19th century. The system, named the Combined Sewer Overflow (CSO), was designed to carry both foul sewage and excess rainfall. The CSO is discharged into the Thames when localised rainfall is of such intensity that the drainage system’s capacity is exceeded to the point where there is a threat of sewer flooding.

Surface water flooding occurs when:

- London’s drainage system cannot cope with the intensity of rainfall and the cumulative water collects on roads and pavements (GLA, 2005); and
- when large amounts of rainwater enter the sewerage system and mix with the foul sewage, and the CSO cannot discharge the excessive volume into the Thames fast enough (GLA, 2003).

London’s Public Services Committee noted that the main reason for the great pressure on London’s sewerage and drainage system (GLA, 2003:15) included:

- the growth in London’s population and the greater demand of modern households (such as for dishwashers and power showers), thereby increasing the level of foul sewage;
- the increase in frequency of high intensity rainfall; and
- the reduction in green spaces in the city to accommodate new buildings. Grass, fields and trees absorb excess rainwater, so their reduction has put greater pressure on the city’s sewerage and drainage system.

In recent years there have been localised flood occurrences within Central London causing disruption to transport. For example, on 7th August 2002, an intense rainfall of over 2.5cm (over an inch) fell on London over a period of an hour and a half. This

led to five main train stations being closed because of floods and a number of underground tunnels being inundated (GLA, 2002a).

Again on August 2004, after heavy rainfall and storm waters, London's sewerage system overflowed, resulting in billions of litres of untreated sewage being pumped into the Thames and killing thousands of fish.

Between 1992 and 2002, approximately 3,600 properties in London were at risk of flooding due to excessive surface water (Entec, 2005b). In their scrutiny report on flooding in London, the Flooding Investigative Committee noted that;

"We received a considerable body of evidence stating that the London's sewerage and drainage system cannot cope effectively with the greater intensity of flooding events which we are now experiencing."

(2002: 27)

A report published by the Thames Gateway London Partnership (Entec, 2005b) noted that the sewerage and drainage systems in the City have a lower standard of protection with a 10 per cent chance of flooding (1 in 10 year event) than estuarial flooding. This means that the flood-risk generated by this source is higher than other sources, *"although the consequences are usually limited in the extent"* (ibid.: 42).

Thames Water pointed out that typical sewers are designed based on the 'storm return period' scenario, which varies between 1 in 10 years and 1 in 30 years of severe storm occurrence. However, these sewers cannot cope with the altered weather pattern anticipated due to climate change, as explained in the GLA report.

"With the recent changes in the weather patterns, if a 1 in 30 year [3.3%] severity of storm occurs more often, the sewer system will not be adequate and there will be a risk of sewer flooding more often."

(GLA, 2003: 15, quoting Thames Water)

A memorandum from the Association of British Insurers also stated that in London;

"Many drainage systems are designed to cope only with high frequency, low severity flood conditions, such as might occur with a 5 per cent annual probability [1 in 20 year chance]."

(Flooding Investigative Committee, 2002: 27, quoting ABI)

9.3.3.4 Flood generated by raising groundwater

The groundwater in London has been abstracted from an aquifer for commercial and industrial uses for two centuries. During the decline of heavy industry in the 1960s when London turned to more commercial uses, the reduced abstraction led to a reversal, to the stage where the water levels now rise up to 2.5 metres per year, threatening tunnels and building foundations in central London (London Climate Change Partnership, 2002; Norwich Union Risk Service, 2005).

A report by the Norwich Union Risk Service noted that the groundwater levels in London vary between 10 – 40 metres below the ground level, with highest points reached towards the East of London at locations such as Woolwich and Barking (Norwich Union Risk Service, 2005).

The rising water level is eroding the thick layer of clay that prevents it from seeping up to the surface, causing flooding or damage to London's infrastructure, sewers, deep tunnels and deep basements. The foundations of tall buildings are also in danger (GARDIT, 2001; Norwich Union Risk Service, 2005).

The General Aquifer Research and Development Team (GARDIT) estimated that 70-mega-litres of water per day must be pumped out to prevent flooding or damage. In 2001 London Underground pumped 30,000 cubic metres of water per day from its tunnels, of which about 4,500 litres was removed from Victoria Station alone (BBC News, 2001; Norwich Union Risk Service, 2005).

9.3.4 Perception of property investors and property professionals on flood-risks in London

With regards to investing in London and the flood-risk, the view of one property investor was:

"You know, sixty, seventy per cent of the UK commercial investment market, high value, is probably in London and the South-East and you can't just say blanket right, flood-risk means we're not investing it."

However another property investor said that with regards to flooding *"the institutional market is very cautious"*

One of the main flooding issues identified by property investors in London was the rising ground water:

"Now industry isn't in London to the same level, so it's the water table that is gradually rising, so I think that the City of London is a fascinating example of that because it is a real issue that very big tall buildings already have to face."

"It's very interesting that in the City of London there's an awareness amongst the investment community that water tables are rising and that in time this is an issue that in twenty, thirty years time you could have a lot of basements in London being flooded, but in ninety, a hundred years time it's pretty server pumping required and may be a Central Government issue."

Despite the potential threat of flooding faced by London, it was felt by one property investor that due to the high value and importance of the area, action would be undertaken by government to ensure the area was not adversely affected:

"The City I think is an interesting case. There will be a sense that Government will try and do something because it's such as massive value of land."

One property adviser commented on the current market and how, when considering issues such as flooding, it is important to understand the market as this can affect what is available to buy.

"albeit the market is currently so hot that we're looking a lot closer now than we were in a more balanced market. Prices are really high - people are trying to off-load all sorts of properties because everyone's desperate to buy out there and we're being very cautious as a consequence."

One property adviser commented that they felt smaller properties and investments were more sensitive to issues such as flooding:

“small sites are actually more sensitive to a flooding problem as it will have a greater impact on cashflow. The larger sites can cope with these issues better because the assets are of such a value, the cashflows are so large the problems are easier to manage.”

However flood-risk is not necessarily a bad thing as the fact that a site has a problem can be addressed if it is going to be redeveloped, as one property adviser said:

“I would have thought there are sites that are currently blacklisted and as a consequence were quite cheap but with very careful re-development planning could probably solve the problems.”

When considering how to adjust the price with regards to flooding on property, it seems that Investors consider the cost of the damage a flood could cause.

“If the damage happens, how much does it cost to put right if it is a sort of one in a thousand year occasion?”

“You’d probably walk away from those situations unless you can get a tangible sensible pricing.”

“we have to be very aware of the longer term on the flooding side but I think that the industry as a whole is quite naïve about it.”

It is interesting to note that whilst property investors do not view London as commercial centre at risk of flooding, the Environment Agency has started to consider the risk. A new development proposed by Bridge House Estates next to Blackfriars Bridge has been labelled by the Environment Agency as being in a ‘high-risk flood zone’ (Anon, 2006).

9.3.5 Flood-mitigation measures

Flood-mitigation measures against flood-risks in London may be categorised into two types of approach:

- direct mitigation measures: building flood defences, tackling rising groundwater; and
- indirect mitigation: implementation of PPG25, development of sustainable designs, targeting for a ‘greener capital’.

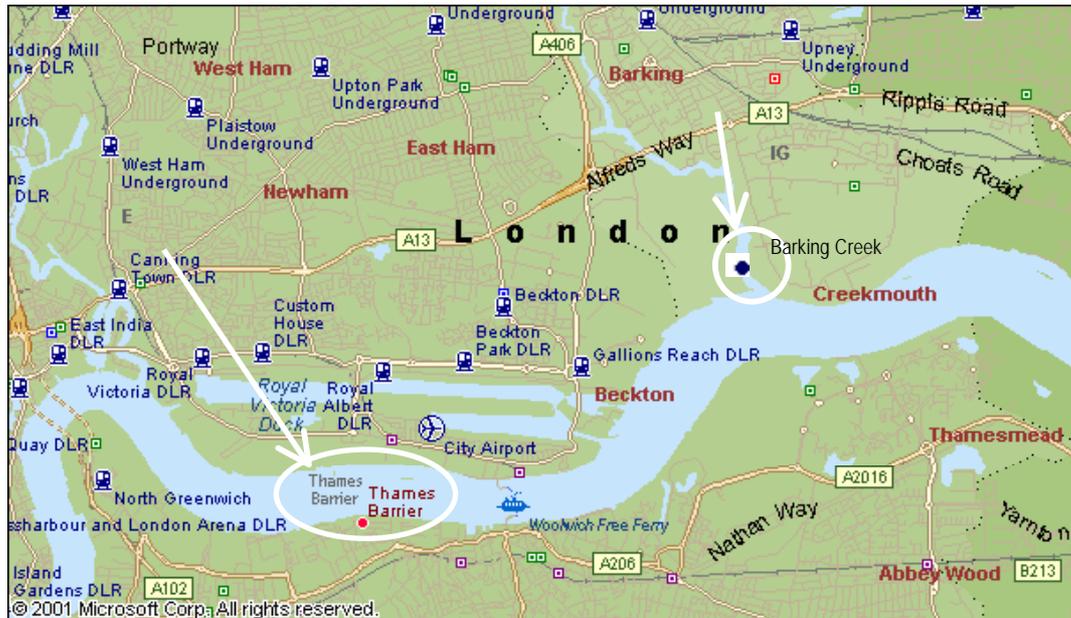
9.3.5.1 Direct flood-mitigation measures

Mitigating the risk of flooding from tidal surges

Following the tidal flooding that hit London in 1953, investigation was undertaken to work out ways to protect London in the future. Construction was undertaken during the seventies and early eighties, culminating in the completion of the Thames Flood Barrier in East London, which was opened in 1983, costing around £535 million. In addition, smaller barriers were also constructed across some of the Thames’

tributaries, such as the barriers at Barking Creek (at the mouth of the Roding, Barking) and the Dartford Creek (at the mouth of the Darent, Kent) (Thames Estuary Partnership, 2006). These barriers were engineered to protect London from tidal surges of up to 7 metres, which currently protects against the probability of 1 in 2,000 years flood (GLA, 2005). Currently there are more than 30 barriers and more than 150 kilometres of embankments and defensive walls along the Thames (Portcities, 2006).

Figure 43 Locations of Thames Tidal Defences in East London



The Thames Barrier is a structure of ten moveable gates positioned end-to-end across the Thames (width of 520 metres), each gate being pivoted and supported between concrete piers that house the operating equipment. When not in use, the gates lie in special recesses on the riverbed to allow free passage of river traffic through the main openings between the piers (Figure 43). When there is a threat of a high tidal surge, the gates form a continuous steel wall facing down river to stem the tide and seal off part of the upper Thames from the sea (Environment Agency, 2006d). Since becoming operational, the Barrier has been in use on more than 80 occasions.

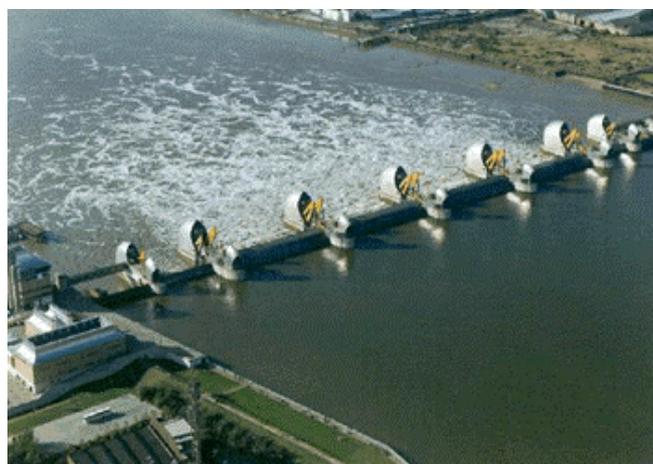
Statistics from the Environment Agency indicate that the frequency of the Thames Barrier closures reached the highest 6-month period during November 2000 – April 2001, where the Barrier had to be closed 24 times. This was followed by the figures for January 2003, when the Barrier had to be closed 18 times during that month alone. The Environment Agency attributed the 2000-2001 closures largely to the extreme intensity of rainfall on the Thames and its tributaries.

Figure 44 Thames Barrier



Source: taken from www.hitite.adlibsoft.com

1. Thames Barrier when the gates are opened.



Source: taken from <http://w3.mech.uwa.edu.au/~kamy/Thames%20Barrier.htm>

2. Thames Barrier when the gates are closed.

Rising sea levels mean that the probability of tidal flooding is also increasing. Related to this, the Thames Barrier is expected to remain effective until year 2030, as currently London is still sinking at 200mm per century, and at the same time the sea level is rising. Thus, the Barrier provides an increasingly lower level of protection against flood-risk with the probability increasing up to 0.1 per cent (1 in 1,000-year event). The sea level is predicted to rise by 600mm – 900mm by year 2100. However if the Antarctic ice cap starts melting this level could be increased, reducing its protection level.

In the response to this, the Environment Agency is leading the ‘*Thames Estuary 2100*’ project that aims to establish an appropriate level of flood protection for London and the Thames Estuary until year 2100. Apart from assessing the effectiveness of the existing flood defences and the drivers behind increasing flood-risks and gaining political and funding support from other stakeholders, this project also proposes a programme of studies that will eventually lead to an effective strategy for flood-risk management in the Thames Estuary for the next 100 years (Thames Estuary Partnership, 2006). In January 2005, a proposal to build a 16km (10 mile) barrier stretching from Sheerness (North Kent) to Southend (Essex) was revealed by the team of scientists for the project.

London's flood defences are not impenetrable as a structural and civil engineer highlighted:

"In reality, many parts of Europe, Britain and indeed the world are located in many development areas or urban areas [which] are located behind defences, raised defences, indeed large areas of London are behind defences so were areas of New Orleans, I mean New Orleans is a very extreme case, the defences weren't properly constructed or properly maintained and they were talking about hurricane events, which clearly we don't get in this country."

"However the defences for London are designed to one in a thousand year standard, they're regularly maintained, they are very robust, and then of course we've got the Thames Barrier as well, but I suppose ultimately the Thames Barrier could potentially fail."

Mitigating risk of flooding from rivers

The management of flood defences for the Thames tributaries is mainly entrusted to riparian owners (individuals or bodies living on or owning river banks). The Environment Agency carries out flood defence works to the main rivers only, which are designated by DEFRA. The Environment Agency identified some the responsibilities of riparian owners as follows;

"You may have flood defences such as walls and embankments on your property, which are vital for the protection of both yourself and others. You would discuss the maintenance of such defences with your local Environment Agency office."

"You are responsible for protecting your property from seepage through natural or man-made banks. Where such seepage threatens the structural integrity of a flood defence, it may become the concern of the Environment Agency."

(Environment Agency, 2006e)

Since so many of the Thames tributaries are hidden from view and/or stand as part of private developments, accessing such watercourses is difficult for inspection and maintenance. A report published by the London Assembly described sections of the Thames tributaries in London as having sub-standard defences and that *"the riparian owners have been informed of the need to upgrade the defences"* (Flooding Investigative Committee, 2002: 24).

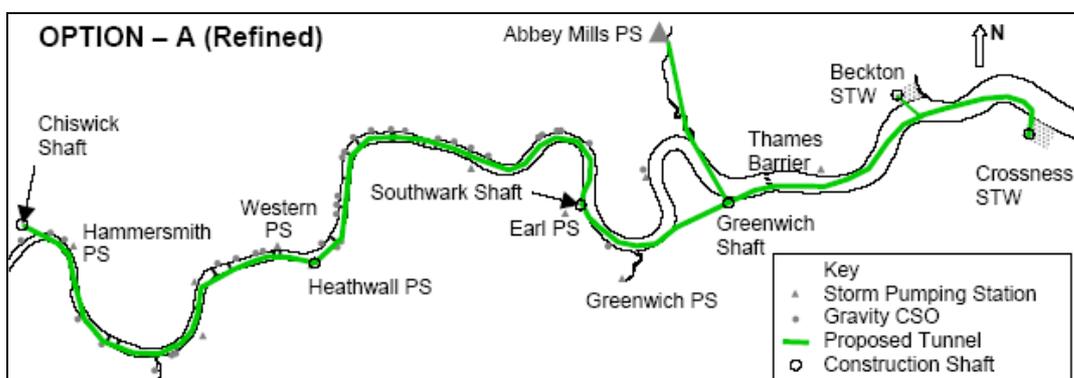
Mitigating risk of flooding from sewerage and drainage system

As demonstrated in section 2.3.3, changing patterns of rainfall and a failure to maintain and develop the capacity of the regional infrastructure are contributing to the failure of storm water and sewage infrastructure in London (Roaf, 2005; Institution of Civil Engineers, 2001).

To tackle the problems of London's sewerage system, Thames Water chairs a research project (the Thames Tideway Strategic Study) investigating the effects of climate change on the design of sewers and the drainage system (see Flooding Investigative Committee, 2002 for details). The report, published in February 2005, proposed the building of a 35km storage-and-transfer tunnel, to run underneath the Thames, from Hammersmith in West London to Crossness in East London (Figure 45). The tunnel will intercept most of the storm flows from 36 unsatisfactory Combined Sewer Overflows (CSOs) along the Tideway for collecting and treatment

at the Crossness sewage works before discharge into the Estuary (Thames Tideway, 2005a).

