

Final report

Project UKCC22

Differential Social Impacts of Climate Change in the UK

January 2009



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Dissemination status

Unrestricted

Research contractor

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EXECUTIVE SUMMARY

UKCC22: Differential Social Impacts of Climate Change in the UK (January 2009)

Project partners: SNIFFER, Scottish Government, the Scottish Environment Protection Agency, Scottish Natural Heritage, Environment Agency, Northern Ireland Council for Voluntary Action, Environment Agency Northern Ireland, Forestry Commission.

BACKGROUND TO THE RESEARCH

The Stern Review highlighted that ‘the impacts of climate change are not evenly distributed – the poorest countries and people will suffer earliest and most’. Evidence shows that not only are the poorest people often more exposed to specific climate change impacts, they are also more vulnerable to those impacts, and find it harder to recover when they occur. Climate change will widen existing inequalities, globally and locally, unless social impacts are actively addressed across the range of adaptation¹ and mitigation² measures.

To inform UK climate change adaptation responses, the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) commissioned CAG Consultants to identify how climate change affects different people within the UK, and how adaptation measures should consider social impacts to help build the capacity of vulnerable groups to adapt to climate change.

OBJECTIVES FOR THE RESEARCH

The specific objectives of the research were to:

- identify the social impacts in the UK which are forecast to increase under climate change projections;
- identify the differential impacts, for example, based on exposure and sensitivity and the capacity to adapt; and
- identify adaptation measures that will need to consider these differential social impacts.

The research involved a literature review to identify the differential social impacts of climate change, analysis, a workshop and research into adaptation responses.

KEY FINDINGS AND RECOMMENDATIONS

The climate is changing and is expected to result in warmer temperatures, with hotter, drier summers, milder and wetter winters, more extreme weather events, such as heat waves, and rising sea levels. Different parts of the four regions of the UK are likely to be affected differently, and more detailed UK Climate Projections will provide smaller-scale data projections and insight into localised climatic conditions.

Changes in the weather, and more extreme conditions, such as heat waves, heavy rainfall, flooding and storms will have significant social impacts on UK society. In particular, climate change will affect physical, as well as mental health and wider quality of life. It will also affect people’s access to, and the quality of, basic goods and services such as water, shelter and

¹ Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected changes in the climate or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007).

² Mitigation is an anthropogenic intervention to reduce the *sources* or enhance the sinks of greenhouse gases (IPCC, 2007).

food, as well as other key priorities for human wellbeing such as education, employment and crime, therefore worsening social deprivation.

The people who are likely to be most vulnerable to the impacts of climate change are those:

- living in places at risk;
- people who are already deprived by the health, level of income, the quality of their homes and mobility; as well as
- people who lack awareness of the risks of climate change, the capacity to adapt, and who are less well supported by family, friends and agencies.

Deprivation often increases vulnerability to climate change, and climate change increases deprivation.

Action is needed at all levels: international, national, within devolved administrations and within regions; at a local level by councils and local agencies; but also at a community level, through voluntary and community groups, and with individuals.

There are two distinct ways to consider the differential social impacts of climate change – existing climate change adaptation measures should be tailored to the needs of vulnerable people; and work building the capacity of vulnerable people should consider the impacts of climate change.

This final project report identifies three types of strategic adaptation responses: (i) policy, (ii) management and operational, and (iii) community-led adaptation. It concludes that action is needed at 3 levels within the UK: nationally and regionally (e.g. by government, agencies, regional bodies etc.), locally (including by local authorities), and, most importantly, by and with communities. The *Social Vulnerability to Climate Change Adaptation Framework* sets out the adaptation measures that might be adopted to address specific social impacts of climate change, such as the impacts on health, crime or access to water and the natural environment, with a focus on vulnerable people.

The report finds that climate change adaptation policy within the UK recognises the social justice implications of climate change but offers little in terms of action. There is a myriad of mechanisms and tools which can be used to examine the differential social impacts of climate change within policy and practice. Sector-specific plans, such as in the health sector, are starting to consider these issues but more work is needed to ensure that adaptation responses involve, engage, empower and ultimately build the adaptive capacity of vulnerable people.

The report identifies a number of gaps for further exploration and action. In particular, more work is needed to understand the impact of global climate change on immigration to the UK and greater focus is needed to promote community-led adaptation.

In line with the principles of the UK Adaptation Programme, socially responsive climate change adaptation policy needs to be delivered within the context of **sustainable development**; action should be **proportionate**, and **integrated** with climate change mitigation; and involve **collaboration** with the people who are most vulnerable to climate change.

Key words: climate change, social impacts, differential, exposure, vulnerability, adaptation.

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1. ABOUT THIS REPORT

1.1 The background to this report

The climate is changing, presenting significant risks and opportunities for society. It has long been known that often the poorest people in society live in areas of environmental degradation.

Now research and policy reviews have highlighted that environmental change, as a result of changing climatic conditions, will also affect the poorest people. For example, the recent *Stern Review on the Economics of Climate Change* pointed out that 'the impacts of climate change are not evenly distributed – the poorest countries and people will suffer earliest and most' (Stern, 2006). Evidence has shown how the current and future social impacts of climate change fall unequally both between countries, in that the developing nations are most at risk, and within countries, with the poorest groups being most affected.

Not only are the poorest people often more exposed to specific climate change impacts, they are also more vulnerable to those impacts and find it harder to recover from them when they occur. Climate change will therefore widen existing inequalities, globally and locally, unless social impacts are actively addressed across the range of adaptation³ and mitigation⁴ measures.

1.2 The purpose of this research

To inform UK climate change adaptation responses, the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER) commissioned CAG Consultants to identify how climate change affects different people within the UK and to identify the adaptation measures that will need to consider differential social impacts and help build the capacity of vulnerable groups to adapt to climate change.

The specific objectives of the research were to:

- identify the social impacts in the UK which are forecast to increase under climate change projections;
- identify the differential impacts, for example, based on exposure and sensitivity and the capacity to adapt; and
- identify adaptation measures that will need to consider these differential social impacts.