Figure 45 Thames Tideway Storage Tunnel Solutions



Source: (Thames Tideway, 2005b)

Responding to this study, the Office of Water Services (OFWAT) published an independent report reviewing the proposal by the Thames Tideway Strategic Study group. The report found that there is an alternative solution, which would avoid the capital costs of £1.7 billion and adding £45 to the annual water bills of people living in London (Weaver, 2006). The alternative solution, has the following key components:

“ ... a 9km-long western storage tunnel from Hammersmith to Heathwall and associated screening plant at Heathwall; new primary treatment facilities at Abbey Mills and in-river skimmers. The estimated cost of this is approximately £0.9 billion.”

(Jacobs Baktie, 2006: iv)

In response to these reports, the Environment Agency has given its approval to the tunnel solution, as stated in their press release;

“The construction of a tunnel to intercept, transfer and treat sewage from the overflows is the only realistic way forward to deliver 21st century standards for a healthy and vibrant river.”

(Environment Agency Press Office, 2005b, quoting EA Thames regional director)

However, the Environment Agency has also raised concerns about the delays in implementing a solution (Environment Agency Press Office, 2005b).

Mitigating risk of flooding from raising groundwater

One solution for dealing with rising groundwater in London was proposed by GARDIT, and this involves increasing groundwater abstraction in the City. The works includes installing more than 50 new water boreholes at strategic locations across London, from which up to 70 mega litres would need to be extracted daily by 2004 (Norwich Union Risk Service, 2005). A report by Norwich Union Risk Service (2005) explained the five-stage solution as follows:

- utilise existing licensed water supply boreholes which have become disused;

- equip proven Thames Water sites near Central London;
- the use of existing and new private boreholes;
- planting new boreholes in Central London; and
- planting new boreholes in Outer London.

During the implementation, Thames Water is committed to support this strategy by providing abstraction of approximately 45 million litres per day (Thames Water, 2006).

Current information in the public domain regarding this mitigation measure has been very limited. The latest available documentation reveals that GARDIT has been tackling the problem of London's rising water levels by drilling boreholes across seven locations in London to extract the water (GLA Press Office, 2001)⁴. Related to this, a recent study on flooding in East London acknowledged that; "*increased water abstraction from identified risk areas has now stabilised the rising water levels*" (Entec, 2005b: 43).

9.3.5.2 Indirect flood-mitigation measures

Apart from raising flood defences that are utilised on an occasional basis, indirect flood-mitigation measures are also needed to ensure that the solution to flooding can be sustainable, which means that the solution would not convey the problem elsewhere or harm the environment (Flooding Investigative Committee, 2002).

Assessments of flood-prone locations

As has already been explained in the literature review, the government's current Planning Policy Guidance Note 25 (PPG 25) '*Development and Flood-risk*' (ODPM, 2001) provides guidance for local authorities in formulating their development plans and in the implementation of development control decisions through a sequential test to determine flood-risks in the areas of proposed developments (listed in Table 1 of the PPG25).

Following this, the Thames Gateway London Partnerships (TGLP) commissioned a Strategic Flood-risk Assessment of East London, which is an area of '*national and regional regeneration priority*'. Through this study, the 11 participating London boroughs are expected to undertake the PPG25 sequential test and assess the consequences of existing and proposed developments located in high flood-risk areas.

Implementation of sustainable drainage solution

One of the most sustainable ways to prevent surface flooding is the provision of Sustainable Urban Drainage Systems (SUDS). Unlike conventional developments, which tend to be surrounded by impermeable concrete surfaces and which force storm water to overflow into existing drainage system, SUDS allow surface water to soak into the earth through different channels and reservoirs. The methods in SUDS include: filter strips and swales, permeable surfaces and filter drains, infiltration devices, and basins and ponds (Ciria, 2005).

⁴ Seven boreholes have been activated by 2001; Merton, Streatham, Honour Oak, Wanstead, Brixton, Battersea and Islington (GLA Press Office, 2001)

A memorandum from the Thames Gateway London Partnership, quoted in the report *'Flooding in London'*, stated that;

"The Boroughs need to be able to force developers to install SUDs in any new developments, and where possible enforce the creation of quality open spaces to assist in the functional infrastructure of water management."

(Flooding Investigative Committee, 2002: 32)

Furthermore, a consultation response report submitted by the London Climate Change Partnership stated that the development of SUDs is vital to go alongside development that could cope with current flood-risks and future risks imposed by the climate change (London Climate Change Partnership, 2004).

The Policy 4C.8 of the London Plan states that;

"The use of sustainable urban drainage systems should be the norm unless there are practical reasons for not doing so ... include the local ground conditions of density of development. In such cases the developer should seek to manage as much run-off as possible on site and explore sustainable methods of managing the remainder as close as possible to the site."

(GLA, 2004c: 200)

An example of SUDs implementation for new developments in London is the Barking Riverside scheme, which allocates storage/balancing pods on the site to mimic the natural drainage processes (Dixon *et al.*, 2005).

Development of flood-resilient schemes

The main way to reduce the risks of flooding in London is by minimising the impacts of climate change. Potential threats to London due to climate change were identified in the report *'London's Warming'* (London Climate Change Partnership, 2002), highlighting the need to make changes in how people use energy and water in more efficient ways.

In November 2005, guidance on building a 'climate change resilient' development was published by the GLA. Aimed at informing stakeholders from the property and construction industry, the document lists the main design issues affected by climate change and the suggested techniques to incorporate adaptation measures in new developments ranging from location, site layout, buildings structure and materials, ventilation and cooling, drainage, use of water, and provision of outdoor spaces (London Climate Change Partnership *et al.*, 2005).

9.3.6 Management of flood-risks in London

There are numerous stakeholders involved in responding to flood-risks in London. The Flooding Investigative Committee noted that;

"at last, with the creation of a London-wide strategic authority in the GLA, there exists a body which has a statutory duty to take an overview of the flooding risk on behalf of Londoners."

(2002: 7)

The GLA has the key role of coordinating the following main stakeholders: Environment Agency, Thames Water, the Boroughs affected by flooding, Thames Gateway London Partnership, the Metropolitan Police and Fire Service, and the Association of British Insurers.

The current implementation of flood-mitigation works in London (refer above) suggests that all flood-risks may not have been equally addressed in terms of their monitoring, maintenance and contribution towards flood defences. Entec (2005b) notes that:

“Our consultations indicate that the area of contribution towards flood defences is prone to dispute and often difficult for the public authorities to administer equitably.”

(Entec, 2005b: 22)

9.3.6.1 Management of flood-risks on the banks of the Thames

Tidal flooding has been shown to be the imminent threat, with the most catastrophic impact on the city of London. This has been reflected in the rigorous mitigation measures, including the construction of the Thames Barrier, which protects not only London but most areas within the Thames region, and the on-going investigative research for its replacement. The final cost for building the Thames Barrier was £535 million.

For funding flood-mitigation measures at local level, the PPG25 paragraph 61 states that:

“any necessary flood defences or flood alleviation works required because of the development form a part of that development. They should normally be fully funded by the developer.”

(ODPM, 2001)

The Flooding Investigative Committee (2002: 47) reported that section 106 agreements had been utilised by the London Boroughs to pay for additional flood-mitigation measures, such as providing upstream storage as part of a school redevelopment.

In terms of funding the flood defences along the Thames banks, the Environment Agency may contribute to the cost of renewal of tidal defences with a residual life of five years or less. Calculating the Environment Agency’s contribution is a complex process; however in general, the practical effect would be:

“developers of property fronting the Thames must pay 50 per cent of any primary defence works required and thereafter the owners of the property must contribute at least 10 per cent of its ongoing maintenance.”

(Entec, 2005b: 20)

9.3.6.2 Management of flood-risks in banks of Thames tributaries

Protection against river flooding would involve *“inspection of watercourses for blockages, and of flood defences to ensure prompt maintenance and repair of those*

defences in poor condition.” (Entec, 2005b: 30; Institution of Civil Engineers, 2001) Yet for watercourses that are not categorised as ‘main rivers’⁵, cooperation of all operating authorities to do the inspections has proven difficult (Flooding Investigative Committee, 2002).

Under the Water Resources Act 1991, the Environment Agency holds the permissive powers for main rivers only, which means that the Agency conducts the river inspection but has no obligation to maintain or carry out new works. For the ‘ordinary watercourse’, the responsibilities are taken by London Boroughs. Regarding this:

“...as responsibility for maintenance is permissive rather than obligatory, risk-based prioritisation of maintenance is not carried out because of competing budgetary priorities. This is one area which could benefit from much closer liaison between the various organisations involved.”

(Entec, 2005b: 19)

The Environment Agency has highlighted difficulties of obtaining access to watercourses where private developments are built up to the river’s edge, which makes inspection and maintenance difficult. Also, practices of illegal dumping in rivers and on banks, the fact that many rivers are hidden from view, and limited advance flood warnings compound problems of flood-risk from river tributaries (Flooding Investigative Committee, 2002; Institution of Civil Engineers, 2001).

The burden of responsibilities for enhancement, repair and maintenance of flood defences of riparian owners also raise contentious issues of inequality. Riparian owners are required to bear the cost of renewing or enhancing defences on their properties, yet other owners who do not have river frontage properties will also reap the benefits of reducing flood-risk against their properties (Entec, 2005b).

The Flooding Investigative Committee voiced its concern that:

“... there are sections of river flood defence in London which currently fall below the Government’s indicative standard of defence against a 1 per cent annual flood-risk, and other sections in a poor or very poor condition.”

(2002: 25).

Management of flood-risks from London’s overwhelmed sewerage and drainage system

The Association of British Insurers noted that flooding from drainage systems is currently ‘*not included in any systematic risk assessment and warning policy*’ (ABI, 2005b: 52). According to the London Assembly Scrutiny Report, the whole drainage system in London:

“is patchy and incomplete, that there is often an unwillingness to take responsibility for certain parts of the network, that maintenance and repair of

⁵ A ‘main river’ is defined as a watercourse shown as such on a main river map, and can include any structure or appliance for controlling or regulating the flow of water in, into or out of the main river. The Environment Agency’s powers to carry out flood defence works apply to main rivers only. Main rivers are designated by the Department for Environment, Food & Rural Affairs in England and by the Welsh Assembly Government (Environment Agency, undated).

the system suffers as a consequence, with serious implications for flooding risk.”

(Flooding Investigative Committee, 2002: 40)

Ownership and the responsibility for the maintenance of drainage systems are often unclear, and the Environment Agency stated that '[this is] *the subject of correspondence between Thames Water and the relevant local authorities*' (Flooding Investigative Committee, 2002: 38, quoting the Environment Agency). Also:

“the criterion for classification of drains appears to require clarification, and ... records of ownership and operational responsibility should be publicly available”

(*ibid.*).

As for sewer maintenance, the Water Industry Act 1991 (c.56) states that part of the general duties of sewerage undertakers is “... *to provide, extend and improve the public sewer system to ensure that their areas are, and continue to be, effectively drained ...*” (Water Industry Act, 1991: s. 94). Within this statutory framework, Thames Water, a commercial company, operates as a public sewerage undertaker (one of ten appointed companies). During the 1990s, Thames Water took over the sewerage management contracts previously undertaken by local authorities, in London and the South-East of England.

However, problems often arise from the interface between Thames Water and the London Boroughs, generated by the way in which responsibilities have been transferred to Thames Water and the agreement of maintenance contracts with the local authorities, which cause confusion particularly amongst the local community (Entec, 2005b; Flooding Investigative Committee, 2002). For example, when sewer flooding occurred in London Borough of Southwark in April 2004, the investigation report of the incident stated that:

“While much valuable [flood emergency] work was done, there were clearly deficiencies ... Residents who did not get through to the Council were generally referred to Thames Water and others who contacted Thames Water were referred to the Council ... the residents complained that no one seemed to be taking responsibility.”

(London Borough of Southwark, 2005).

There is also evidence that insufficient funding is being applied to a major problem, which needs a comprehensive and programmed solution.

In delivering mitigation works against sewer flood, Thames Water works with the industry regulator OFWAT, which granted funding of £80 million to relieve 1,750 properties across the Thames region (including London) from internal flooding and 250 properties from severe external flooding during a five-year period from April 2000 to March 2005 (namely Asset Management Period 3) (Flooding Investigative Committee, 2002). In allocating the funding, (which is limited, considering that Thames Water had requested for flood relief of 3,000 properties), a priority system is adopted according to the seriousness of the flood-risks and the frequency of flooding occurrence on the property.

Such mitigation works are clearly inadequate to deal with the severity of this widespread problem. With no-one having overall responsibility and with the amount

of property values (ignoring here the human life, health and other costs) at risk of damage from the inadequacy of the existing defensive structures to protect, there is a very real danger a severe flood event could reduce the value of Thames-based property by billions causing a huge institutional, personal and financial crisis.

9.3.7 Summary

Flooding has been part of London's history. With the rising sea levels and changing weather patterns occurring as part of the ongoing impacts of climate change, the City has become more susceptible to flooding, and with ever-rising property prices, the monetary value of assets at risk is huge.

Tidal flooding is perceived as the most imminent threat to London and other areas along the Thames region and this has been recognised by the rigorous mitigation measures introduced by the Environment Agency which handles most of the funding and operational side of the Thames Barrier in East London.

However, evidence suggests that mitigation measures for other flood-risks (fluvial and surface flooding) in London are still subject to uncertainties, particularly in terms of which stakeholders are responsible for conducting monitoring and maintenance works. Note that risks from rising groundwater in London are excluded from this statement, because this is an absence of current information available in the public domain. Funding is a major issue, and limited availability means that works must be prioritised and the threat of flooding in London is not being addressed equally in all affected areas. The maintenance and enhancement of river tributaries may have to rely entirely on the capacity and willingness of riparian owners. It is almost inevitable that flood-mitigation expenses will be transferred to residents, for example, in hikes in utility bills.

Reviews of a number of studies on flooding in London suggest that in delivering mitigation measures against flood-risks in the city, the following issues need to be addressed:

- management of flood-mitigation measures where stakeholders (Environment Agency, Thames Water, GLA, London Boroughs, etc) need to hold clear statutory duties and responsibilities, which cover not only managing the source of flood-risks and monitoring and maintaining flood defences, but also raising the awareness of flood-risks amongst London inhabitants;
- a clear and integrated plan is needed to deal with all sources of flooding, including the anticipated increased flood-risk from climate change;
- steps are needed to ensure that all new developments are climate change proofed;
- funding is structured and prioritised to reflect needs;
- injection of enough funding to mitigate all flood-risks to meet government's indicative standard by 2007 and thus prepare London for the Olympics in 2012.

9.4 Green Park, Reading

9.4.1 Introduction

Green Park is a development of offices in Reading, Berkshire. It is located close to junction 11 of the M4 and the site is approximately 72 hectares (180 acres) in size.

Figure 46 Plan of Green Park, Reading



Source: PBA (undated)

The site is still in the process of development, with the plan being that on completion of the phased scheme, there will be 209,030 sq m (2.25 million sq ft) of business accommodation. The third phase of the development will take into account a further 92,900 sq m (1 million sq ft) of business and leisure accommodation. Approximately 2,000 people are currently working in offices on the site, which is developed by Prudential Assurance Company Ltd and managed by Prudential Property Investment Managers Ltd (PruPIM).

The site is developed on land, which used to be low-grade agricultural land, with part of the site lying within the Foundry Brook flood-plain, a tributary of the River Kennet that drains land to the south of Reading.

9.4.2 Flooding issues in the development of Green Park

The history of the flooding problems faced by the area were described by a Structural and Civil Engineering Representative as follows:

“There were significant flooding problems in south Reading as a result of constraints and constrictions in the natural flood-plain of the Foundry Brook, which were caused by the dumping of sewage sludge from the adjacent Manor Farm sewage treatment works. The sewage sludge had been piled up and dumped in the flood-plain together with other land fill over many decades and, in times of flood, this has constrained the flood-plain and caused backing up of flood waters and was causing problems at Courage Brewery and residential areas in south Reading.”

The flooding issues affecting the site and surrounding areas were addressed during the development of Green Park, with the plans for the site having been conceived around 15-20 years ago in conjunction with the National Rivers Authority (predecessors to the Environment Agency), as explained by a Consultant:

“... at the outset with Green Park [it was] agreed with the predecessors of the Environment Agency, [what] land would be retained at that low level and designated as flood-plain.”

The developers constructed a new flood channel as part of their scheme and part of the channel is a lake (called Long Water), which is located in the middle of the Green Park Development. The role of Long Water was explained by a consultant as providing:

“... both the flood flow conveyance, as a flood relief channel to the main Foundry Brook, to which it runs parallel; while also providing flood-plain area for the storage of flood waters.”

In addition to the development of the flood channel, the actual development was raised in height to the two hundred year flood level (0.5% chance of a flood occurring in any one year).

These measures were tested by the views of occupiers, as one Property Professional stated:

“occupiers and the investors of the various buildings are happy with that standard.”

“... indeed [Green Park] brought benefit to other areas that have previously flooded so ... the perceptions of the local residents [and] the occupiers of the buildings would be that there is no flood-plain issue any more.”

9.5 Summary

Despite the current and projected increased flood-risk in London, investors and occupiers are still eager to locate in these areas. This may be due in part to the fact that London has not yet suffered a major flood event and / or to the perception that flood defences are adequate to the existing levels of risk.

There are other South-East locations where new developments have been designed specifically to mitigate the effects of flood-risk, such as Green Park in Reading. Mitigation work has been undertaken to secure planning permission to protect the financial investment in the project and to increase the security of occupiers and insurers. However, London is still the preferred location for many businesses, especially for Head Office accommodation.

The New Orleans' experience, where flood defences failed dramatically, has not caused UK-based businesses to think about relocating away from London. There is a widespread belief that there are certain locations (London being one of them) which will be protected at any financial cost. While it tends to be perceived that tidal surge presents the main risk of flooding to London, rising groundwater is a major threat to property in the City of London and many buildings already have to have water pumped from their basements. This is a problem not only for older buildings, where it

is now too difficult to introduce mitigation measures, but also for newer buildings with deeper foundations and basement car parking.

In addition, London's Victorian sewage and drainage system is unable to cope with flash storms or intensive rainfall. Localised flooding is already a problem because of the limited capacity in the system, giving rise to instances of the water authority (Thames Water) undertaking controlled discharges of foul water directly into the Thames.

This research suggests that many investors greatly under-estimate the nature and level of flood-risks in London. There is a mistaken assumption that the Thames barrier offers significant protection and that the government will take all measures necessary to ensure that the capital does not flood. However, findings from previous sections in this report indicate that these expectations are somewhat unrealistic.

Whilst the circumstances of New Orleans are not directly comparable to those of London, they do illustrate how warnings of inadequate flood defences can be ignored by the responsible authorities, how foreseeable events can combine to produce unforeseen and devastating damage to property and lives, and how limited, slow and patchy the recovery programme can be.

With London being the financial, administrative and cultural capital of England as well as an international centre for investment and tourism and with such a large concentration of financial assets (not all of it property) focused on the capital, it must be speculated as to how much medium- to long-term financial, social, environmental and political damage would result from a worst case scenario flooding event. Given the UK's unique insurance market, such an event is certainly likely to damage the nature of insurance over in the UK forever and that in itself will have a major impact on the UK property market and society at large.

10. RESIDENTIAL CASE STUDIES

10.1 Introduction

The purpose of the residential case studies was to examine examples of flood alleviation schemes which had been developed for residential settlements and to examine the different techniques being used by developers to reduce the risk of flooding faced by dwellings.

The examples chosen were taken from the South of England and are located in the Thames Region. They include the Maidenhead, Windsor and Eton Flood Alleviation Scheme, Barking Riverside in the Thames Gateway and the proposed development at Kennet Valley Park in Reading.

In the Thames Region, there are 175,000 residential properties at risk of fluvial flooding and 402,000 residential properties at risk of tidal flooding (Halcrow, 2001).

10.2 Residential case study methodology

The research into the case studies was undertaken in early 2006 and based upon a review of relevant reports and literature and, where appropriate, interviews with stakeholders involved in these areas.

12.3 Barking Riverside, London⁶

12.3.1 Introduction

London has experienced a number of flooding incidents, of which one of the worst to date was the tidal flooding in 1953 (refer Section 9.3.1 for more details). Construction to prevent against tidal flooding was undertaken during the seventies and early eighties, and the Thames Flood Barrier became operational in 1983. In addition, smaller barriers were also constructed across some of the Thames' tributaries, such as the barriers at the Barking Creek (at the mouth of the Roding, Barking) and the Dartford Creek (at the mouth of the Darent, Kent) (Thames Estuary Partnership, 2006). These barriers were engineered to protect London from tidal surges of up to 7 metres, which currently stands at the probability of 1 in 2,000 years (GLA, 2005).

However, with rising sea levels, these flood defences are expected to remain effective only until 2030, when existing defences would continue but at a lower level for protection against a flood-risk probability of 1 in 1,000 years. In response to this, the Environment Agency is leading the '*Thames Estuary 2100*' project that aims to

⁶ The quotes in the following discussion of the flood-mitigation measures being used in Barking Riverside were obtained from a separate research project now based at Oxford Brookes University, examining '*The role of UK development industry in brownfield regeneration*'. This is part of a wider research programme called SUBR:IM (Sustainable Urban Brownfield Regeneration: Integrated Management), and is funded by EPSRC (see www.subrim.org.uk). For further information on this research please contact Professor Tim Dixon in the Oxford Institute for Sustainable Development at Oxford Brookes University (tdixon@brookes.ac.uk).

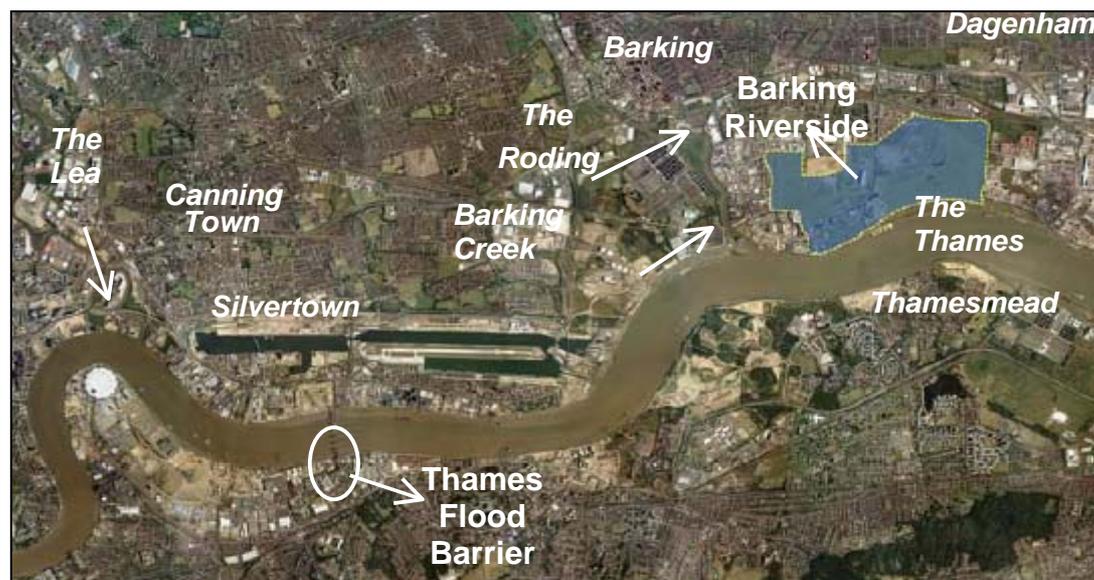
establish a level of flood protection for London and the Thames Estuary until year 2100.

Concerns of flood-risk have been one source of criticism levelled against one of the country's biggest schemes to address the housing shortage in the South-East, namely the Thames Gateway. By 2016, the area is designated to accommodate 91,000 new homes. A report published by the ABI (2005c) notes that in accordance of all of the UK's main growth areas for new housing, the Thames Gateway has the greatest proportion of properties (89%) in the floodplain. Rigorous flood-mitigation, therefore, is crucial.

In June 2005, a report on strategic flood-risk assessment of East London was released (Entec, 2005b). The Thames Gateway London Partnership and the Environment Agency commissioned this report, which would provide boroughs within the Gateway area with the guidance on appropriate development locations and type, according to the prevailing flood-risks in their locality.

One of the key development sites in the Thames Gateway is the Barking Riverside, which is located within the London Borough of Barking and Dagenham and situated between the A13 and the River Thames (Figure 47). The development scheme covers about 150 hectares (370 acres) of brownfield land, and it is projected to accommodate around 10,000 new homes over the next 15 to 20 years.

Figure 47 Thames Barrier and Barking Riverside



Source: Barking Riverside (undated)

12.3.2 The scheme

The Barking Riverside scheme is part of the London Riverside regeneration scheme. It is being developed through a joint venture between English Partnerships and Bellway Homes with the following principles (taken from www.barkingriverside.co.uk):

- the creation of a new sustainable community (including homes for 26,000 people, new employment for 1,500 people);
- the provision of integrated community facilities and amenities;

- the provision of improved transport connection;
- the provision of mixed home ownership including affordable homes; and,
- the provision of a high quality environment (40% open space).

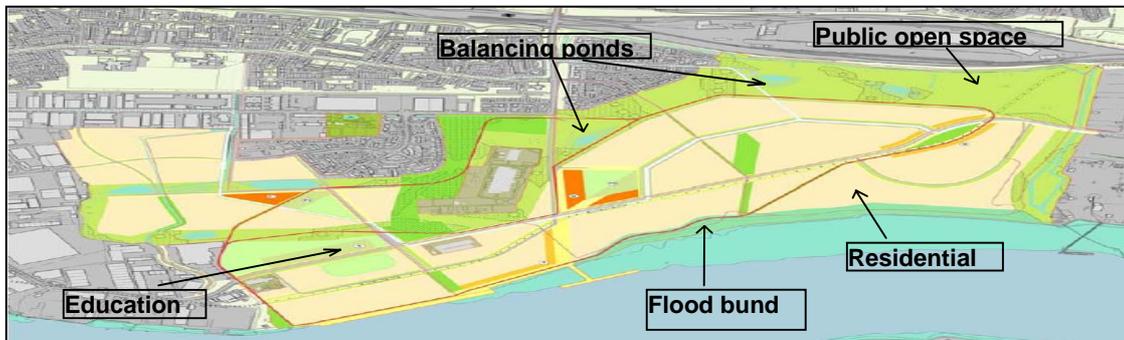
The initial stage of the scheme started in 1994, and over 900 houses are already completed on site. On December 2004, an outline planning application was submitted for the remainder of the site (framework plan is illustrated in Figure 48). The scheme will be undertaken through four 5-year development phases, with each phase aiming at the completion of about 3,000 new homes.

The large scale of this planning application raises a lot of issues from the point of view of environment and infrastructure, particularly as the site suffers from the legacy of its previous uses as industrial sites, which have now become derelict, heavily contaminated and a home to wildlife. Rigorous assessments are still under way including consultations between the local authority, public bodies, such as the Environment Agency, as well as the other stakeholders involved in the London Riverside regeneration scheme.

Related to assessing the environmental issues of the scheme, one Development Control Officer from the London Borough of Barking and Dagenham explained that:

“In terms of processing the [Barking Riverside planning application], it was accompanied by an Environmental Statement. There are an awful lot of legal challenges to Environmental Statements – interpretation of a procedure and all the rest of it – so getting those elements right is something we are particularly concerned about. We do not want to be in the position of granting planning permission and having it challenged straight away.”

Figure 48 Barking Riverside framework plan



Source: Barking Riverside (undated)

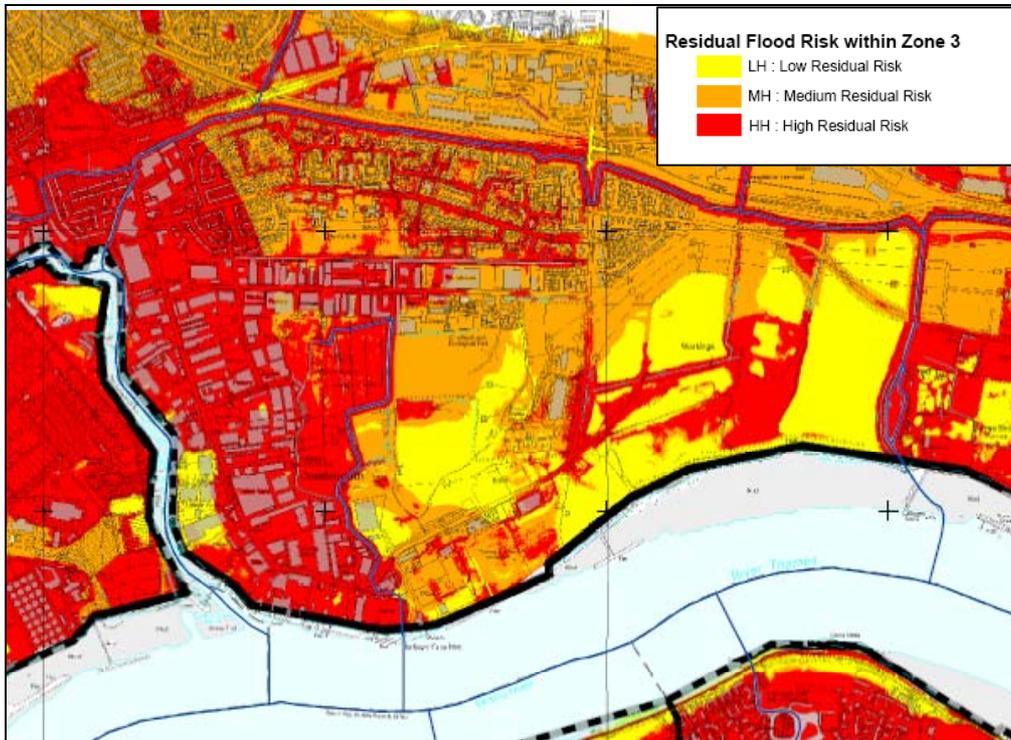
12.3.3 Flood-risks and flood-mitigation measures

A map produced by Entec (2005a) outlines the ‘residual’ flood-risks that are not likely to be prevented by the current Thames tidal defences. Figure 49 shows that the Barking Riverside site falls mostly within the low residual flood-risk category. The areas marked as high residual flood-risk include (*ibid.*):

- the fluvial floodplain from the Thames tributaries;
- the land that is likely to fall within the rapid inundation zone; and,

- the low-lying land that is below the flood threshold level of not posing a threat to human life.

Figure 49 Residual flood-risk map



Source: (Entec, 2005a)

Interviews with stakeholders involved in the Barking Riverside scheme indicated that overall, stakeholders were well aware of the prevailing flood-risks within the site and were comfortable with the capacity of the Thames tidal defences (Dixon, 2006). Some of them revealed that the actual flood-risk within the Barking Riverside site in fact, does not come from tidal rise. One stakeholder from a public body said;

“Although the [Barking Riverside] site is very well defended, there is not really much of a risk from tidal flooding. Fluvial flooding was more of an issue, that is to say, flood water carried by the streams that pass through the site on their way to the Thames.”

A report by the Barking and Dagenham Flood Defence Scrutiny Panel (2003) also stated:

“The Panel was satisfied that, in the context of the existing Thames Barrier and associated defences, risk to the Borough from tidal surge flooding from the Thames is small ... A potential risk for the Council arises from the possibility of fluvial flooding from rivers in other Boroughs, which might occur in the event of failure of flood defences over which the Council had no control.”

(London Borough of Barking and Dagenham, 2003)

With the apparent risks of flooding within the Barking Riverside site, the joint venture has undertaken a rigorous assessment, working with the planning authority and the Environment Agency. One stakeholder revealed;

“There is an enormous amount of work that has been done to support development proposals on this site, largely the way that we have protected ourselves against flood-risks.”

“We are providing a platform that is safe from flood, there are a number of documents ... there is a Flood-risk Assessment, which is a substantial document that was produced to accompany the planning application. That has been submitted and needs to be approved by the Environment Agency.”

“[The Environment Agency] then look at worst-case scenarios, which covers the ‘1 in 1,000’ storm scenario, barriers become stuck, heavy rainfall and in addition to that flooding – you look at the worst case - then you produce a map of what [area] would flood or would not, and basically we need to ensure that none of the housing floods.”

One stakeholder working for the joint venture attributed their capacity to conduct such a rigorous approach to the availability of clear guidance, as he stated:

“[Flooding] is no longer a patchy issue. Now there is a framework produced a proper best practice and process to how you assess flooding. That is helpful, because the developer can say, ‘right, I now know what I am dealing with, what I need to do’, whereas as before [it] was a bit more vague.”

A technical report published by ABI (2005b), which describes the management of flood-risks in the UK’s four main growth areas, notes that there are the following three main flood-mitigation measures within the Barking Riverside site:

1. Raising the level of land for construction:

One stakeholder from the joint venture explained;

“Basically what we are doing [on the site] is raising the land levels of the development platforms significantly, on average about eight metres out of the ground.”

One regeneration official interviewed also confirmed this:

“... this brings the building level above the level of the flood tide, so it is higher than the flood defences currently are. And even if needed to increase the flood defences, [they] would only go up another hundred and fifty millimetres and [the development] is still higher than that. So flooding for the properties is not an issue.”

2. Development of water storage areas:

One local authority official said:

“You get two issues coming together; we get a spring high tide [from the Thames tributaries] and the storage capacity on [the Barking Riverside] site. [When the tide is high] the flap gates [at Barking Creek] are closed down, so you get the [fluvial] water coming down and we have got nowhere to store it.

The way in which that is being dealt with on the Barking Riverside is that underneath the power lines which we cannot build on, [the developer] proposed to create lakes that will also act as the storage capacity for the [fluvial] flooding.”

This is illustrated in Figure 48, which shows the ‘balancing ponds’ and green areas marked as ‘public open space’ at the northern part of the site.