This *Final Report* summarises the findings of this research, incorporating the findings of:

- (i) A *Literature Review*, which was undertaken to explore existing evidence of the differential social impacts of climate change. The findings of this review are published in a separate document *Differential Social Impacts of Climate Change: Literature Review* (CAG Consultants, 2009) and were presented to a UK-wide stakeholder workshop held in Birmingham on 30th September 2008.
- (ii) A *Workshop Report* which details how delegates at a workshop on 30th September 2008 mapped the existing action being taken within the UK to address the differential

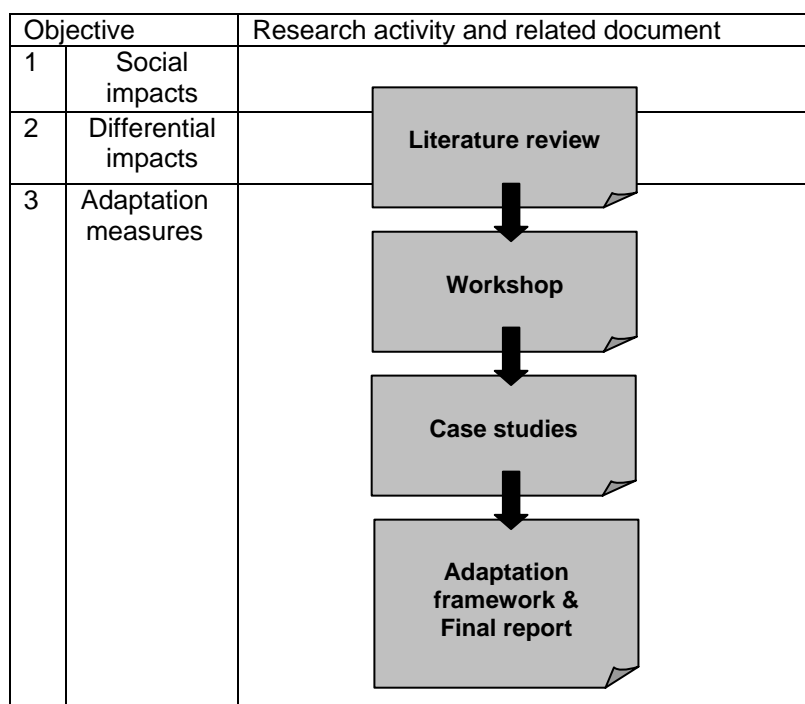
³ Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected changes in the climate or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007).

⁴ Mitigation is an anthropogenic intervention to reduce the *sources* or enhance the sinks of greenhouse gases (IPCC, 2007).

social impacts of climate change and identified a number of gaps and priorities for further action and investigation. *Adapting to the Differential Social Impacts of Climate Change in the UK: Workshop Report* and the accompanying Annex Report (CAG Consultants, 2008) are also published as separate documents.

(iii) Four *Case Studies* about issues perceived as gaps and areas for further exploration by workshop delegates, namely: community empowerment and capacity building; the synergies between adaptation and mitigation; effective communication of climate change; rural employment; and decision-making and accountability processes. These issues were explored in more detail by CAG Consultants through additional research and interviews.

(iv) A *Social Vulnerability to Climate Change Adaptation Framework* was developed using information from the literature, workshop, case studies and further research. The Framework identifies the types of policy, management and operational, and social resilience and adaptive capacity building measures that can be taken at a national/regional, local and community level to address the differential social impacts of climate change.



1.3 The structure of this report

This report is structured according to the four main lines of enquiry for the research:

- (i) Section 2: The social impacts of climate change
- (ii) Section 3: Social vulnerability and capacity to adapt to climate change
- (iii) Section 4: Adaptation measures for addressing social vulnerability, and building adaptive capacity to climate change (summarised in a Social Vulnerability to Climate Change Adaptation Framework)
- (iv) Section 5: Future action
- (v) Annexes: These contain the *UK Climate Change Scenarios* data for all UK regions and the *Social Impacts Framework*.

2. THE SOCIAL IMPACTS OF CLIMATE CHANGE

2.1 Climate change scenarios for the UK

Climate change is happening. According to the Fourth Assessment Report (AR4) by the UN Intergovernmental Panel on Climate Change (IPCC), human activity is very likely to have, and continue to contribute to increases in global averaged temperatures (IPCC, 2007). UKCIP02 climate change scenarios (Hulme *et al.*, 2002) show that the UK is likely to experience:

- **Increases in average annual temperatures** of between 0.5 and 1°C by 2040, with greater warming in southern England and South Wales. These areas are very likely to experience high temperatures, with excesses of 4°C and between up to 2.5°C to 4°C in Scotland by 2080 (Werritty and Chatterton, 2004).
- **Hotter summers**, with average summer temperatures expected to rise by between 0.5 and 2°C by 2040 (high confidence) and up to 50% less precipitation in the summer months by 2100 (medium confidence), with greater inter-annual variability expected in Scotland.
- **Milder and wetter winters**, with average winter temperatures expected to rise by between 0.5 and 1 °C by 2040 (high confidence) and up to 30% more precipitation in winter months (high confidence), except western Scotland. Increases are forecast in autumn, particularly in North West Scotland and Northern Ireland, with the Welsh/English border areas seeing the largest decreases (15%) in spring precipitation.
- **More common weather extremes**
 - **The number of hot days is expected to increase**, with high temperatures similar to those experienced in August 2003 or July 2006 (>3°C above average) expected to become more common (medium confidence).
 - **A decrease in the number of cold winter days** is expected, with low temperatures similar to those experienced in February 1947 or January/February 1963 (>3°C below average) expected to become highly uncommon (medium confidence).
 - **Heavier winter precipitation** is expected to become more frequent (high confidence), increasing by up to 20% in West and North West Scotland and by up to 20-35% in the South, East and North East Scotland.
 - **More frequent winter storms and mild, wet and windy weather** are expected across the UK (low confidence), particularly in southern and central England, but with the exception of a few areas in northern Scotland.
 - **Reduced snowfall** is expected, with the largest reductions along the coast and the English lowlands, with the smallest reductions expected in the Scottish Highlands and parts of Northern Ireland.
- **Sea levels will continue to rise** by as much as 20-80 cm in south-west England and by 0-60 cm in Scotland (low confidence). Extreme sea levels are expected more frequently, with storm surge events occurring up to 20 times more frequently in some coastal locations by 2100 (medium confidence) (Lowe and Hardy, 2008).

The UK will also be affected by the impacts of climatic changes in other parts of the world. Scientists have expressed 'very high confidence'⁵ that global warming is already affecting terrestrial biological systems and 'high confidence' that hydrological systems (and the water quality and run-off of glacial-fed rivers, lakes and rivers) are being affected and growing seasons are lengthening. We can also say with 'medium confidence' that increases in temperature are affecting agriculture and human health (with changes in infectious disease vectors in parts of Europe, and earlier onset of and increases in seasonal production of allergenic pollen in Northern Hemisphere high and mid-latitudes).

More detailed UK Climate Projections, while not expected to vary hugely from the 2002 scenarios, will provide probabilistic projections for all 25 x 25 km UK land grid squares and for some aggregated regions. Annex 1 summarises the 2002 UK climate change scenario predictions for 2050 and 2080 for each UK country and English region.

2.2 Social impacts of climate change in the UK

Social impacts, according to the International Association for Impact Assessment (IAIA) are 'all impacts on humans and on all the ways in which people and communities interact with their socio-cultural, economic and biophysical surroundings' (IAIA, 2003:2).

Policy and decision-makers are required, under Her Majesty's Treasury's Green Book and through statutory Regulatory Impact Assessments (now referred to as simply 'Impact Assessment'), to take account of social impacts, as well as 'differential impacts' and 'other distributional issues which may also arise due to age, gender, ethnic group, health, skill or location' in order to promote fairness (HM Treasury, date unknown).