Another stakeholder from the joint venture said:

“On the assumptions agreed with the Environment Agency, we [proposed] a way in which the water could be contained so that it did not flood anyway, so there are some balancing ponds. There are some areas that will be allowed to flood and then they will just drain back when the water level subsides.”

10.2.1 Perception of risks

Current documentations and studies on flooding suggest that the government and public bodies have been seeking solutions to address the problem of climate change and its impact on the increase of flood-risks.

Nonetheless, apart from these decision-makers the public’s perception towards flood-risks still varies. A press release on the research conducted by the Environment Agency reported that 5 million people in 2 million properties in England and Wales live in flood-risk areas (Environment Agency Press Office, 2005a). Of these figures;

- 41% of these people are still unaware of the threat;
- 34% of those in flood-risk areas had not checked whether their buildings and contents insurance are covered flood damage;
- 7% had found out how to get flood warnings; and,
- 42% admitted they would not know what to do in the event of a flood.

12.3.4 Summary

Barking Riverside is part of the London Riverside Regeneration Scheme and forms part of the Thames Gateway, which is a housing growth area designated by the government. The area is at risk of flooding, and stakeholder interviews highlighted that, whilst the area may be perceived to be at risk of a tidal flood because it falls outside the protection of the Thames Barrier, the crucial risk is in fact fluvial flooding. The problem is exacerbated to some extent because the potential source of fluvial flooding (and therefore possible defence) is outside the administrative borders.

This has influenced the flood-mitigation measures, which have been designed for the site and has meant that the developers have had to concentrate flood alleviation solutions on the site itself rather than on the courses of flood waters. The measures employed at Barking Riverside are, firstly, to raise the level of land so that the buildings are above the anticipated flood line and, secondly, to provide additional water storage on-site.

10.3 Kennet Valley Park, Reading

10.3.1 Introduction

Kennet Valley Park is a proposed mixed-use scheme, which will provide approximately 7,500, homes in Reading. The scheme is being developed by Prudential with the vision of creating a community, which is both sustainable and attractive. In October 2006, The Prudential withdrew their planning application submitted to West Berkshire Council, Reading Borough Council and Woking District Council to allow for further consideration of issues raised by local interest groups, and it is anticipated that a new application will be submitted in early 2007.

10.3.2 The scheme

The scheme is being developed by Prudential with the following key principles in place (Kennet Valley Park, Undated)

The creation of inclusive communities including:

- integration of affordable housing;
- provision of accessible transport choices;
- flexible master plan framework;
- good quality design of open and public spaces; and,
- retention and management of landscape feature.

The proposed site for the new development covers an area of approximately 910 hectares (2,250 acres) and is located north of the M4 to the southwest of Reading. Only a fifth of the site is being used for residential development, the balance being used, as shown in

Figure 50.

10.3.3 Proposed Flood-mitigation Measures

Parts of the site are at risk of flooding and also currently perform the function of a floodplain in terms of storing floodwaters when they occur.

The main measures in proposed to deal with the flooding problem are:

- to transfer the floodwater storage capacity to Theale Lake, which will be enlarged to provide additional capacity; and,
- to raise the level of the development so it is taken out of the floodplain.

Figure 50 Plan of the proposed development of Kennet Valley Park



Source: Kennet Valley Park (undated, b)

“Flood protection work will be engineered not only to avoid placing adjoining areas under increased risk, but also to provide improved flood protection to approximately 500 properties at the edge of or within the floodplain of the River Kennet, between Theale and Reading and at Sheffield Bottom.”

Kennet Valley Park (undated c)

An engineer involved in the scheme describes the proposed flood-mitigation measures thus:

“The development area itself will be raised to above the thousand year flood level and indeed floor levels of buildings will be even higher than that so the very minimum of design standard for houses will be a thousand year plus twenty per cent ... but the act of raising it results in the loss of half a million cubic metres of [water] storage.”

To combat this and replace the lost flood-plain, areas of open water will be retained, as explained by an Engineer:

“We are going to build a reservoir or we plan to build a reservoir at Theale Lake which will contain about three million cubic metres of storage. So three million cubic metres in comparison to half a million is a lot of additional storage, the result of that is that we can reduce flood levels in Reading in the order of two hundred millimetres.”

It is claimed therefore that development of the site will bring additional flood prevention benefits to other areas of Reading, as described by one engineer:

“For the thousand year event, there are about five hundred properties which will enjoy reduced flood-risk as a result of this scheme.”

It is proposed that the widening of Theale Lake will provide some of the material required to raise the development site. It can therefore be argued that as the excavated material is going to be used nearby as part of the proposed housing development, the excavation of Theale Lake and provision of additional flood water storage is something which could not be undertaken unless being paid for by a developer who can realise at least some of the benefits.

The meadows which are within the development site flood quite regularly, and this is part of their natural function, as an Engineer explains:

“The meadows are an area that we will not develop on at all. The flood meadows are important to be maintained, that will all be part of the Country Park and opened up for access.”

There have been some negative comments by the Environment Agency in the local press in 2005, such as *“The plan is a leap in the dark that could cause flooding to The Oracle and Reading town centre”* (Reading Evening Post, 2005). However as a structural and civil engineer explained:

“It’s a very good scheme, [but] the Environment Agency do still have concerns but we are working to resolve these at the moment.”

It has been reported that the objections raised by the Environment Agency have *“under-mined Prudential’s marketing efforts”* (Cockram, 2006: 3). However it could be argued that if the issues are resolved to the satisfaction of the Environment Agency and planning consent is granted, then potential buyers would no longer be concerned with the flood-risk; similar to buyer behaviour on sites that have been flooded years ago, where this may no longer be considered.

It is suggested that the proposed development and flood alleviation work at Kennet Valley Park will not only benefit the immediate development, but will also reduce the flood-risk to the wider area as explained by an engineer:

“The result of that is that we can reduce flood levels in Reading by the order of two hundred millimetres and the places like the Oracle, which you probably know which are at risk of flooding, then that flood-risk will be reduced as a result of the scheme.”

10.3.4 Summary

Kennet Valley Park is a mixed used scheme proposed by Prudential for the South West of Reading. One of the major issues facing the development is the flood-risk posed to the area, because part of the site currently acts as a floodplain storing floodwaters.

To alleviate the flood issues two main measures have been proposed:

1. transfer the storage capacity function to Theale Lake, which is to be enlarged; and,
2. raise the level of the development site.

To an extent it could be argued that the two measures are inter-dependent, with the excavated soil being used to raise the development. This therefore suggests that one measure, such as enlarging the lake, could not be undertaken alone as the volume of excavated material would be such that the cost to transport and dispose of it elsewhere would make it financially unviable.

This proposed scheme demonstrates how a developer can play a role in proving a mixed use housing development scheme, which also allows for wider flood-mitigation works to be undertaken. The proposed scheme is claimed by the developer not only to alleviate the flooding to the site, but also the wider area of Reading, highlighting how a holistic approach could provide additional benefits for a larger area, which is a progression from simply installing hard engineering defences to protect a certain site.

10.4 The Maidenhead, Windsor and Eton Flood Alleviation Scheme - (MWEFAS)

10.4.1 Introduction

The Maidenhead, Windsor, and Eton Flood Alleviation Scheme (MWEFAS) was approved in 1995 and constructed between 1996 and 2002. The scheme was devised to provide a 1 in 65 year standard of protection to 5,500 homes and reduce the risk of disruption to main line rail routes and the M4 motorway (Atkins, 2004).

The area around Maidenhead, Windsor, and Eton has a history of flooding, with an event once in every five to seven years. The last major flood was in March 1947 (which has a return period of 1 in 56 years) when 2,000 homes were inundated with floodwater, and in 1990 a lesser flood affected around 500 homes. It has been estimated that if a flood on the scale of that which occurred in 1947 were to happen today, 5,500 properties (commercial and residential) would be affected (Royal Windsor Website, 2006) and the estimated cost of such a flood would be over £40 million (University of Cambridge, 2004). Figure 51 shows what the potential impact could be today, comparing photos taken of part of the affected area of Bexley Street, during the floods of 1947 and today. The higher value goods today are indicated in the photo by the cars, telephone posts and television aerials and this means that the costs of a similar flood to the 1947 event would be much greater today, both in terms of increased prices and additional losses.

Figure 51 Photos of Bexley Street in 1947 and 2002



Bexley Street taken by Phill Well in 1947



Bexley Street in 2002

10.4.2 Details of the scheme

The MWEFAS incorporates a 11 km (about 7 miles) man-made flood relief channel for the River Thames which runs north of the current river between Taplow and Windsor and is called the Jubilee River, after the Queen's Golden Jubilee celebrations in the year the scheme was opened (Figure 52). The scheme is the

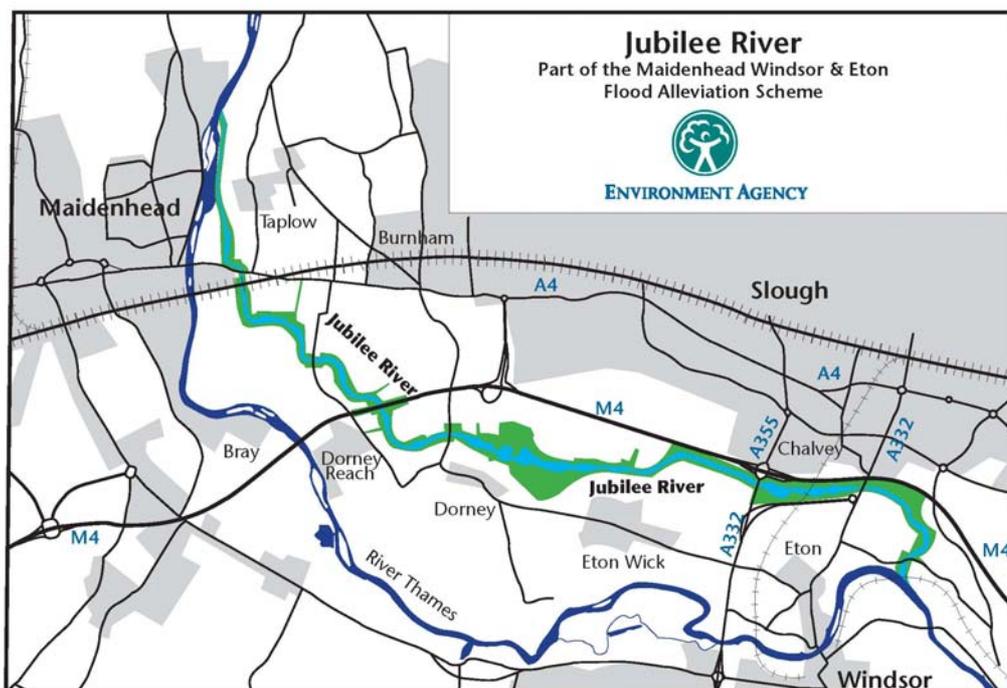
largest inland flood alleviation scheme in the UK (Atkins, 2004) and cost in the region of £110 million.

The scheme was devised to work by providing an additional channel to divert water flow from the river Thames at Taplow and rejoining the Thames at Datchet. The scheme is operated by the Taplow Sluice, which regulates the flow of water into the Jubilee River. It is opened when a gauge on the Maidenhead Bridge indicates that the Thames has reached a certain level (180 meters ³/second). An Engineer explained:

“What the Jubilee River does is basically, to provide a parallel channel to the River Thames so it’s increasing the conveyance. Obviously if you increase the conveyance, you therefore are taking more flood water down more quickly so you’re reducing the flood levels upstream.”

The design of the Jubilee river was such that it would attract wildlife, which had been displaced from the Thames as a result of the heavy river traffic and usage. The Jubilee River also includes 193 hectares of woodland, 250,000 trees and shrubs, wildflowers, grasslands and wetlands (Atkins, 2004) and provides new publicly accessible open spaces, so improving the environmental quality of the area.

Figure 52 Map of the Jubilee River



Source: Environment Agency (2006c)

The same Engineer opined:

“The Maidenhead scheme was not a scheme designed to facilitate development in any way. It was really because of the history of development that had gone on in the Maidenhead area, without effective planning control. I understand that the Environment Agency’s predecessors had objected to much of this development.”

10.4.3 The floods of January 2003

The floods of January 2003 saw the Jubilee river scheme put to the test for the first time when the areas of Maidenhead to Windsor that the relief channel was designed to protect were not affected by any major flooding and 1000 homes were saved (Atkins, 2004). However, areas downstream, including Chertsey, Marlow, Cookham and Wraysbury were flooded. Reading saw floods which were only exceeded by the 1947 and 1894 events and in Old Windsor, the floods ranked eleventh since 1890 (FRAGs, 2004).

These floods raised concerns with members of the public that the MWEFAS had exacerbated the level of flooding. In response, the Environment Agency set up Flood-risk Acton Groups (FRAGs) to scrutinise independently the causes of the flooding along the River Thames in January 2003 (FRAGs, 2004).

The main conclusions as to the reasons behind the floods were:

- the weather – several days of heavy rainfall in late December 2002 and a saturated catchment with swollen rivers contributed to the severity of the flooding; and,
- the Jubilee River – the flooding downstream was not affected by the scheme, but there was a recommendation that the operation of the Taplow Weir be reviewed. The report confirmed that the scheme had effectively protected Maidenhead, Eton and Windsor.

Other reports following the January 2003 floods have shown that there were problems with the Jubilee River. Findings from the report published by Atkins (2004) found that one weir failed and also that there had been erosion to the channel bed and some embankments. The report also highlighted a more fundamental problem with the Jubilee River, that the flow capacity of the Jubilee River was in fact lower than the original design specification. This consequently raised concern with residents that the level of protection provided by the reduced capacity was not as high as had been anticipated.

An Engineer interviewed explained that one of the flaws with the MWEFAS was that it only passed excess floodwater on from Maidenhead and did not provide additional storage capacity in the area:

“You’ve got the impact of increasing flood flows downstream so the combination of increasing the conveyance [with reduced] storage has increased flood levels downstream at Chertsey for instance. So basically if [the scheme has been stopped] at Maidenhead then it would have passed the problem down to Windsor and Eton. So they continued the scheme down to Chertsey, but still somewhere down the line someone’s going to get hit wherever you stop the scheme. So the people of Chertsey were quite rightly saying, well, you need to take the scheme further down. So it’s a bit like chasing your tail, really. But once you’ve started on a solution of just providing conveyance then you are always going to have the problem passed downstream, unless you provide additional new storage.”

However this does not mean the scheme was ill-conceived, as the value of the flood alleviation has to be taken into account on a wider scale, as commented on by an engineer interviewed:

“I think that a balanced judgment was made that the reduction in flood level in a wide area of Windsor and Eton etc, was of great public good. A small net increase in flood levels downstream in Chertsey was a drawback, as net public bad, but the public good so out weighed the public bad that a pragmatic decision was taken to proceed.”

A further report conducted for the Environment Agency (Environment Agency, 2004b), showed that the impact of the North Maidenhead Flood Embankment (an element of the MWEFAS) had increased water levels in Strande Lane, Cookham by 140mm and at Widbrook Common by 330mm. This further highlights the potential impact of the MWEFAS project on surrounding areas and shows that whilst the scheme may be offering protection to the areas of Maidenhead, Windsor and Eton, there may be an unforeseen impact on water levels elsewhere.

The Community Support Group (CSG), which is an association of residents affected by the January 2003 floods, has expressed concerns over the findings of the report *“credibility remains low in view of incorrect river height and flood information issued into the public domain for 14 months, followed by a number of recent changes to that data”* (Community Support Group South, 2006: 1) and feels that further research in to the 2003 flood event is still required.

10.4.4 Summary

The MWEFA scheme was designed to provide protection to 5,500 homes in the Maidenhead, Windsor and Eton area to a 1 in 65 year standard. It has been designed to operate by providing a new channel to take excess water flows from the river Thames when required. The MWEFA scheme was a different kind of mitigation project from those previously discussed in that it was designed to alleviate a historic problem, rather than solve a flooding problem so a site could be developed.

Whilst reports have cleared the Jubilee River of causing the January 2003 floods, problems identified in subsequent reports in relation to raising waters levels and failures in design have meant that public confidence in the scheme has been damaged, which, it can be argued, has in turn damaged the credibility of the Environment Agency in terms of its ability to provide effective, innovative flood defence schemes. One river engineer commented that:

“I think the Environment Agency has unfortunately suffered a bad reputation as a result of it.”

In addition, failures in the construction and design of the scheme have meant that the Jubilee River does not meet the design maximum channel capacity levels. This shows that whilst effective schemes can be designed, it is the implementation of a proposal, which is vital to ensure that it actually provides the level of protection it has been designed for.

Despite the controversy over the January 2003 floods and limitations of its implementation, the scheme is an example of how a project can combine flood defence objectives with environmental regeneration and shows how integrated catchment area management can achieve the aims of flood prevention whilst enhancing the locality.

10.5 Summary

From the three residential case studies, it can be seen that the mitigation measures employed by developers are varied and are a clear move away from the hard engineering solutions of physical flood barriers and defences which have been widely held as being unsustainable, both in terms of the protection they provide and the financial and environmental cost of maintenance.

In the two case studies of Kennet Valley Park (a proposed scheme) and Barking Riverside in the Thames Gateway, developers were directly involved in the design of the flood-mitigation schemes and, in both these cases, part of the solution was to raise the level of the site, which has also been highlighted as a key element in the questionnaire results and interviews. The case study of Kennet Valley Park has also highlighted where there may be instances when only a developer can undertake the scale of works required to provide an effective flood-mitigation solution, as they have the financial resources, in the funds from the sale of homes off-set the mitigation costs and also have the control over the adjoining land which makes the practicability of the work possible.

This illustrates that large scale developments are an opportunity to install flood-mitigation schemes, if required, which will not only benefit the development, but also the wider community, an opportunity which could not be realised without the development scheme.

The Kennet Valley Park case study and MWEFA scheme in particular have shown how a holist approach to the design of flood-mitigation schemes can result in an ecological benefit with conservation of areas such, as water meadows in the Kennet Valley Park proposal or the provision of new habitat for displaced species in the MWEFA scheme. The focus on environmental enhancement shows how sensitive planning of flood defences can add value to an area, whilst meeting the primary objectives of flood-risk alleviation and securing a development on a site not otherwise suitable.

The case studies also show how important it is to manage the public's expectations of flood alleviation schemes. The MWEFA scheme highlights how a scheme can sometimes create a problem, or be perceived as creating a problem, down or up stream. Whilst the investigation in the MWEFA scheme and January 2003 floods concluded that the Jubilee River did not contribute to the flooding of areas downstream at Chertsey, Marlow, Cookham and Wraysbury, there is still the doubt in residents' minds, which has probably been fuelled by the reported structural and design failings of the River. It may be the case that there is a presumption with a government body like the Environment Agency that any flood-mitigation works it undertakes will solve the problems for all adjoining areas, which may be an unrealistic expectation.

It can be argued that high profile flooding events create problems and controversy surrounding flood-mitigation measures, and in turn damage the reputation of other schemes, which could in turn make other developers more cautious of venturing into new schemes because of a fear of public distrust and possible litigation. This could possibly become the case for the Environment Agency because it has no legislative obligation to undertake flood defence works, but could face liability claims if its schemes are believed to have created trouble elsewhere. This problem is not unique to the Environment Agency but also impacts on the wider development community.

The public presumption that defences offer 100% protection against a flood means that this problem is likely to continue and therefore wider education of the public

about the use and effectiveness of flood-mitigation measures is required if the expectations are to be managed effectively.

11. CONCLUSIONS AND FURTHER RESEARCH

11.1 Introduction

In the UK, there is now a general perception and acceptance that the level and frequency of flooding is increasingly driven by climate change. This perception is also heightened by the increased value of land and buildings subject to insurance claims and by pressure to build on flood-plains, to protect 'Green Belt' areas and to increase housing supply, particularly in the South-East of England.

Current estimates indicate that about 2.2 million residences and 140,000 commercial properties are at risk of flooding from the sea or rivers, or are in danger from coastal erosion. The total value of capital assets at risk has been estimated at around £220 billion, with 50% lying in the Thames Region. The response by the property industry stakeholders to dealing with flood-risk will therefore be crucial to how effectively this threat is managed and mitigated in future.

Underlying all of this is the role of the insurance industry, which, until now, has generally been able to offer insurance cover for almost all flooding risk, in part because of the blanket policy coverage (the principle of solidarity or mutuality) and in part because of government agreement to 'match' insurance cover with improved flood defences. Given recent environmental and other catastrophic claims against the insurance industry, the ability of the traditional level and scope of this private insurance cover for flood damage is at risk in the UK.

This targeted qualitative research therefore set out to investigate the current attitudes and perceptions of key property stakeholders and their strategies for dealing with the risk of flooding. Within these overall aims, the research tackled the following objectives:

- *to examine the perceptions of key stakeholders listed in section 11.2, in relation to properties at risk from flooding at a national and local case study level;*
- *to examine stakeholders' policies and strategies with regard to flood-risk to both commercial and residential property;*
- *to establish the current strategies of residential developers to building new properties in areas at risk from flooding, to determine what issues they see as important and the measures they are employing to reduce the risk of flooding and also lessen the impact of flood water should it occur;*
- *to examine the drivers for change (including market response, more stringent planning, building regulations and the withholding of insurance) in the design and construction of new residential properties, which are being built in areas at risk from flooding;*
- *to highlight best practice examples of flood-risk adaptation and mitigation;*
- *to gain an understanding of the approach that commercial investors take in relation to property at risk of flooding nationally and at case study level in London and the South-East;*

- *to assess the perception of flood-risk held by occupiers and what their strategies are in relation to occupying property at risk; and*
- *to investigate the role that insurance plays in property investors' strategies.*

11.2 Stakeholder attitudes and perceptions

The research surveys (including the postal questionnaire, interviews and case studies) covered the following key stakeholder groups:

- **Developers** of residential and commercial property, whose understanding of flood-risk affects decisions about the location of new development, site purchase, building design and site-based flood-mitigation measures;
- **Lenders**, who provide finance for property acquisitions and development;
- **Property occupiers**, covering a range of industry sectors including retail, professional, ICT (information and communication technology), finance, industrial and leisure;
- **Property Investors**, including property companies (who provide a return to shareholders), institutional investors (including pension funds and insurance companies) and private estates; and,
- **Valuers**, who provide valuations of property, mainly to lenders and investors, when buying and selling property.

The findings from the surveys indicate that stakeholders' perception of flooding as a potential risk was greater where:

- they had experienced a flood event; and / or
- they came into contact with planning regulation of flood-risk areas.

Conversely, stakeholders' perception of flooding as potential risk was lower where:

- they had not experienced a flood, or had only experienced flood events that had caused minimal disruption;
- they believed they were adequately covered by flood-risk insurance; and / or
- flood defences were in place.

The developers, especially residential developers, felt that there was a high level of awareness in their organisations about flood-risk, which might be expected in view of developers' close involvement in the planning process, the recent proposals to update planning policy guidance (PPG25) on flood-risk issues and the role of the Environment Agency as a consultee on planning applications.

Overall the stakeholder respondents ranked land contamination as a more significant risk than flooding, indicating that environmental factors are considered not just in relation to their physical impact on property, but also in terms of the legal liabilities, regulatory obligations and duties attaching to them. Therefore, increased recognition of flooding as a risk factor may in part depend on greater regulation of development in flood-risk areas.

Property occupiers, several of whom confessed to low levels of awareness of flood-risk, are generally more remote from the planning process. Like the other stakeholders, their perception would be more likely to change if flood-risk insurance became unavailable on a property they were looking to acquire. So far, none of the stakeholder respondents had experienced difficulty obtaining insurance cover for property in flood-prone areas. However, the literature review showed that most businesses tend to over-estimate the protection provided by insurance and that 80% of businesses affected by a major incident either never re-open or close within 18 months. A withdrawal of insurance cover would therefore be likely to act in a similar way to increased regulation, in changing stakeholder perceptions of flooding as a risk and altering strategies for dealing with it.

The presence of flood defences generally lowered stakeholder perceptions of flooding as a risk factor, rather than being viewed as a sign of a potential problem. Most respondent developers were more willing to develop sites with a 1% flood-risk where flood defences were in place rather than sites with 0.5% flood-risk that were undefended. This supports findings from the literature review that flood defences tend to encourage development rather than provide an incentive to choose an alternative location. Responses to the presence of flood defences therefore appear to be not wholly rational. Indeed the evidence from literature indicates that engineering solutions to raising flood defences are the least sustainable option for the future and that there needs to be a shift to managed solutions, including allowing rivers more space in urban areas and managed realignment of the coast.

Although most of the survey respondents felt they had a high awareness of flood-risk issues, most misinterpreted a '1 in 10 year flood return' to mean a flood would only occur once in 10 years rather than a 10% annual probability. This finding supports moves to drop old-style terminology and in future express flood-risk in terms of a percentage annual probability, as part of improving understanding and management of this risk.

11.3 Stakeholder strategies

The research investigated stakeholder strategies toward developing, investing, lending, occupying and valuing property subject to flood-risk.

The findings indicated that flood-risk is gradually entering into stakeholders' strategies in dealing with property and it would appear that awareness has been growing over the last five-to-six years, since the UK floods of 2000. Currently strategies revolve around:

- undertaking greater investigation and due diligence in relation to property acquisitions in areas identified as being at risk of flooding; and,
- building flood-mitigation measures into developments sited in areas at risk of flooding.

Generally, the increased level of flood-risk in London and the South-East has not altered attitudes to locating or investing in the region. However, strategies toward flood-risk property would change significantly throughout the UK in the event that flood-risk insurance became unavailable.

11.3.1 Flood-risk assessments

Stakeholder respondents relied on flood-risk maps, which have been produced by the Environment Agency since 2002, for identifying sites at risk of flooding. These maps have been criticised as not wholly accurate, but currently represent the best information publicly available. Lack of accuracy means that flood-risk may be overstated in some areas and understated in others, leading to some land being unnecessarily sterilised for development while areas at risk are built on.

Developers, particularly residential developers, were largely undertaking flood-risk assessments as a matter of course when considering site acquisitions. They recognised that mitigating flood-risk would be important to successful onward sales or lettings of completed schemes, therefore an assessment was necessary to designing the appropriate mitigation works, assessing the cost of works and negotiating the purchase price of land.

Current planning policy requires planning authorities to take a risk-based approach and to adopt a sequential test to development applications in flood-prone areas. The planning decision can come into conflict in cases of brownfield regeneration sites, which includes areas of docklands and rundown former waterside industry sites, where the planning presumption would normally be in favour of redevelopment. The sequential approach to flood-risk has been particularly criticised as unreliable because about 27% by value of new homes in England are built in flood hazard areas against Environment Agency advice. Most respondent developers said that faced with this situation they would proceed with a modified scheme to reflect Environment Agency concerns, although a small number of house builders said they would abandon development plans.

Most investors, but not all, also undertook flood-risk assessments prior to acquiring a property investment. Smaller investors in particular tended to have a more ad hoc approach to investigating flood-risk, while larger companies were more alive to the issue. Nevertheless, undertaking flood-risk assessments as part of pre-contract due diligence appeared to be a relatively recent phenomenon amongst investors, having started only in the last few years. Further, it would appear that investors have not yet implemented flood-risk assessment as part of the periodic review of property held in their portfolios, even though they monitor other aspects of property performance and risk. This failure suggests they could be unaware of changes in the level of flood-risk to which their property is exposed, due either to increased flood-risk driven by climate change or brought about through the impact of new development up or downstream of existing property. Given that property investment is an important component of many pension and insurance portfolios, and therefore a huge issue for wider social stability, the flood-risk factor now deserves greater attention.

Decisions made today will have long-term consequences for the future, therefore it is important that flood-risk is factored into stakeholders' strategies to ensure the development, investment and occupation of buildings is sustainable. The findings from this research therefore indicate a need for greater accuracy in flood-risk mapping to provide a sound basis for development decisions and on-going risk reviews of property investments and occupation.

11.3.2 Flood-mitigation measures and building design

The research indicates that the most common approach to flood-mitigation was by developers implementing works to reduce flood-risk across whole sites, rather than

through making changes to building design. The most popular whole-site measures were to:

- raise the level of the development site, although this was not a cheap option; and,
- the installation of Sustainable Urban Drainage Systems (SUDs), which are aimed at reducing runoff and the rate of storm water discharge.

Residential developers were more likely than the commercial developers to install SUDs in their development schemes, whereas more commercial developers installed flood–water stores. Of the relatively few commercial and residential developers who were investigating new methods of flood-mitigation, most were looking at ways to provide more flood-plain capacity, new flood defence structures and raised floor designs for buildings.

In relation to mitigating flood-risk for individual buildings, residential developers generally made greater use of building–specific measures than commercial developers and were particularly inclined towards raising the ground-floor level of buildings. Some residential and commercial developers sometimes implemented wet proofing of buildings and installed anti-flooding devices into the buildings’ foul drainage system, but were not implementing the full range of design features geared to creating flood–resilient buildings and homes.

Flood damage and reinstatement costs to buildings can be reduced through the choice of construction materials and design, for example, by the use of less porous materials and by locating vulnerable services above ground floor level. Retro–fitting buildings with flood resistant materials is not only expensive, it is often not carried out following a flood event because insurers will not pay the additional cost over and above equivalent reinstatement. In Scotland, however, the Building Regulations are more stringent to reflect the region’s harsher climate and buildings tend to suffer less storm damage than in other UK regions. Also, levels of flood protection are higher in Scotland.

These findings suggest that a change in the Building Regulations for the rest of the UK would be effective in bringing about greater use of flood–resilient design and materials in flood hazard areas and in climate-proofing buildings to face the anticipated increases in the number and force of future storms.

11.4 Flood-risk in London and the South-East

The research interviews and case studies showed that the economic strength of the South-East still acts as a draw to investors and to businesses eager to maintain a headquarters presence in the capital. They were, however, tending to undertake stricter due diligence on acquisitions in relation to flood-risk. Investors’ confidence also appeared based on the belief that the UK government will do everything possible to prevent London from flooding and that the Thames barrier offers significant protection.

Regional plans include 128,500 new homes allocated to the Thames Gateway by 2016, to provide much needed affordable housing. The ABI has warned that insurance cover cannot be assumed for new properties in flood–prone areas, including the Thames Gateway, and has advised that taking a sequential approach to developing the lowest risk areas first could reduce losses considerably. However, planning measures alone are not likely to be sufficient to mitigate flood-risk and increased defences will be needed, even though this approach is not judged ‘climate proofed’.

However the research interviews and case studies highlight the view that not all floodplain development is necessarily bad, as the proposals at Kennet Valley Park near Reading illustrate, where proposed development and flood alleviation works are designed to improve the flood situation for a wider area.

11.5 Flood-risk insurance

Most respondents to the research had not experienced any difficulty obtaining flood-risk insurance for property to date, and for the small number that had, either a higher premium or higher excess on the policy had been the outcome. However, the research findings show that that:

- if flood-risk insurance became unavailable, stakeholder strategies toward property in flood hazard areas would change significantly; and,
- increasing flood-risk is likely to put a strain on insurance availability in future.

11.5.1 Stakeholder reactions to no insurance

Most commercial and residential developer respondents said they would abandon development plans if flood insurance was not available or if a site had flooded in the last five years and been subject to claims for damage.

At present the availability of flood-risk insurance can vary for adjacent residential and commercial property, because whereas commercial occupiers tend to use brokers who negotiate with and inform underwriters about flood-mitigation works, in the high volume residential insurance market underwriting tends to be automated with no room to consider individual factors. Therefore residential developers may disregard sites attractive to commercial developers, because householders would not be offered cover, while business insurance could be negotiated.

Although most lenders said they did not have a policy to avoid property lending in flood-risk areas, most said that they would not lend on property where flood-risk insurance was unavailable and that flood insurance would be a prerequisite of granting a loan or mortgage, even where flood defences are in place. Some would lend, but at a reduced loan-to-value ratio or at a higher rate of interest to compensate for the increased risk.

Most occupiers said they would abandon negotiations to lease business premises if flood insurance was not available. Occupiers' inability to obtain flood-risk insurance was also an important disincentive to investors.

The valuers who responded indicated that if insurance was not available, then they would either make a very significant adjustment to the yield on an investment valuation, considerably reducing the capital value, or simply advise the client not to purchase. There was a wide range of opinion on the yield adjustments that should be made, which suggests a lack of information on which to base a valuation. The literature search showed that while there is some published work about value impacts on residential property, very little work has been done on the effect of flooding on commercial property values. Several valuers stated that they felt better guidance was needed on how to value property in a flood-risk areas, as the impact of flood-risk was generally underestimated, and information about property at risk of flooding was in need of improvement.

11.5.2 Insurance availability

The UK is different from many other countries in that flood insurance is generally readily available in the private insurance market. However, there is now a real danger that climate change could undermine the future availability of such insurance.

Insurance can certainly help speed recovery following a flood, but there is no absolute need or right to have insurance and not all risks are insurable. It seems likely that in the UK the desire for full insurance is driven as much by cultural attitudes as by financial structures. Certainly insurance cover within the full repairing and insuring lease (FRI lease) has become a central concept of the commercial property sector, underpinning the security of investment income.

Following extreme UK weather events between 1995 and 2000, flood-risk became uninsurable in some areas. This prompted the Association of British Insurers (ABI) to publish a set of principles, renewed in 2006, that amount to a conditional 'agreement' with the government that continued cover for households and businesses will be dependent on increased investment in flood defences, curtailment of development in flood-prone areas and faster more effective decision-making on defences. However, in August 2006, DEFRA announced a cut in flood defence funding. Nevertheless, the ABI, in its report on coastal flood-risk to the east of England in (ABI, 2006b), continues to point to the need to improve coastal defences and reinforces the insurance industry's desire to keep flood insurance cover as standard for UK policy holders, but making clear that it will "*continue to signal to customers and government where the pressures are becoming unsustainable*" (ABI, 2006b).