There are various tools available to help decision-makers assess the differential social impacts of policies, such as those on climate change. For example, Sustainability Appraisal and Equality Impact Assessment (see section 4). To assess the differential social impacts of climate change, we used the Environment Agency's Social Appraisal Tool criteria, which builds on existing government guidance on appraisal and sustainable development criteria (Warburton *et al.*, 2005). The *Social Impacts of Climate Change Framework*, which is presented in Annex 2, summarises the types of social impacts of climate change.

For the purpose of this project, we focused on three main trends and extremes of weather, and three categories of social impacts: warmer weather and heat waves; increased precipitation and flooding; and high winds and storms.

While much discussion on climate change focuses on dramatic changes to extreme weather, low level changes can also have a significant effect if combined with other factors. The social impacts discussed below are described in isolation. It is important to remember that these impacts vary depending on a range of factors and may be:

- direct;

⁵ Where uncertainty is assessed more quantitatively using expert judgement of the correctness of underlying data, models or analyses, then the following scale of confidence levels is used to express the assessed chance of a finding being correct:

very high confidence at least 9 out of 10; high confidence about 8 out of 10; medium confidence about 5 out of 10; low confidence about 2 out of 10; and very low confidence less than 1 out of 10.

Where uncertainty in specific outcomes is assessed using expert judgment and statistical analysis of a body of evidence (e.g. observations or model results), then the following likelihood ranges are used to express the assessed probability of occurrence: virtually certain >99%; extremely likely >95%; very likely >90%; likely >66%; more likely than not > 50%; about as likely as not 33% to 66%; unlikely <33%; very unlikely <10%; extremely unlikely <5%; exceptionally unlikely <1%.

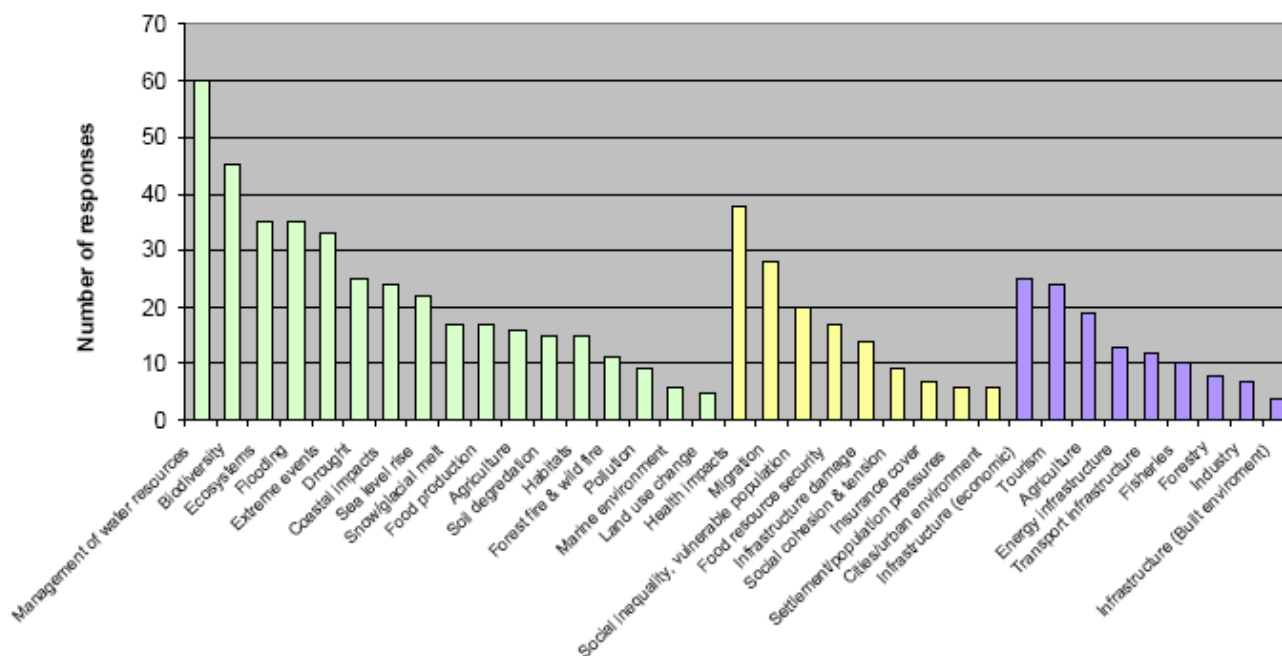
- secondary or indirect, i.e. not a direct result of climate change, but occur away from the original effect or as a result of a complex pathway, such a medium to long term disruption to and demands on the education system needing to provide for large number of families displaced by extreme weather conditions;
- cumulative, such as the impact on the ability to insure a property following a series of flood events; and/or
- synergistic, where effects interact to produce a total effect greater than the sum of the individual effects. For example, the combined impact on a family’s ability to work after a flooding event, combined with mental health problems as a result of living with flood risk⁶.

The health impacts of climate change are well-recognised within international climate science and policy, such as the Stern Review on the *Economics of Climate Change* (Stern, 2006) and the IPCC’s AR4 report. However, they do not examine the wider social impacts on safety, access to education or social inclusion.

2.3 Impacts on health and wellbeing

According to consultees to the EU Green Paper: *Adapting to Climate Change in Europe – Options for EU action*, the most severe social, environmental and economic impacts of climate change are likely to be the impacts on human health, migration, social inequality and food security (CEC, 2008) - see figure 1. Indeed, climate change will more severely affect people living in developing parts of the world (IPCC, 2007), and therefore indirectly affect UK citizens through resulting migration to the UK, and effects on trade and food security.

Figure 1 – Severity of social, environmental and economic impacts of climate change in Europe



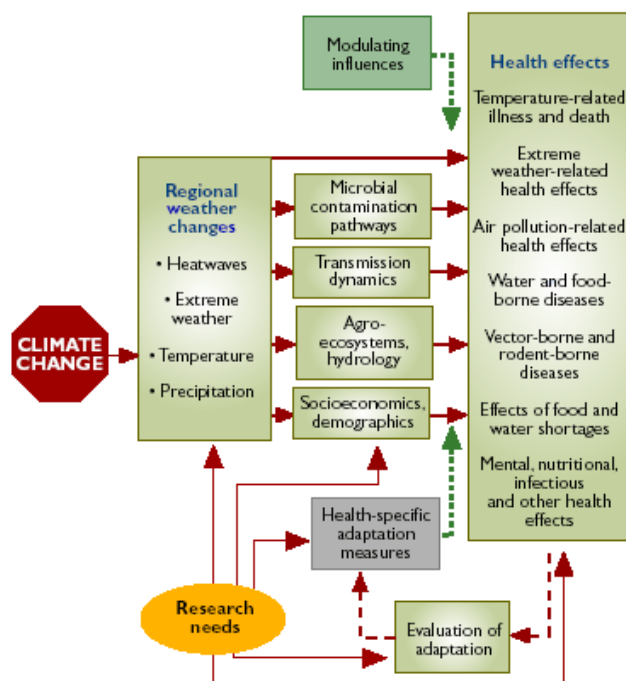
⁶ For more information, see ODPM (2005). *A Practical Guide to the Strategic Environmental Assessment Directive*. <http://www.communities.gov.uk/documents/planningandbuilding/pdf/practicalguidesea.pdf>