The ability to offer continued cover for flood-risk is, however, not wholly in the control of the UK insurance industry. Insurance is dependent on the international reinsurance market, which protects individual insurance companies against catastrophic risks. Climate change means that reinsurers are likely to become increasingly selective about the risk portfolios they cover, and if UK insurers become unable to reinsure flood-risk then they will not be able to continue this cover for individual policyholders.

Risk evaluation therefore plays a significant role in the insurance industry and flood-risk is being taken very seriously. UK insurance company Norwich Union is investing in developing its own flood-risk maps that offer greater precision, enabling premiums to be assessed for individual addresses based on post codes. While greater precision in flood-risk data and prediction offers benefits for risk management, the repercussions for property stakeholders and government are likely to be complex, because the relationship between risk and insurance will be fundamentally altered. Insurance relies on a significant element of uncertainty and is not designed for frequent predictable events. Therefore, if flooding becomes more certain in some locations as against others, then it also becomes less insurable. The system of 'mutuality' could break down in the UK as policyholders outside flood-risk areas refuse to pay for this element of cover, which they do not need. The reduced loss-bearing capacity of premiums could then leave insurers unable to pay out against flood damage claims.

In many countries the system of mutuality does not function for the very reason that it is uneconomic, and in some countries flood insurance schemes are government-backed. For example, the National Flood Insurance Programme operated by the US government, requires communities to implement mandatory risk mitigation measures, such as controls on development location, in exchange for cover.

Moves by UK insurers to demand risk mitigation as a condition of cover will only work if property stakeholders and the government responds appropriately, through controls on development location, flood resilient building and investment in defences. While development control issues are being addressed through the yet-to-be implemented revised PPG 25 and increased Environment Agency powers, flood defence spending has recently been cut and the adoption of flood-resilient building design appears slow. Meanwhile, increasing flood-risk is more likely to translate into higher premiums and / or reduced cover, with the danger that an insurance underclass will develop amongst households and businesses in flood-hazard areas which has no insurance protection at all, unless, that is, government-backed protection is implemented for these areas. The social, economic and political implications of this could therefore be enormous.

11.6 Research recommendations

This research therefore indicates a need for:

- greater accuracy and level of detail in publicly-available flood-risk information and maps, incorporating flood history and site specific information, produced by the Environment Agency;
- the early implementation of revised planning policy guidance (PPG 25) and increased Environment Agency powers in relation to development applications;
- education to raise the general awareness of occupiers, investors and their professional advisers about flood-risk issues;
- greater promotion and use of flood-resilient design and construction materials in flood-risk areas, possibly through amendments to the Building Regulations, in new development, major refurbishments and reinstatement works to flood damaged property;
- guidance produced by the valuation profession on the approach to valuing flood-risk property, particularly in cases where flood-risk insurance becomes unavailable or too expensive;
- more valuer education and training specific to undertaking valuations in flood-risk areas and of individual flood-prone buildings;
- periodic reviews by investors, particularly pension funds, insurers and their advisers of flood-risk levels attaching to property investment portfolios; and,
- scenario planning, involving leaders in the property sector, insurance sector and government to agree strategies for mitigating flood-risk for existing communities and new development, to cover the eventuality of properties becoming uninsurable for flood-risk as a result of climate change.

Aspects requiring further research include:

- the impact of flooding on commercial property values and property investment portfolios;

- the design and content of education and training courses for property professionals to enable them to respond effectively to flood-risk issues in the built environment; and
- the effect on consumer behaviour of the reduced availability and / or increased cost of flood-risk insurance.

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Appendix 1 - Questionnaire methodology

Introduction

The aim of the questionnaires was to assess the perception of key stakeholders to the risks of flooding and analysis their strategies, if any, for dealing with these risks. This Appendix outlines the methodology used in the nationwide survey of key stakeholders and should be read in conjunction with section 7.

Research design

The questions for the survey were developed and informed by the literature review. The questionnaires were piloted in late May 2005 with a sample of industry experts and academics (sample size 39). Copies of the questionnaires are contained in Appendix 2.

The research questionnaire was sent out to seven different stakeholder groups, who are listed in Table 7 Questionnaire groups. Reminder letters were sent out after a few weeks to increase the number of responses.

Table 7 Questionnaire groups

Stakeholder groups
Developers - Commercial
Developers - Residential
Lenders
Occupiers
Property Investors
Valuers

The questions for each stakeholder group were developed to relate specifically to their interaction with property with the aim of establishing their perceptions of flood-risk and also how they would respond to different flooding scenarios. There were a number of common questions included so general trends and perceptions of risk could be established. The subjects covered in each stakeholders questionnaire are summarised below:

- Developers – both commercial and residential: contained questions on flooding experience, perceptions to increased risk of flooding in the South-East of England, the approach to undertaking a flood-risk assessment, the development strategy based on several different flooding scenarios and flood-mitigation measures implemented in a development.
- Lenders - contained questions on flooding experience, perceptions to increased risk of flooding in the South-East of England, the approach to undertaking a flood-risk assessment, and lending strategy based on several different flooding scenarios.
- Occupiers - contained questions on flooding experience, perceptions of increased risk of flooding in the South-East of England, the approach to undertaking a flood-risk assessment, questions to identify the factors that would be important (or not)

in persuading them to occupy a property and strategy to taking a new tenancy based on several different flooding scenarios.

- Property investors - contained questions on flooding experience, perceptions to increased risk of flooding in the South-East of England, approach to undertaking a flood-risk assessment, questions to identify the factors that would be important or not in persuading them to purchase a property and strategy to taking acquiring a new property based up on several different flooding scenarios.
- Valuers - contained questions on flooding experience, perceptions to increased risk of flooding in the South-East of England, approach to undertaking a flood-risk assessment, questions about undertaking a valuation for a property at risk of flooding and the professional advice in place.

The sample

The sample for each stakeholder group was randomly selected from populations taken from different data sources. Table 8 gives an overview of the data sources used.

Table 8 The data sources for the samples to send out the questionnaires for each stakeholder group.

Stakeholder	Data source
Developers - Commercial	Commercial Developers list the Freemans Guide
Developers - Residential	House builders list
Lenders	List from the Freemans Guide and list from the Council of Mortgage Lenders
Occupiers	Occupiers lists from EGi and the Freemans Guide
Property Investors	Property Investors list the Freemans Guide
Valuers	RICS mailing list service

Questionnaire responses

The questionnaires were distributed in late June 2005. A total of 1,231 questionnaires⁷ were sent out with 121 responses being received back, which represents a response rate of 9.8%. The breakdown amongst the different stakeholders can be seen in Table 9.

⁷ The number of questionnaires sent out has been adjusted to take into account those returned to us undelivered. This is to ensure that the 'undelivered' questionnaires do not confuse the picture with regard to the number of people who did not respond and give an unrepresentative picture of the response rate from any one stakeholder group, as 'undelivered' questionnaires may be as a result of errors with the mailing list rather than a characteristic of that particular group.

Table 9 Total questionnaire responses.

Group	Number sent	Number received	Percentage received
Developers - Commercial	209	22	10.50%
Developers - Residential	245	21	8.60%
Lenders	142	14	9.85%
Occupier	246	21	8.50%
Property investor	241	28	11.70%
Valuers	149	15	10.10%
Totals	1231	121	9.8%

The lowest numbers of responses received were from the lenders (14 in total), with the property investors returning the highest number of completed questionnaires (28).

Non-response follow-up

To assess why people had not responded to the questionnaire (to assess non-response bias), the survey was followed with a brief form to be faxed back asking the reasons why the contact had been unable to respond and also to complete one of the common questions which had appeared on all the questionnaires. This meant a comparison could be made between those who completed the questionnaire to give us a measure of how representative our questionnaire replies were.

The non-response follow-up forms were dispatched in late July 2005. A total of 1,110 letters with fax-back forms were sent and 231 responses received, which represents a 20.8% responses rate, see Table 10.

Table 10 Responses to the non-response follow-up

Group	Total sent	Total received	Percentage received
Developers - Commercial	134	42	31.3%
Developers - Residential	66	39	59.1%
Lenders	286	22	7.69%
Occupier	223	49	22.0%
Property investor	187	41	21.9%
Valuers	212	38	17.9%
Totals	1108	231	20.8%

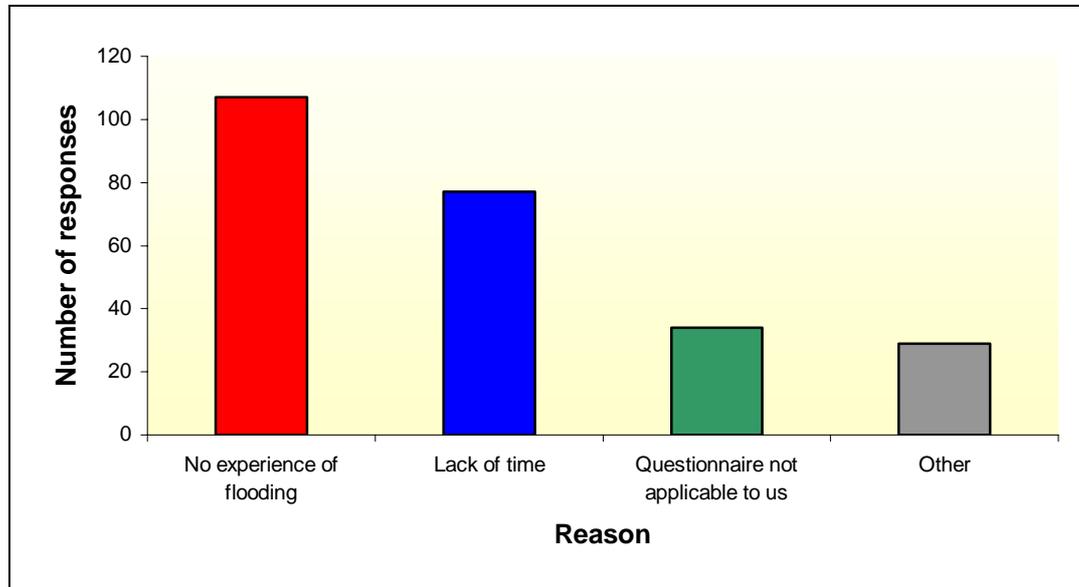
Reasons for non-response

Analysis of the results received from the non-response follow-up faxes showed that the main reason for not completing and returning the questionnaire was a lack of experience in relation to flooding, which accounted for 43% of responses (see Figure

53). The reasons given by those who ticked the 'other' box included it being against company policy to complete questionnaires or the information not being available.

This could suggest that the results may be biased, to the extent that it excluded the perceptions and strategy responses of people who had no experience of flooding.

Figure 53 The reasons why respondents did not complete the questionnaire



Concluding comments

Questionnaires were sent to seven different stakeholders involved in the property industry to assess their perceptions of the risk of flooding and strategies for dealing with this. The response rate to the questionnaire was 9.8%. Whilst the total number of responses was just below 10%, the small number from the individual stakeholder groups meant comparisons could not be made between sub-groups, for example between property companies and institutional investors. Also the low number of responses meant analysis on the geographical location of respondents could not be successfully undertaken.

A non-response follow-up form asked why respondents had not replied and the response rate was 20.8%, with almost two-thirds having not completed the questionnaire due to a lack of flooding experience, which they felt necessary in order to complete the form. However through the non-response follow-up form, the research did manage to capture the perceptions of a further 231 stakeholders to the risk of flooding and other perils which may affect property.

Although the response rate to the questionnaire was not high, additional insight into the issues covered in the questionnaire has been achieved through the non-response follow-up interviews and case studies.

Appendix 2 - Questionnaire Surveys

Developers Commercial - Questionnaire

Developers Residential - Questionnaire

Lenders – Questionnaire

Occupiers - Questionnaire

Property Investors - Questionnaire

Valuers - Questionnaire

Property and Flood Impact Research

Commercial Developers' Questionnaire

The College of Estate Management is undertaking a research project, which is funded by Prudential Property Investment Managers, Norwich Union, Marsh Ltd, Peter Brett Associates, English Partnerships, Fairview Homes, King Sturge and the Harold Samuel Trust.

Researchers are looking at the impact of current and future flood risk on the commercial and residential property sectors and stakeholder strategies.

This questionnaire forms the first phase of the project and should only take around 10 minutes to complete. You will receive a summary of the results once the research has been completed.

Your help is much appreciated and all the information you provide will be treated in a strictly confidential manner without revealing details of individual responses.

If you would like any further information please contact Dr Tim Dixon (t.j.dixon@cem.ac.uk) or Sarah Kenney (s.kenney@cem.ac.uk) on 0118 921 4686 at The College of Estate Management, Reading.

We would be grateful if you could return this questionnaire in the pre-paid envelope by **Friday 22nd July** at the latest.

In this questionnaire 'flood risk areas' means locations where the Environment Agency have stated there is a significant risk of flooding.

Please fill in the following details (or attach business card)

Name: _____
Position: _____
Company: _____

1. YOUR ORGANISATION

The information provided in this section will help with classification and statistical comparisons and will be treated in a strictly confidential manner.

Q1 In which of the following sectors is your company active? (Please tick all that apply)

- Residential
- Retail
- Offices
- Industrial
- Leisure
- Mixed use schemes

Q2 Please indicate your annual completions for 2004 or your latest financial year.

_____ year (please state financial year)

- Total Housing units
- Total sqft of Retail space
- Total sqft of Office space
- Total sqft of Industrial space
- Total sqft of Leisure space

Q3 What area of development land did your company acquire last financial year?

_____ acres/hectares (delete as appropriate)
_____ year (please state financial year)

2. DEVELOPMENT AND FLOOD RISK

Q4 How would you rank the issue of flood risk in relation to the other perils listed below and which may affect property?

(Please rank in order where 1 is most important and 4 is least important. If you consider an issue unimportant please put a X in the box)

- Contamination
- Subsidence
- Storm damage (eg. From high winds)
- Flooding

Q5 How would you rate the level of awareness within your company to the potential risk of flooding to your company's development sites? (please circle the appropriate value)

Very high awareness	High awareness	Some awareness	Poor awareness	Very poor awareness
5	4	3	2	1

Q6 What percentage of your company's development sites (both those in your land bank and those currently under construction) are at risk from flooding? (please tick the relevant box)

- 100% - 76%
- 75% - 51%
- 50% - 26%
- 25% - 0%
- Don't know

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THE COLLEGE
OF ESTATE
MANAGEMENT

Falton: HRH The Prince of Wales

Research Department, College of Estate
Management, Whiteknights, Reading
RG6 6AW

Tel: 0118 986 1101
Fax: 0118 975 5344

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DEVELOPMENT & FLOOD RISK cont...

Q7 In the last five years has your company had any experience of developing on land which is in a flood risk area?

- Yes
 No
 Don't know

Q8a In the last five years were any site acquisitions abandoned by your company because they were located in a flood risk area?

- Yes **Go to Q8b**
 No **Go to Q9a**

Q8b What area of site acquisitions were abandoned in the last five years?

_____ acres/hectares (*delete as appropriate*)

Q9a Has the perceived increased risk of flooding in London and the South East of England caused your company to alter their attitude to developing in these areas?

- Yes **Go to Q9b**
 No **Go to Q10**

Q9b If yes, in which ways?

Q10 When an area is described as being at risk from a '1 in 10 year return flood', what do you understand this to mean?

- A flood would only occur once in every 10 year period
 There is a 10% annual probability of a flood event

Q11a Has your company ever experienced any difficulties obtaining insurance for the development period of a new site because it was located in a flood risk area?

- Yes **Go to Q11b**
 No **Go to Q 12a**
 Self insure for this risk **Go to Q12a**
 Don't know **Go to Q12a**

Q11b If so what problems were encountered?

- Insurer would not provide cover
 Policy excluded flood damage cover
 Higher premiums
 High excess on the policy
 Policy conditional on flood mitigation measures being built before development began
 Other (*please specify*) _____

Q12a Has your company ever had difficulties obtaining finance for a development because it was located in a flood risk area?

- Yes **Go to Q12b**
 No **Go to Q13**
 Don't know **Go to Q13**

Q12b If so what problems were encountered?

- Finance refused
 Low loan/value ratio offered
 Higher interest rate
 Other (*please specify*) _____

Q13 Which types of flooding does your company feel can be successfully mitigated against in your developments? (*please tick all that apply*)

- Flooding from rivers
 Coastal
 Estuarial
 Rising groundwater levels
 Sewer
 Infrastructure failure (eg. burst water pipe)
 Other (*please specify*) _____

Q14 Is your company investigating new flood mitigation measures?

- Yes (*please provide details below*)
 No

Details: _____

Q15 At what stage of a development would your company undertake a flood risk assessment (FRA)? (*please tick only one*)

- Prior to acquisition, as soon as a site is considered for development
 After acquisition when the outline scheme is being designed
 Only if requested by the Local Planning Authority at the consultation stage
 Only if required once the outline planning application has been submitted
 Other (*please specify*) _____

Q16 Which sources of information are used in your company's flood risk assessments? (*please tick all that apply*)

- Insurance status of area (ABI guidance)
 Environment Agency guidance
 Planning authority information
 Historical data
 Local knowledge / local agents
 Don't know
 Other (*please specify*) _____

Q17 If a flood risk assessment suggested that a proposed development was at risk from flooding, how would the level of risk influence your company's development strategy? *(please tick the appropriate boxes)*

	Always	Sometimes	Never	Don't know
Eco homes				
SAP				
Sustainable Building Codes				
ENVEST				
Considerate Constructors Scheme				
Environmental Profiling				

Q18 In developing a site at risk from flooding, how frequently does your company implement the following mitigation measures? *(please circle the appropriate values)*

	Always	Often	Sometimes	Rarely	Never
Install flood skirt to building	5	4	3	2	1
Locate main services (eg. electrics) in the roof	5	4	3	2	1
Basement level used for parking	5	4	3	2	1
Fit anti-flooding devices to sewage systems	5	4	3	2	1
Dry-proofing measures (eg. covers at door)	5	4	3	2	1
Wet-proofing measures (eg. concrete floors)	5	4	3	2	1
Whole development					
Raise the level of the land in the development	5	4	3	2	1
Install flood defences	5	4	3	2	1
Alter layout (eg. green areas in risk zones)	5	4	3	2	1
Install flood water stores	5	4	3	2	1
Reduce runoff (eg. by using SUDS)	5	4	3	2	1

Q19 Do you inform investors about your flood mitigation measures? *(please circle the appropriate value)*

Always	Often	Sometimes	Rarely	Never
5	4	3	2	1

Q20 If the Environment Agency objected to the development at the planning stage but consent was granted due to other material considerations how would your company proceed?

- Proceed as planned
- Proceed but modify to accommodate the Environment Agency's concerns
- Abandon development

Q21 How important do you think it is to consider the potential impacts of climate change in the following aspects of the development process? *(please circle the appropriate values)*

	Very Important	Important	Neutral	Irrelevant	Don't know
Site remediation	5	4	3	2	1
Master plan / site layout	5	4	3	2	1
Building design	5	4	3	2	1
Construction process	5	4	3	2	1
Choice of materials	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Q22 Which of the following potential climate change impacts are of most concern to your company? *(please circle the appropriate values)*

Subsidence / erosion	5	4	3	2	1
Increased flood risk	5	4	3	2	1
Increasing average temperatures	5	4	3	2	1
Increase in severity and frequency of storms	5	4	3	2	1
Increased risk of remediation schemes failing	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Q23 In your view how important are the following factors in improving the sustainability of future floodplain development on brownfield land? *(please circle the appropriate values)*

Improved and stronger planning guidance	5	4	3	2	1
Better containment techniques	5	4	3	2	1
Withholding of insurance	5	4	3	2	1
Better flood defences	5	4	3	2	1
Improved building design	5	4	3	2	1
Better and clearer guidance on flood risk	5	4	3	2	1
Tighter legislative controls	5	4	3	2	1
Cheaper mitigation solutions	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Q24 If a particular remediation option on brownfield land was less capable of withstanding the impacts of future climate change than an alternative, would your company?

- Reject that option and use an alternative
 Not be concerned
 Only switch if there were no additional costs

Q25 Are there any other issues you think should have been covered by this survey?

Q26 Would you be willing to participate in a follow-up interview and/or case study for this research?

- Yes **Interview**
 Yes **Case study**
- Yes **Both**
 No

Thank you for your assistance with this questionnaire

We will send you a summary of the findings when the research is complete

Property and Flood Impact Research

Residential Developers' Questionnaire

The College of Estate Management is undertaking a research project, which is funded by Prudential Property Investment Managers, Norwich Union, Marsh Ltd, Peter Brett Associates, English Partnerships, Fairview Homes, King Sturge and the Harold Samuel Trust.

Researchers are looking at the impact of current and future flood risk on the commercial and residential property sectors and stakeholder strategies.

This questionnaire forms the first phase of the project and should only take around 10 minutes to complete. You will receive a summary of the results once the research has been completed.

Your help is much appreciated and all the information you provide will be treated in a strictly confidential manner without revealing details of individual responses.

If you would like any further information please contact Dr Tim Dixon (t.j.dixon@cem.ac.uk) or Sarah Kenney (s.kenney@cem.ac.uk) on 0118 921 4686 at The College of Estate Management, Reading.

We would be grateful if you could return this questionnaire in the pre-paid envelope by **Friday 22nd July** at the latest.

In this questionnaire 'flood risk areas' means locations where the Environment Agency have stated there is a significant risk of flooding.

Please fill in the following details (or attach business card)

Name: _____
Position: _____
Company: _____

1. YOUR ORGANISATION

The information provided in this section will help with classification and statistical comparisons and will be treated in a strictly confidential manner.

Q1 In which of the following sectors is your company active? (Please tick all that apply)

- Residential
- Retail
- Offices
- Industrial
- Leisure
- Mixed use schemes

Q2 Please indicate your annual completions for 2004 or your latest financial year.

_____ year (please state financial year)

_____	Total Housing units
_____	Total sqft of Retail space
_____	Total sqft of Office space
_____	Total sqft of Industrial space
_____	Total sqft of Leisure space

Q3 What area of development land did your company acquire last financial year?

_____ acres/hectares (delete as appropriate)
_____ year (please state financial year)

2. DEVELOPMENT AND FLOOD RISK

Q4 How would you rank the issue of flood risk in relation to the other perils listed below and which may affect property?

(Please rank in order where 1 is most important and 4 is least important. If you consider an issue unimportant please put a X in the box)

- Contamination
- Subsidence
- Storm damage (eg. From high winds)
- Flooding

Q5 How would you rate the level of awareness within your company to the potential risk of flooding to your company's development sites? (please circle the appropriate value)

Very high awareness	High awareness	Some awareness	Poor awareness	Very poor awareness
5	4	3	2	1

Q6 What percentage of your company's development sites (both those in your land bank and those currently under construction) are at risk from flooding? (please tick the relevant box)

- 100% - 76%
- 75% - 51%
- 50% - 26%
- 25% - 0%
- Don't know

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DEVELOPMENT & FLOOD RISK cont...

Q7 In the last five years has your company had any experience of developing on land which is in a flood risk area?

- Yes
- No
- Don't know

Q8a In the last five years were any site acquisitions abandoned by your company because they were located in a flood risk area?

- Yes **Go to Q8b**
- No **Go to Q9a**

Q8b What area of site acquisitions were abandoned in the last five years?

_____ acres/hectares (*delete as appropriate*)

Q9a Has the perceived increased risk of flooding in London and the South East of England caused your company to alter their attitude to developing in these areas?

- Yes **Go to Q9b**
- No **Go to Q10**

Q9b If yes, in which ways?

Q10 When an area is described as being at risk from a '1 in 10 year return flood', what do you understand this to mean?

- A flood would only occur once in every 10 year period
- There is a 10% annual probability of a flood event

Q11a Has your company ever experienced any difficulties obtaining insurance for the development period of a new site because it was located in a flood risk area?

- Yes **Go to Q11b**
- No **Go to Q 12a**
- Self insure for this risk **Go to Q12a**
- Don't know **Go to Q12a**

Q11b If so what problems were encountered?

- Insurer would not provide cover
- Policy excluded flood damage cover
- Higher premiums
- High excess on the policy
- Policy conditional on flood mitigation measures being built before development began
- Other (*please specify*) _____

Q12a Has your company ever had difficulties obtaining finance for a development because it was located in a flood risk area?

- Yes **Go to Q12b**
- No **Go to Q13**
- Don't know **Go to Q13**

Q12b If so what problems were encountered?

- Finance refused
- Low loan/value ratio offered
- Higher interest rate
- Other (*please specify*) _____

Q13 Which types of flooding does your company feel can be successfully mitigated against in your developments? (*please tick all that apply*)

- Flooding from rivers
- Coastal
- Estuarial
- Rising groundwater levels
- Sewer
- Infrastructure failure (eg. burst water pipe)
- Other (*please specify*) _____

Q14 Is your company investigating new flood mitigation measures?

- Yes (*please provide details below*)
- No

Details: _____

Q15 At what stage of a development would your company undertake a flood risk assessment (FRA)? (*please tick only one*)

- Prior to acquisition, as soon as a site is considered for development
- After acquisition when the outline scheme is being designed
- Only if requested by the Local Planning Authority at the consultation stage
- Only if required once the outline planning application has been submitted
- Other (*please specify*) _____

Q16 Which sources of information are used in your company's flood risk assessments? (*please tick all that apply*)

- Insurance status of area (ABI guidance)
- Environment Agency guidance
- Planning authority information
- Historical data
- Local knowledge / local agents
- Don't know
- Other (*please specify*) _____

Q17 If a flood risk assessment suggested that a proposed development was at risk from flooding, how would the level of risk influence your company's development strategy? *(please tick the appropriate boxes)*

Site attributes and flood risk	Strategy				
	Continue as planned	Continue but include flood mitigation measures	Develop but for a less sensitive use	Hold land pending improved defences	Abandon plans
Floodplain location, 0.5% (1 in 200) risk of flooding and there are no flood defences.					
Floodplain location, 1% (1 in 100) risk of flooding and there are no flood defences.					
Floodplain location, 1% (1 in 100) risk of flooding, flood defences are in place.					
Floodplain location, 1% (1 in 100) risk of flooding. Plans to build defences by 2007.					
Site suffered a flood event in the last 5 years resulting in an insurance claim for damage.					
Flood insurance not available due to the risk of flooding.					

Q18 In developing a site at risk from flooding, how frequently does your company implement the following mitigation measures? *(please circle the appropriate values)*

Within the property	Always	Often	Sometimes	Rarely	Never
Raise the ground floor level of the property	5	4	3	2	1
Locate services (eg. gas) above flood line	5	4	3	2	1
Locate living accommodation on first floor	5	4	3	2	1
Fit anti-flooding devices to sewage systems	5	4	3	2	1
Dry-proofing measures (eg. covers at door)	5	4	3	2	1
Wet-proofing measures (eg. concrete floors)	5	4	3	2	1
Whole development					
Raise the level of the land in the development	5	4	3	2	1
Install flood defences	5	4	3	2	1
Alter layout (eg. green areas in risk zones)	5	4	3	2	1
Install flood water stores	5	4	3	2	1
Reduce runoff (eg. by using SUDS)	5	4	3	2	1

Q19 Do you inform purchasers about your flood mitigation measures? *(please circle the appropriate value)*

Always	Often	Sometimes	Rarely	Never
5	4	3	2	1

Q20 If the Environment Agency objected to the development at the planning stage but consent was granted due to other material considerations how would your company proceed?

- Proceed as planned
- Proceed but modify to accommodate the Environment Agency's concerns
- Abandon development

Q21 How important do you think it is to consider the potential impacts of climate change in the following aspects of the development process? *(please circle the appropriate values)*

	Very Important	Important	Neutral	Irrelevant	Don't know
Site remediation	5	4	3	2	1
Master plan / site layout	5	4	3	2	1
Building design	5	4	3	2	1
Construction process	5	4	3	2	1
Choice of materials	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Q22 Which of the following potential climate change impacts are of most concern to your company? *(please circle the appropriate values)*

Subsidence / erosion	5	4	3	2	1
Increased flood risk	5	4	3	2	1
Increasing average temperatures	5	4	3	2	1
Increase in severity and frequency of storms	5	4	3	2	1
Increased risk of remediation schemes failing	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Q23 In your view how important are the following factors in improving the sustainability of future floodplain development on brownfield land? *(please circle the appropriate values)*

Improved and stronger planning guidance	5	4	3	2	1
Better containment techniques	5	4	3	2	1
Withholding of insurance	5	4	3	2	1
Better flood defences	5	4	3	2	1
Improved building design	5	4	3	2	1
Better and clearer guidance on flood risk	5	4	3	2	1
Tighter legislative controls	5	4	3	2	1
Cheaper mitigation solutions	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Q24 If a particular remediation option on brownfield land was less capable of withstanding the impacts of future climate change than an alternative, would your company?

- Reject that option and use an alternative
 Not be concerned
 Only switch if there were no additional costs

Q25 Are there any other issues you think should have been covered by this survey?

Q26 Would you be willing to participate in a follow-up interview and/or case study for this research?

- Yes **Interview**
 Yes **Case study**
- Yes **Both**
 No

Thank you for your assistance with this questionnaire

We will send you a summary of the findings when the research is complete

Property and Flood Impact Research

Lenders' Questionnaire

The College of Estate Management is undertaking a research project, which is funded by Prudential Property Investment Managers, Norwich Union, Marsh Ltd, Peter Brett Associates, English Partnerships, Fairview Homes, King Sturge and the Harold Samuel Trust.

Researchers are looking at the impact of current and future flood risk on the commercial and residential property sectors and stakeholder strategies.

This questionnaire forms the first phase of the project and should only take around 10 minutes to complete. You will receive a summary of the results once the research has been completed.

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We would be grateful if you could return this questionnaire in the pre-paid envelope by **Friday 22nd July** at the latest.

In this questionnaire 'flood risk areas' means locations where the Environment Agency have stated there is a significant risk of flooding.

Please fill in the following details (or attach business card)

Name: _____
Position: _____
Company: _____

1. YOUR ORGANISATION

The information provided in this section will help with classification and statistical comparisons and will be treated in a strictly confidential manner.

Q1 What is the percentage of your company's business value in the following sectors?

%	Residential
%	Retail
%	Offices
%	Industrial
%	Leisure
%	Mixed use schemes
%	Other (please specify) _____

Q2 How much lending did your company undertake in the last financial year?

£ _____
_____ year (please state financial year)

Q3 How much lending was refused because of the property or land was located in a flood risk area?

£ _____

2. LENDING AND FLOOD RISK

Q4 How would you rank the issue of flood risk in relation to the other perils listed below and which may affect property?

(Please rank in order where 1 is most important and 4 is least important. If you consider an issue unimportant please put a X in the box)

- | | |
|--------------------------|------------------------------------|
| <input type="checkbox"/> | Contamination |
| <input type="checkbox"/> | Subsidence |
| <input type="checkbox"/> | Storm damage (eg. From high winds) |
| <input type="checkbox"/> | Flooding |

Q5 When an area is described as being at risk from a '1 in 10 year return flood', what do you understand this to mean?

- A flood would only occur once in every 10 year period
 There is a 10% annual probability of a flood event

Q6 Does your company avoid lending in certain localities because of the flood risk in that area?

- Yes
 No
 Don't know

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Petron: HRH The Prince of Wales

Research Department, College of Estate
Management, Whiteknights, Reading
RG6 6AW

Tel: 0118 986 1101
Fax: 0118 975 5344

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LENDING & FLOOD RISK cont...

Q7a Has the perceived increased risk of flooding in London and the South East of England caused your company to alter their attitude to lending in these areas?

Yes **Go to Q7b**
 No **Go to Q8**

Q7b If yes, in which ways?

Q8 Would your company offer a loan/mortgage if flood insurance was withheld?

Yes
 No
 Don't know

Q9a When commissioning a valuation prior to lending, do you require a flood risk assessment to be undertaken as standard?

Yes always **Go to Q9b**
 Only if a problem suspected **Go to Q9b**
 No **Go to Q10**

Q9b Which sources of information are used in your company's flood risk assessments? (*please all that apply*)

Insurance status of area (ABI guidance)
 Environment Agency guidance
 Planning authority information
 Historical data
 Local knowledge / local agents
 Don't know
 Other (*please specify*) _____

Q10 If a flood risk assessment suggested that a property was at risk of flooding, how would the level of risk influence your company's strategy in granting a loan/mortgage? (*please tick the appropriate boxes*)

	Lending strategy					
	Lower loan to value ratio	Higher interest rate	Make flood insurance a pre-requisite of granting the loan	Retain part of the loan against resilience works being done	No change to strategy	Would not lend against this property
Site attributes and flood risk						
Floodplain location, 0.5% (1 in 200) risk of flooding and there are no flood defences.						
Floodplain location, 1% (1 in 100) risk of flooding and there are no flood defences.						
Floodplain location, 1% (1 in 100) risk of flooding, flood defences are in place.						
Floodplain location, 1% (1 in 100) risk of flooding. Plans to build defences by 2007.						
Site suffered a flood in the last 5 years resulting in an insurance claim.						
Flood insurance not available due to the risk of flooding.						

Q11 Are there any other issues you think should have been covered by this survey?

Q12 Would you be willing to participate in a follow-up interview and/or case study for this research?

Yes **Interview** Yes **Both**
 Yes **Case study** No

Thank you for your assistance with this questionnaire
 We will send you a summary of the findings when the research is complete

Property and Flood Impact Research

Occupiers' Questionnaire

The College of Estate Management is undertaking a research project, which is funded by Prudential Property Investment Managers, Norwich Union, Marsh Ltd, Peter Brett Associates, English Partnerships, Fairview Homes, King Sturge and the Harold Samuel Trust.

Researchers are looking at the impact of current and future flood risk on the commercial and residential property sectors and stakeholder strategies.

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Your help is much appreciated and all the information you provide will be treated in a strictly confidential manner without revealing details of individual responses.

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We would be grateful if you could return this questionnaire in the pre-paid envelope by **Friday 22nd July** at the latest.

In this questionnaire 'flood risk areas' means locations where the Environment Agency have stated there is a significant risk of flooding.