Regional weather changes have already affected human health, according to the World Health Organisation Report *Climate Change And Human Health - Risks And Responses* (WHO, 2003). For example, flooding is estimated to have resulted in 6.8 million deaths between 1990 and 2004 (Few *et al.*, 2004) and heat stress, such as that experienced during the 2003 heat wave which caused up to 13.2% excess deaths across England and Wales (McGregor *et al.*, 2007) and is expected to claim up to 3,000 lives in South East England by 2012 (DH, 2008). As shown in figure 2, climate change is likely to cause:

Figure 2 – Health effects of climate change

(Source: WHO, 2003)

- **Injury and deaths** due to storm or flood damage to trees and property. For example, four men died in 1999 when they fell off a gantry while working on the Avonmouth Bridge in high winds (Kovats and Allen, 2008). Indirect deaths may also be caused by hypothermia, electrocution, burns, carbon monoxide poisoning during a flood or suicides due to the impacts on mental health.
- **Water borne diseases** through contamination due to flooding, deterioration in water quality due to heat or reduced hygiene due to scarcity of water. For example, the WHO estimated that in 2000 climate change was responsible for approximately 2.4% of worldwide diarrhoea and 6% of malaria in some middle-income countries (WHO, 2003). People affected by the floods in the UK during July 2007 reported incidents of sickness and diarrhoea (Pitt, 2008).
- **Respiratory problems.** Flood-affected people living in damp conditions have reportedly experienced asthma, sore throats, cold sores and bad chests (Reacher *et al.*, 2004), while high temperatures will worsen air pollution, which is likely to cause up to 1,500 extra deaths and hospital admissions (DH, 2007), particularly in areas of existing poor air quality.
- **Food borne infections.** Food crops may be at risk from biotic diseases, livestock may be affected by zoonoses (infections transmitted between vertebrate animals and man) and fisheries could be affected by disease and changes in genetic diversity, which may in turn affect the food chain (FAO, 2008). High temperatures may also increase bacterial pathogens including salmonella, campylobacter and listeria spp, mycotoxins and aflatoxins.
- **Skin-related problems** can be aggravated by contaminated water and strong sun, which can also increase exposure to UV radiation and risks of skin cancer.
- **Access to health care services** may also be affected by climate change, as it puts increased demands on staff, services and health (e.g. hospital) infrastructure and equipment.



The mental health impacts of climate change are less well recognised in research and policy, although there is evidence that climate change-related events can cause:

- **Stress, anxiety, and mental health problems.** Loss of possessions, damage to property and disruption to lives has evidently resulted in stress, anxiety, panic attacks, agoraphobia, depression and tiredness amongst many flood victims, resulting in strains on community and family relations (Tapsell *et al.*, 1999; Hajat *et al.*, 2003; Few *et al.*, 2004; Thrush *et al.*, 2005b). For example, such events have been associated with increases in family breakdown (Tapsell *et al.*, 2002), increases in domestic violence (following the Grand Forks flood in 1997 in the USA) and even suicide (50 suicides in Poland are thought to have been caused by the River Oder flood in 1997).
- **Loss of opportunities for relaxation** may be a factor, as increases in temperatures, flooding or storms damage natural and cultural amenities, such as childrens' play areas, waterways or historic buildings.

People's safety and crime levels in the UK may also be compromised by climate change. The most significant impacts are likely to be:

- **International and terrestrial conflict** in other parts of the world due to resource, fuel and food insecurity (Abbott, 2008) as a result of rising sea levels, desertification and shrinking fresh water supplies. This may affect trade to the UK, as well as immigration. For example, the IPCC suggests that 150 million environmental refugees will exist by 2050, while environmental degradation is estimated to have already displaced up to 10 million people per year (Bogardi *et al.*, 2007).
- **Social unrest** over basic resources. For example, scarcity of water in flood hit areas in 2007 caused arguments and tensions in communities, over bottled water supplies and bowsers (Pitt, 2008), while hot weather has been linked to higher levels of street violence and riots, such as those in Oldham in 2001 (McGregor *et al.*, 2007).
- **Fires** on grasslands and in forests are also a high risk in hot weather (DCLG, 2006).

2.4 Impacts on access to, and quality of, goods and services

Climate change is very likely to negatively affect access to basic resources such as water, food, shelter and essential services, such as:

- **Water**, due to declines in rainfall, particularly in areas of existing water stress and due to increased demands for agricultural irrigation and household use in hot and dry periods. Flooding can put critical infrastructure at risk. For example, the flooding of the Mythe Treatment Works in Tewkesbury in 2007 meant that 350,000 people and 7,500 businesses were without water and that drinking water supplies were not restored for 17 days. The quality of potable and recreational waters may be compromised by contamination following flood events, or due to warmer temperatures.
- **Global food security** and prices are an increasing concern as drought in southern Asia and sub-Saharan Africa is expected to reduce crop yields by up to 20% by 2020 under medium-range climate change scenarios and productive land is increasingly under pressure from urbanisation and fuel production e.g. biofuels. Fisheries may also be affected by higher temperatures, reduced oxygen levels and disruption to catches and transportation in high winds. On the other hand, crop production and growing

seasons in mid-to-high latitudes could increase and result in diversification of crops (NFU, 2005 in Darch *et al*, 2007), as well as pests.

- The safety and comfort of many **homes** is at risk from flooding, higher temperatures, as well as high winds. Around 2 million homes in England and Wales and 100,000 homes and businesses in Scotland are at risk from flooding, while high winds can cause damage to properties and high temperatures can create damp in poorly ventilated homes and cause discomfort to babies, young children, older people and those with existing physical and mental health problems.
- **Energy** supplies to the UK could also be at risk, both from extreme weather in the UK affecting critical infrastructure and from global events affecting energy prices. Around 8,423 electricity generation sites and assets are estimated to be at risk from flooding (Environment Agency, 2007) and over a third of energy industry process elements are sensitive to changes in temperature (Met Office, 2006) - see figure 3. Fuel poverty, due to rising energy prices, is expected to continue to be a major challenge, despite recent £1 billion investment and energy efficiency measures.
- Access to **education/training and jobs** will also be directly and indirectly affected by climate change. Shifting to a low carbon economy through investment in renewable energy is expected to generate around 160,000 jobs, as well as drive education and training in climate change-related skills. However, flooding, heat and storms can severely disrupt education (107,000 pupil days were lost in Hull during the floods in summer 2007) (Hansard, 2007), business and employees' lives.
- **Recreation, culture and tourism** opportunities could be affected by changing weather conditions. Warmer summer temperatures and milder winters may affect outdoor leisure trends, as well as significantly affect natural and built amenities, such as water bodies, ski resorts and coastal towns.
- Natural **landscapes and biodiversity** are already being affected, as changes in precipitation and temperature affect animal and plant species and ecologically and economically valuable habitats, such as woodlands, forests, grasslands, heath, marches etc. Some habitats, such as blanket and lowland bogs may benefit from increased winter rainfall and the creation of wetlands for flood storage.
- **Transport and communications** will be disrupted by damage from flooding, storms and high temperatures, without managed adaptation - see figure 3. Road, rail, telephone and internet connections could all be affected and reduce essential communications and mobility, particularly during emergencies. For example, high temperatures in 2003 caused deformations in road surfaces and restrictions on the rail network (Wooller, 2004), while flooding in July 2007 resulted in the closure of eight motorways and many other roads, bringing large parts of five counties and four cities to a standstill (Pitt, 2008).

Figure 3 – Infrastructure at risk from flooding in England and Wales

Source: EA in Pitt (2007)

Asset	Number of sites in flood zone (flood risk probability)			
	Significant (1 in 75)	Moderate (1 in 75 to 1 in 200)	Low (1 in 200 or fewer)	Total in all three zones
Water and sewerage	737	223	179	1,145
Electricity (generation and distribution)	2,215	2,363	3,818	8,423
Gas (works and distribution)	5	8	10	23
Telephone exchanges	82	67	86	241
Motorways	139km	104km	132km	382km
A roads	884km	553km	809km	2,278km
Railway lines	1,470km	750km	948km	3,213km

2.5 Poverty and social inclusion

Climate change will disproportionately affect the poorest in society.

- Those people who are already poor are more likely to live in places at risk from climatic change.
- Particularly in the developing world, but also in the UK, women, children and the elderly will be most vulnerable. For example, the 20,000 people who died in France during the extreme heat wave in Europe in 2003 included significantly more elderly women than men.
- By impacting on people’s health, wellbeing and access to essential needs and services, climate change will affect people’s quality of life and could force many more people into poverty, particularly in the developing world. For example, the losses and costs of clean up and adaptation for small businesses and poor households affected by flooding will be hardest felt by the poor.
- Extreme events can often separate, as well as bring together communities. For example, people may leave behind friends and older and poorer residents who can’t move away, when evacuated during a flood. While some flood events have forged new relations and community cohesion. Social divisions may be created between households and communities who are differentially affected by, for example, a flood event, and those receiving resources, such as coastal defences, insurance, or water supplies.
- Socially excluded people are less able to participate in decision making, thereby further reducing their capacity to adapt to future events.

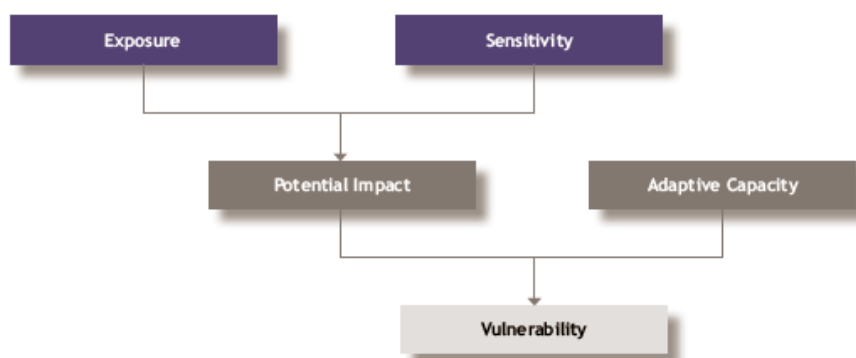
3. SOCIAL VULNERABILITY & CAPACITY TO ADAPT TO CLIMATE CHANGE

3.1 What do we mean by vulnerability and adaptation capacity?

People’s vulnerability to climate change depends on their exposure to climatic changes; their sensitivity to its impacts (the psychological and behavioural responses to an event); and their capacity to adapt, as expressed in figure 4.

Figure 4 – Components of vulnerability

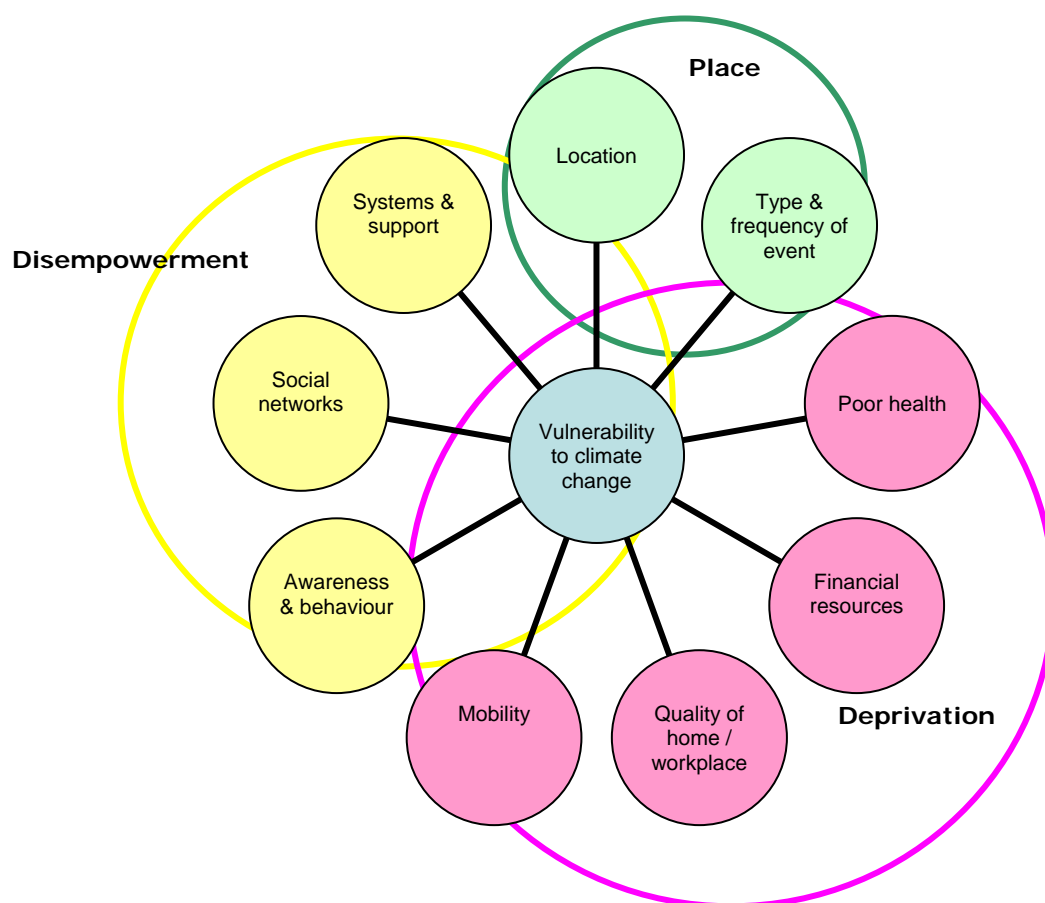
Source:
Australian Greenhouse
Office, quoted in Spickett *et al.* (2008)



Evidence suggests that the people who are most vulnerable to the social impacts of climate change are likely to be those people:

- living in **places** at risk;
- who are **socially deprived** (e.g. by poor health, low income, inadequate housing or lack of mobility);
- who are **disempowered** by lack of awareness, adaptive capacity, support services and exclusion from decision-making. These factors are illustrated by figure 5 (adapted from CAG Consultants, 2009).