Please fill in the following details (or attach business card)

Name: _____
Position: _____
Company: _____

1. YOUR ORGANISATION

The information provided in this section will help with classification and statistical comparisons and will be treated in a strictly confidential manner.

Q1 What is the size of your company?

- 0 - 25 employees
 26 - 49 employees
 50 - 99 employees
 100 - 249 employees
 250 - 499 employees
 500 - 999 employees
 1000 - 5000 employees
 Over 5000 employees

Q2 What area of space does your company occupy in the following locations?

<input type="text"/>	sqft	Scotland
<input type="text"/>	sqft	Wales
<input type="text"/>	sqft	North East England
<input type="text"/>	sqft	North West England
<input type="text"/>	sqft	Midlands
<input type="text"/>	sqft	South East England
<input type="text"/>	sqft	South West England

Q3 In which industry does your company operate?

- Retail
 Banking
 Insurance
 Accountancy
 Legal
 Finance
 Public administration
 IT / software / telecoms
 Professional / advisory
 Transport
 Other (please specify) _____

Q4 What area of space did your company rent in your last financial year? (please confirm the year)

_____ sqft
_____ year (please state financial year)

Q5 How much space does your company occupy in the following property categories?

<input type="text"/>	sqft	Residential
<input type="text"/>	sqft	Retail
<input type="text"/>	sqft	Offices
<input type="text"/>	sqft	Industrial
<input type="text"/>	sqft	Leisure

PLEASE TURN OVER

FLOOD RISK

Q6 How would you rank the issue of flood risk in relation to the other perils listed below and which may affect property?

(Please rank in order where 1 is most important and 4 is least important. If you consider an issue unimportant please put a X in the box)

- Contamination
- Subsidence
- Storm damage (eg. From high winds)
- Flooding

Q7 How would you rate the level of awareness within your company to the potential risk of flooding to your company's property portfolio? *(please circle the appropriate value)*

- | | | | | |
|---------------------|----------------|----------------|----------------|---------------------|
| Very high awareness | High awareness | Some awareness | Poor awareness | Very poor awareness |
| 5 | 4 | 3 | 2 | 1 |

Q8 What percentage of the properties your company occupies is at risk from flooding? *(please tick the relevant box)*

- 100% - 76%
- 75% - 51%
- 50% - 26%
- 25% - 0%
- Don't know

Q9 Do you feel that your company is adequately protected by insurance for this flood risk?

- Yes
- No

Q10 In the last five years have any properties your company occupies been affected by flooding?

- Yes
- No
- Don't know

Q11a In the last five years has your company walked away from a new tenancy of a property because it was located in a flood risk area?

- Yes **Go to Q11b**
- No **Go to Q12a**

Q11b How much space did you abandon as a result of the risk of flooding?

sqft	Residential
sqft	Retail
sqft	Offices
sqft	Industrial
sqft	Leisure

Q12a Has the perceived increased risk of flooding in London and the South East of England caused your company to alter their attitude to locating in these areas?

- Yes **Go to Q12b**
- No **Go to Q13**

Q12b If yes, in which ways?

Q13 When an area is described as being at risk from a '1 in 10 year return flood', what do you understand this to mean?

- A flood would only occur once in every 10 year period
- There is a 10% annual probability of a flood event

Q14a Has your company ever experienced any difficulty in obtaining flood insurance for a property because it was located in a flood risk area?

- Yes **Go to Q14b**
- No **Go to Q15a**
- Self insure for this risk **Go to Q15a**
- Don't know **Go to Q15a**

Q14b If so what problems were encountered?

- Insurer would not provide cover
- Policy excluded flood damage cover
- Higher premiums
- High excess on the policy
- Other *(please specify)* _____

Q15a Do you obtain an evaluation of the flood risk to a property before taking a tenancy?

- Yes always **Go to Q15b**
- Only if a problem is suspected **Go to Q15b**
- No **Go to Q16**

Q15b Which sources of information are used in your company's flood risk assessments? *(please tick all that apply)*

- Insurance status of area (ABI guidance)
- Environment Agency guidance
- Planning authority information
- Historical data
- Local knowledge / local agents
- Don't know
- Other *(please specify)* _____

Q16 If a flood risk assessment suggested that a property you proposed to occupy was at risk of flooding how would the level of risk influence your company's strategy? (please tick the appropriate boxes)

	Strategy		
	Continue with tenancy negotiations	Continue with tenancy negotiations but look for a rental discount	Abandon tenancy negotiations and look elsewhere
Site attributes and flood risk			
Floodplain location, 0.5% (1 in 200) risk of flooding and there are no flood defences.			
Floodplain location, 1% (1 in 100) risk of flooding and there are no flood defences.			
Floodplain location, 1% (1 in 100) risk of flooding, flood defences are in place.			
Floodplain location, 1% (1 in 100) risk of flooding. Plans to build defences by 2007.			
Site suffered a flood event in the last 5 years resulting in an insurance claim for damage.			
Flood insurance not available due to the risk of flooding.			

Q17 If a property was located within a flood risk area, which factors would most persuade your company to take a tenancy? (please circle the appropriate values)

	Very Important	Important	Neutral	Irrelevant	Don't know
Low rent	5	4	3	2	1
Flood insurance available	5	4	3	2	1
Strategic location	5	4	3	2	1
Flexible lease terms offered	5	4	3	2	1
Flood defences planned	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Q18 How important would the following factors be in dissuading your company from taking a tenancy of a property located in a flood risk area? (please circle the appropriate values)

	Very Important	Important	Neutral	Irrelevant	Don't know
Inability to obtain flood insurance	5	4	3	2	1
High cost of flood insurance	5	4	3	2	1
Landlord seeking longer term	5	4	3	2	1
Landlord seeking high rent	5	4	3	2	1
No flood defences planned	5	4	3	2	1
No benefit from flood mitigation measures	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Flood Impact Research

Q19 Are there any other issues you think should have been covered by this survey?

Q20 Would you be willing to participate in a follow-up interview and/or case study for this research?

Yes **Interview**
 Yes **Case study**

Yes **Both**
 No

Thank you for your assistance with this questionnaire

We will send you a summary of the findings when the research is complete



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Flood Impact Research

Property Investors' Questionnaire

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Researchers are looking at the impact of current and future flood risk on the commercial and residential property sectors and stakeholders strategies.

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We would be grateful if you could return this questionnaire in the pre-paid envelope by **Friday 22nd July** at the latest.

In this questionnaire 'flood risk areas' means locations where the Environment Agency have stated there is a significant risk of flooding.

Please fill in the following details (or attach business card)

Name: _____
Position: _____
Company: _____

1. YOUR ORGANISATION

The information provided in this section will help with classification and statistical comparisons and will be treated in a strictly confidential manner.

Q1 Please tick the category which best describes your company's business

- Institutional investor
 Private Estate
 Property company
 Overseas owner
 Other (please specify) _____

Q2 What proportion of your company's total investments are held as property?
_____ %

Q3 What value of properties did you acquire in your company's last financial year? (please confirm the year)
£ _____
_____ year (please state financial year)

2. INVESTING AND FLOOD RISK

Q4 How would you rank the issue of flood risk in relation to the other perils listed below and which may affect property?

(Please rank in order where 1 is most important and 4 is least important. If you consider an issue unimportant please put a X in the box)

- Contamination
 Subsidence
 Storm damage (eg. From high winds)
 Flooding

Q5 How would you rate the level of awareness within your company to the potential risk of flooding to your company's property portfolio? (please circle the appropriate value)

Very high awareness	High awareness	Some awareness	Poor awareness	Very poor awareness
5	4	3	2	1

Q6 What percentage of your company's property portfolio is at risk from flooding? (please tick the relevant box)

- 100% - 76%
 75% - 51%
 50% - 26%
 25% - 0%
 Don't know

PLEASE TURN OVER

INVESTING AND FLOOD RISK cont...

Q7 Do you feel that your company is adequately protected by insurance for this flood risk?

- Yes
 No

Q8 In the last five years, have any properties within your company's portfolio been affected by flooding?

- Yes
 No
 Don't know

Q9a In the last five years, have any property acquisitions been abandoned by your company because they were located in a flood risk area?

- Yes **Go to Q9b**
 No **Go to Q10**

Q9b What is the value of the property acquisitions abandoned?

£ _____

Q10 When an area is described as being at risk from a '1 in 10 year return flood', what do you understand this to mean?

- A flood would only occur once in every 10 year period
 There is a 10% annual probability of a flood event

Q11a Has the perceived increased risk of flooding in London and the South East of England caused your company to alter their attitude to investing in these areas?

- Yes **Go to Q11b**
 No **Go to Q12a**

Q11b If yes, in which ways?

Q12a Does your company borrow to acquire property?

- Yes **Go to Q12b**
 No **Go to Q13a**

Q12b Has your company ever had difficulties obtaining finance for a development because it was located in a flood risk area?

- Yes **Go to Q12c**
 No **Go to Q13a**
 Don't know **Go to Q13a**

Q12c If so what problems were encountered?

- Finance refused
 Low loan/value ratio offered
 Higher interest rate
 Other (please specify) _____

Q13a Has your company ever experienced any difficulty in obtaining flood insurance for properties because they were located in a flood risk area?

- Yes **Go to Q13b**
 No **Go to Q14a**
 Self insure for this risk **Go to Q14a**
 Don't know **Go to Q14a**

Q13b If so what problems were encountered?

- Insurer would not provide cover
 Policy excluded flood damage cover
 Higher premiums
 High excess on the policy
 Other (please specify) _____

Q14a Do you obtain an evaluation of the flood risk to a property before you proceed with a acquisition?

- Yes always **Go to Q14b**
 Only if a problem is suspected **Go to Q14b**
 No **Go to Q15**

Q14b Which sources of information are used in your company's flood risk assessments? (please tick all that apply)

- Insurance status of area (ABI guidance)
 Environment Agency guidance
 Planning authority information
 Historical data
 Local knowledge / local agents
 Don't know
 Other (please specify) _____

Q15 If a flood risk assessment suggested that an office investment was at risk of flooding how would the level of risk influence your company's acquisition strategy? *(please tick the appropriate boxes)*

	Strategy		
	Continue with acquisition	Continue with acquisition but look for a discount in the price	Abandon acquisition
Site attributes and flood risk			
Floodplain location, 0.5% (1 in 200) risk of flooding and there are no flood defences.			
Floodplain location, 1% (1 in 100) risk of flooding and there are no flood defences.			
Floodplain location, 1% (1 in 100) risk of flooding, flood defences are in place.			
Floodplain location, 1% (1 in 100) risk of flooding. Plans to build defences by 2007.			
Site suffered a flood event in the last 5 years resulting in an insurance claim for damage.			
Flood insurance not available due to the risk of flooding.			

Q16 If a property was located within a flood risk area, which factors would most persuade your company to acquire it? *(please circle the appropriate values)*

	Very Important	Important	Neutral	Irrelevant	Don't know
Strong rental market	5	4	3	2	1
Flood insurance available	5	4	3	2	1
Strategic location	5	4	3	2	1
Good capital growth	5	4	3	2	1
Flood defences planned	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Q17 How important would the following factors be in dissuading your company from investing in a property that is located in a flood risk area? *(please circle the appropriate values)*

	Very Important	Important	Neutral	Irrelevant	Don't know
Inability of tenant to obtain flood insurance	5	4	3	2	1
Difficulty in letting property	5	4	3	2	1
Tenants seeking shorter term	5	4	3	2	1
Tenants seeking lower rent	5	4	3	2	1
Tenant seeking more flexible lease terms	5	4	3	2	1
High cost of buildings flood insurance	5	4	3	2	1
Other (please specify)	5	4	3	2	1

Flood Impact Research

Q18 Are there any other issues you think should have been covered by this survey?

Q19 Would you be willing to participate in a follow-up interview and/or case study for this research?

Yes **Interview**
 Yes **Case study**

Yes **Both**
 No

Thank you for your assistance with this questionnaire

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Property and Flood Impact Research

Valuers' Questionnaire

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We would be grateful if you could return this questionnaire in the pre-paid envelope by **Friday 22nd July** at the latest.

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Please fill in the following details (or attach business card)

Name: _____
Position: _____
Company: _____

1. YOUR ORGANISATION

The information provided in this section will help with classification and statistical comparisons and will be treated in a strictly confidential manner.

Q1 How many investment valuations did you undertake last year in each of these sectors?

	1-10	11-20	21-50	50-100	100 +
Retail					
Offices					
Industrial					
Leisure					
Mixed use					

Q2 Which companies do you undertake investment valuations for? (Please tick all that apply)

- Institutional investor
- Private Estate
- Property company
- Overseas owner
- Banks / lenders
- Other (please specify) _____

Q3b Why were the valuations carried out? (Please tick all that apply)

- Financial statement
- Performance measurement
- Advice sale
- Advice acquisition
- Loan
- Portfolio restructuring
- Other (please specify) _____

Q3a In the last five years, do you have experience of undertaking valuations for properties located in flood risk areas?

- Yes **Please go to Q3b**
- No **Please go to Q4**

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Research Department, College of Estate
Management, Whiteknights, Reading
RG6 6AW
Tel: 0118 986 1101
Fax: 0118 975 5344

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2. VALUATION AND FLOOD RISK

Q4 How would you rank the issue of flood risk in relation to the other perils listed below and which may affect property?

(Please rank in order where 1 is most important and 4 is least important. If you consider an issue unimportant please put a X in the box)

- Contamination
- Subsidence
- Storm damage (eg. From high winds)
- Flooding

Q5 When an area is described as being at risk from a '1 in 10 year return flood', what do you understand this to mean?

- A flood would only occur once in every 10 year period
- There is a 10% annual probability of a flood event

Q6a When undertaking a valuation (for market value or an investment appraisal) do you carry out an assessment of the risk of flooding to the property as standard?

- Yes always **Go to Q6b**
- Only if a problem suspected **Go to Q6b**
- Only if requested to by client **Go to Q6b**
- No **Go to Q7**

Q6b Which sources of information are used in your company's flood risk assessments? *(please tick all that apply)*

- Insurance status of area (ABI guidance)
- Environment Agency guidance
- Planning authority information
- Historical data
- Local knowledge / local agents
- Don't know
- Other *(please specify)* _____

Please go to Q8a

Q7 If you do not undertake a flood risk assessment as standard do you caveat for this in your reports?

- Yes
- No

Q8a Do you feel the current professional valuation guidance for flooding is adequate?

- Yes **Go to Q9**
- No **Go to Q8b**

Q8b How could it be improved? _____

Q9 What level of importance do you feel the market attaches to these risks when considering an investment valuation? *(please circle the appropriate values)*

	Very important	Important	Neutral	Not important	Don't know
Tenant covenant	5	4	3	2	1
Economic trends	5	4	3	2	1
Changes in Landlord and Tenant law	5	4	3	2	1
Changes in property taxation	5	4	3	2	1
Flooding risk	5	4	3	2	1
Contamination	5	4	3	2	1

Q10 – Valuation

We would like to ask you some questions about a commercial office valuation, which is to be valued on a market value basis.

It must be stressed that there are no right or wrong answers. We are only interested in the approach you might take to adjust the valuation to take into account different elements of risk for various flooding scenarios.

Scenario

You have been instructed by a client to undertake a market valuation for the acquisition of an office investment in Reading. The details of the investment are as follows:

- *The net passing rent on the property is £80,000p.a. (This is a full market rent based on comparables of other properties in the location, which are not at risk of flooding);
- * All risk yields on similar properties are 10% (But these properties are not at risk of flooding);
- * There are 18 years unexpired on a 20 year lease, let on FRI terms;
- * 5 yearly rent reviews

For the various scenarios outlined in the table below, please show what adjustments, if any, you would make to the all risks yield and how these adjustments would be qualified.

<i>Site attributes and flood risk</i>	Adjustment to the all risks yield	Comments
Floodplain location, 1 in 200 (0.5%) risk of flooding and there are no flood defences.		
Floodplain location, 1 in 100 (1%) risk of flooding and there are no flood defences.		
Floodplain location, 1 in 100 (1%) risk of flooding, flood defences are in place.		
Floodplain location, 1 in 100 (1%) risk of flooding. Plans to build defences by 2007.		
Site suffered a flood event in the last 5 years resulting in an insurance claim for damage.		
Flood insurance not available due to the risk of flooding.		

Q11 Which other adjustments to your valuation would you consider making for flood risk and why?

Q12 Would you be prepared to provide us with any specific valuation data concerning properties located in flood risk areas (all data would be used for analytical purposes and would be treated on a strictly confidential basis)?

Yes
 No

Details:

Flood Impact Research

Q13 Are there any other issues you think should have been covered by this survey?

Q14 Would you be willing to participate in a follow-up interview and/or case study for this research?

Yes **Interview**
 Yes **Case study**

Yes **Both**
 No

Thank you for your assistance with this questionnaire

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– Is it Worth the Risk? – The Impact of Environmental Risk on Property Investment Valuation	1997
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Whiteknights, Reading, Berks, RG6 6AW

Tel: 0118 921 4686 Fax: 0118 921 4617

email: research@cem.ac.uk

website: www.cem.ac.uk