Figure 5 – Factors affecting vulnerability to climate change



3.2 Place

Different **locations** in the UK will be affected differently by climate change. For example:

- South England and South Wales are likely to experience more extreme high temperatures, with excess of 4°C by the 2080s, and decreases in relative humidity;
- eastern and southern parts of the UK in particular will experience the largest percentage changes in winter precipitation, with similar changes for north west Scotland and Northern Ireland in terms of autumn precipitation;
- large decreases in cloud cover are expected across the country, especially in the south, but not in north west Scotland in the spring and autumn;
- southern and central England, in particular, are likely to experience stronger winds in winter;
- the coast and English lowlands are expected to see the largest reductions in snowfall across the UK, with the smallest changes to be seen in the Scottish Highlands and parts of Northern Ireland;
- sea levels are expected to rise around the UK coast (with much of southern Britain sinking and much of northern Britain rising).

Heat waves are more likely to occur in those locations facing the greatest increases in temperature, particularly South East England and will mostly affect those areas and people which are less able to adapt, i.e. cities, which act as heat islands, and the elderly and infirm. Storms are more likely to affect southern and central England, with increases in the frequency and severity of lightning over South West England. People living in areas of coastal, fluvial or surface water flood risk are more likely to be affected by flooding.

Some areas may experience multiple changes in weather. Indeed, the UK Adaptation Framework recognises that there are likely to be certain 'hotspots where a number of climate impacts will be felt in one location, for example, floodplains, coast, estuaries and large urban areas' (HM Government, 2008:13).

The **type and frequency of an event** will affect the level of impact on people living in places at risk. For example, the impacts of flooding depends on the type (fluvial, coastal, surface) of flooding, its speed, timing, duration, depth, as well as its frequency – households and communities who have been flooded before sometimes know what to expect and can therefore be more adept at adapting.

3.3 Deprivation

Overall, social deprivation can mean that you are more exposed to flooding, heat waves and other associated affects (Lucas *et al.*, 2004). For example, according to research commissioned by the Environment Agency, SNIFFER and others, people living in more deprived areas:

- are 62% more likely than others to be living in areas at high risk of flooding in affected areas (Walker *et al.*, 2006);
- could also be more susceptible to the effects of heat waves due to their association with existing poor health and housing (McGregor *et al.*, 2007);
- live in areas of existing poor air quality (which can be exacerbated by high temperatures) in England (Walker *et al.*, 2007) and Scotland (Fairburn *et al.*, 2007) and Belfast (King and Sturman, 2000);
- who live near rivers are more likely, than less deprived people, to live near rivers which are of poor and bad water quality (Damery *et al.*, 2006), which may be exacerbated by high temperatures and run-off from precipitation;

- are less likely to live near, and therefore have easy access to, parks and green spaces in England and woodland in Scotland, in order to retreat from high temperatures (NAO, 2006 and Fairburn *et al.*, 2005 respectively);
- may be less able to access environmental information (such as advice on flooding) by internet, because of lack of skills and access to technology (Rothwell, 2004); and
- on low incomes, older people, young people, women, ethnic minorities, and lone parents, particularly in rural areas, have less access to transport and therefore, less capacity to retreat from climate change risks and access essential services in times of need (SEU, 2003).

People with existing **poor physical and mental health** are more likely to be sensitive to the impacts of climate change. During a heat wave, people suffering from chronic and severe illness such as heart conditions, diabetes, respiratory or renal insufficiency, Parkinson's disease or severe mental illness are particularly vulnerable. Contamination and damp conditions from flooding can particularly affect those with low immune systems, while the trauma of being flooded can exacerbate existing mental health problems. The elderly (over 75 years) and young children are more vulnerable due to low immunity, particularly in extreme heat, but also due the stress of disruption and loss of sentimental items during a flood.

People on **low incomes** are less able to buy themselves out of risk, for example, by moving to places at less risk from flooding, buying flood protection measures or insurance. The Association of British Insurers estimates that 35% of people in very low income households do not have any insurance and 44% only have contents insurance (ABI, 2007), while flood resistance and resilience measures (at between £3,000 and £10,000) can be unaffordable to many (Bowker, 2007).

The quality of our **homes and workplaces** are crucial to protecting us from the impacts of climate change. Water and energy efficient appliances can help conserve resources; insulation, ventilation and vegetation can help maintain comfortable temperatures; and suitable drainage, vegetation and flood protection measures can help make houses more flood resilient. However, large numbers of houses in the UK, particularly those occupied by vulnerable people, are still 'not decent' and in poor condition. Meanwhile, many employees, particularly in outdoor jobs such as in agriculture and tourism, are more likely to be exposed to climatic changes.

Mobility by public or private transport is crucial, particularly in reaching safety, or in accessing health and social care services or resources after an extreme event. However, cars have often given people a false sense of security and put people at risk from injury or even death whilst trying to drive through a flood or storm.

3.4 Disempowerment

Awareness and behaviour is critical to people's recognition and need to adapt (Adger *et al.*, 2004). Information about climate change risks may not reach those who, for example, have recently moved to, or are temporarily living in an area (e.g. tenants, seasonal workers or people staying in caravans on the coast) or who are unable to read or understand the information (due to low educational attainment, language barriers, or with sight impairment). Willingness to adapt can depend on trust of the information provider or past experience of e.g. past flooding events.

Social networks, such as family, friends and neighbours provide informal information, advice and support to people vulnerable to climate change. For example, the tight social networks and strong family bonds within the Latino community in Chicago are suspected to have been a factor in the relatively low number of heat-related deaths during the 1995 heat wave. Those who live alone and without such networks, or who are reliant on carers, can often be more vulnerable to changes in weather and extreme events.

Systems and support services, such as health care and social services, are vital for vulnerable people. But, as was highlighted in France during the 2003 heat wave, failures in communication, data management and decision-making can be exacerbated by climate change and sudden events (McGregor *et al.*, 2007).

4. ADAPTATION MEASURES FOR ADDRESSING SOCIAL VULNERABILITY, AND BUILDING ADAPTIVE CAPACITY TO CLIMATE CHANGE

4.1 Types of adaptation measures

The purpose of this report, and this section, is to identify those adaptation measures which need to consider the differential social impacts of climate change. Section 5 reflects on the types of measures needed, and existing action, and makes recommendations for future action.

According to the IPCC climate change adaptation is an ‘adjustment in natural or *human systems* in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities’ (IPCC, 2007). The capacity to adapt ‘is dynamic and is influenced by a society’s productive base, including natural and man-made capital assets, social networks and entitlements, human capital and institutions’ (IPCC, 2007).

There are three types of adaptation approaches:

- a) *anticipatory adaptation* – Takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
- b) *autonomous adaptation* – Not the result of a conscious response to climatic stimuli but triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
- c) *planned adaptation* – Result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Whether anticipatory, autonomous or planned, all policy and practice needs to consider the impacts of climate change, and the needs of those people who are going to be most vulnerable – decisions relating to:

- (i) climate change;
- (ii) managing the risks of climate change e.g. flooding;
- (iii) managing the impacts and pathways i.e. water, the natural environment;
- (iv) community capacity building, including with vulnerable groups e.g. through health promotion, community development or regeneration; and
- (v) working directly with vulnerable receptors (people).

Action is needed at three different levels of governance within the UK:

1. **Nationally and regionally** – including by UK Government, devolved administrations, national agencies, such as regulators, business (e.g. utility companies) regional bodies and strategic health authorities;
2. **Locally** – including local authorities, social housing providers, Primary Care Trusts and hospitals;
3. **Community** – including community organisations (e.g. faith groups, Womens’ Institute), interest groups (e.g. anglers), key figures in the community (e.g. GPs, priests and community activists), Community Resilience Forums

The *Social Vulnerability to Climate Change Adaptation Framework*, presented in figure 6 below, sets out the range of adaptation measures that might be adopted to specifically address the social impacts of climate change, with particular focus on the people who are most vulnerable. The measures described come from a wide range of sources in addition to the workshops, case studies and interviews carried out for this project. Many are drawn from other adaptation

frameworks or specific adaptation plans (e.g. The Heat Wave Plan for England) or from on the ground experience (e.g. the floods in Gloucestershire in 2007). Some are measures that have been used in other contexts but are none-the-less considered to be appropriate adaptation responses. For example support for community-based small-scale sustainable energy projects is on-going as a measure to reduce carbon emissions and to increase the sustainability of communities but is also an appropriate adaptation measure for communities on the extreme ends of distribution networks where these may be disrupted by climate impacts. Inevitably there are gaps in possible adaptation responses.

Figure 6 – Social Vulnerability to Climate Change Adaptation Framework

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
HEALTH AND WELLBEING				
Physical e.g. injury, deaths, illness, disease	Increased heat related mortality and morbidity, particularly elderly due to heat waves	<p>Strategic health risk assessment.</p> <p>National Heat Wave Plan⁷ requiring heat wave planning at regional and local level</p> <p>Heat Wave Planning by regional health services addressing capacity issues e.g. bed spaces in hospitals and staffing of services such as NHS Direct.</p> <p>Provide advice and guidance for public, health/social care professionals, staff of residential nursing care homes, employers</p> <p>Co-ordination of dissemination of advice and guidance.</p> <p>Collation of regional statistics on heat-related mortality and morbidity and alerting national authorities to any sharp increases</p> <p>Warning systems put in place by Met Office in conjunction with health services based on weather forecasts and incidence of heat-related mortality and morbidity</p> <p>Establish budgets for the provision of cool spaces in hospitals, care homes etc</p> <p>Urban design guidance to include ways of countering the urban heat island effect</p>	<p>Preparedness by local providers of health and social care.</p> <p>Dissemination of advice to vulnerable groups and their carers.</p> <p>Dissemination of guidance and provision of training to health / social care professionals, and staff of residential nursing care homes.</p> <p>Dissemination of advice to employers of staff working in hot environments or carrying out activities requiring high levels of physical exertion</p> <p>Reporting of heat-related mortality and morbidity to regional/ national authorities</p> <p>Implementation of measures to provide cool spaces for those at risk by buildings managers.</p> <p>Local planning policies to counter the urban heat island effect in major conurbations</p>	<p>Incorporate heat waves into Community Risk Registers and build into neighbourhood programmes to develop community resilience</p> <p>Dissemination of advice to vulnerable individuals and their carers through community networks</p>
	Increased risks to public health from food poisoning, pests, legionella, vector-borne diseases, and respiratory problems due to warmer temperatures and consequent reduction in air quality	<p>Strategic health risk assessment</p> <p>Health risk assessment of specific risks linked to regional geography</p> <p>Policy to improve capability to identify</p>	<p>Monitoring and reporting of the incidence of potentially heat-related illnesses/diseases</p> <p>Dissemination of guidance and provision of training to health/social care</p>	

⁷ E.g. Department of Health 2007, 'Heatwave plan for England'

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
		changing disease patterns ⁸ Provide guidance to health/social care professionals and public health officers Co-ordination of dissemination of guidance Incorporate into health service budgets	professionals and public health officers Provision of vaccines and other medication appropriate to ameliorating risks from specific illnesses/diseases Increase frequency of putrescible waste collections	
	Increase in cases of skin cancer and cataracts due to increased UV exposure	Active support and funding for the SunSmart Campaign run by Cancer Research UK	Workplace Health Promotion campaign materials distributed to employees in outdoor occupations Provision of shading in green and open spaces in schools and other public spaces	
	Increase in alcohol consumption due to warmer temperatures	Factor into policies and programmes on alcohol abuse		
	Improved health due to physical activity in warm weather	Factor into policies on health promotion, sport and leisure	Improve provision of outdoor sport/recreational facilities	
	Reduced cold related mortality and morbidity due to decline in frequency of very cold days	Collection of statistics and monitoring of trends in cold related mortality and morbidity Collation of regional statistics on cold-related mortality and morbidity Factor into policies and programmes on Fuel Poverty and care of vulnerable groups e.g. elderly	Reporting of levels of cold related mortality and morbidity	
	Increased injuries and deaths due to flooding / high winds/ storms	Address through regional emergency/contingency planning Employer organisations and trade unions to issue advice to workers about dangers of travelling or working in exposed situations during storms and floods.	Address through emergency/contingency planning Dissemination of advice to workers in at risk occupations	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience
	Increase in infectious diseases and illness such as skin, stomach and respiratory complaints due to the aftermath of flooding and living	Incorporate into health risk assessment of flooding Collation of levels of possibly flood-	Reporting of level of possibly flood-related diseases and illnesses	

⁸ E.g. Public Health etc. (Scotland) Act 2008

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
	in damp conditions	related diseases and illnesses		
	Reduced access to health care due to disruption from floods and storms	Address through regional continuity management plans	Address through local continuity management plans	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience
	Chemical exposure due to damage to pipelines and storage from floods and storms	Incorporate in health risk assessment of flooding and storms Address through regional emergency/contingency planning	Address through emergency/contingency planning Training of emergency services and health professional to deal with chemical spills Provision of appropriate equipment for emergency services to deal with chemical spills	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience in areas which might be exposed to chemical spills
	Pressure on health services due to inward migration of 'climate change refugees' from other countries	Address through health service planning and immigration policy	Increase resourcing for primary health care in line with level of immigration	
Mental health	Anxiety, stress and other mental health problems due to heat/dehydration	Address through National Heatwave Plan	Provision of support and advice by local authorities, health/social services.	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience
	Anxiety, stress and other mental health problems due to flooding/storms and aftermath	Provide advice and guidance for public, health/social care professionals and local authorities	Provision of support and advice by local authorities, health/social services. Long-term support for flood/storm victims living in temporary accommodation and caravans over extended periods	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience Address through referral system in conjunction with community networks and use of community champions ⁹
	Disruption to mental health care due to flooding/storms	Address through regional continuity management plans	Address through local continuity management plans	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience

⁹ E.g. 'Village Agents' used in Gloucestershire after recent flooding

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
	Pressure on mental health services due to inward migration of 'climate change refugees' from other countries	Address through health service planning and immigration policy	Increase resourcing for mental health services in line with level of immigration	
Crime and social order	Risk of fire from natural causes and arson in drought conditions	Production of public information on dangers of fire during drought conditions	Dissemination of public information on dangers of fire during drought conditions Increase policing of areas at risk e.g. moors and forestry	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience
	Risk of social unrest, crime, violence, and excessive consumption of alcohol due to heat waves	Address through regional emergency/contingency planning	Address through emergency/contingency planning Increase policing levels during heat waves	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience
	Risk of intercommunal disputes and violence due to inward migration of people fleeing from climate change impacts in their home countries	UK policies to support effective adaptation responses in other countries. Address through national policies on equalities, human rights and migration.	Address through local policies on equalities and provision/allocation of basic resources such as housing. Training for police and community workers.	Raise awareness about the causes of inward migration in recipient communities. Development of direct links between community organisations (e.g. faith groups) in UK with communities under climate change stress in other countries and refugees.
	Increased risk of social unrest and violence due to disputes over allocation of resources (e.g. water / housing) following flooding and storms	Address through regional emergency/contingency planning	Address through emergency/contingency planning	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience
	Potential for looting following floods and storms	Address through regional emergency/contingency planning	Address through emergency/contingency planning Utilise curfews Increase policing of areas where homes and workplaces have been evacuated	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience Provision of materials for securing of damaged /evacuated building
ACCESS TO, QUALITY AND CHOICE OF GOODS AND SERVICES				
Water and	Increased water stress due to reduced rainfall in summer /	Further develop policies to support integrated management of water		

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
sewerage	increasing frequency of droughts and increased demand from new development	resources based on the requirements of the Water Framework Directive National planning guidance and planning policies in spatial strategies to discourage development in areas experiencing water stress Investment by water companies to reduce distribution losses and increase storage capacity Advice and incentives provided by water companies to encourage consumers to cut demand	Local planning policies requiring water conservation/efficiency measures to be incorporated in new developments Increase abstraction and storage of water during winter flows to offset summer losses Local campaigns to increase awareness of the need to reduce demand and to install water conservation and efficiency measures	Awareness raising amongst gardeners, allotment holders, gardening clubs about need to reduce water consumption.
	Threat to access to potable water due to: potential for groundwater contamination, reduced efficiency of treatment, dissolved oxygen depletion and algal blooms in rivers and reservoirs due to hot weather, saline intrusion of freshwater aquifers due to sea level rise		Monitor groundwater, rivers and reservoirs and revise of areas of groundwater protection as appropriate Monitor freshwater aquifers utilise freshwater recharge as appropriate	
	Threat to access to potable water from contamination of water supplies and disruption of treatment works and supply infrastructure due to flooding and heavy rainfall	Address through strategic flood risk assessment and regional emergency/contingency planning Increased investment by Water Services Companies in flood protection and relocation of vulnerable infrastructure Water Services Companies to have contingency plans for supplying water	Address through emergency / contingency planning Upgrade flood defences at water treatment works	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience
	Risk of sewer overflows as a result of flooding and heavy rainfall	Address through strategic flood risk assessment and regional emergency/contingency planning National planning guidance supporting SUDS Revise national standards for capacity of drains and sewers Increased investment by Water Services	Address through emergency / contingency planning Local planning policy requiring SUDS Upgrade sewage treatment works and capacity of drainage system. Reduce	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
		Companies and Local Councils in sewage and drainage system.	runoff to sewers.	
	Employment and business opportunities in civil engineering and water conservation / efficiency	Support through economic development policies and funding	Business advice services employ adaptation tools, particularly for SMEs ¹⁰	
Food	<p>Reduced availability and increased cost of vegetables and fruit (from UK and abroad) due to:</p> <ul style="list-style-type: none"> water stress pests and diseases soil erosion waterlogging of soil storm damage 	<p>Support for research into drought/ disease resistant crops and new farming methods adapting to climate impacts.</p> <p>Dissemination of research findings and best practice¹¹</p> <p>Address cost issues for low income households through the benefits systems and provision of school meals</p>	<p>Change in institutional procurement of food and menus</p> <p>Work with farmers and food producers to identify impacts and adaptation measures¹²</p>	<p>Encouragement and resources for people to grow their own food e.g. allotments, community gardens, garden sharing schemes.</p> <p>Support for community initiatives such as food co-ops to give low-income households access to a wider range of food.</p>
	<p>Reduced availability and increased cost of animal/dairy products (in UK and abroad) due to impacts on animal health and increased livestock deaths due to:</p> <ul style="list-style-type: none"> extreme heat wet weather and flooding pests and diseases 	<p>Support for research into animal husbandry and breeds that can adapt to climate impacts.</p> <p>Dissemination of research findings and best practice</p> <p>Address cost issues for low income households through the benefits systems and provision of school meals</p>	<p>Change in institutional procurement of food and menus</p> <p>Work with farmers and food producers to identify impacts and adaptation measures</p>	
	<p>Reduced availability and increased cost of fish/shell fish due to adverse impacts on fisheries (in UK waters and abroad) such as:</p> <ul style="list-style-type: none"> decline in water quality due to reduced water flows in droughts decline in water quality due to contaminate run-off in heavy rainfall/floods rising sea temperatures 	<p>Support for research into sustainable fishing and new methods of fish farming.</p> <p>Dissemination of research findings and best practice</p> <p>Address cost issues for low income households through the benefits systems and provision of school meals</p>	<p>Change in institutional procurement of food and menus</p> <p>Work with farmers and food producers to identify impacts and adaptation measures</p>	

¹⁰ E.g. UKCIP's Climate Adaptation Resource for Business Advisors (CLARA)

¹¹ E.g. National Union of Farmers: *Farming Futures Website* and DEFRA advice to farmers and food producers

¹² E.g. work currently being undertaken by the Environment Agency

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
	Increased incidence of food poisoning due to heat waves and contamination of food during flooding	Utilise the findings of research being undertaken by the Foods Standards Agency and others into climate impacts on food safety See also above under health		
	Increased availability of locally grown food crops because of longer growing season and introduction of new crops due to warmer climate.	Support through economic development policies and funding	Local Authorities support initiatives for marketing locally produced food e.g. farmers' markets and veg box schemes	Encouragement and resources for people to grow their own food e.g. allotments, community gardens, garden sharing schemes
Housing and property	Discomfort in poorly adapted buildings during very hot weather	National planning guidance and policies to require new development to incorporate adaptation to probable climate impacts. Production of national advice for householders on how to keep homes cool aimed particularly at vulnerable groups	Local planning policies to require new development to incorporate adaptation to probable climate impacts. Increased investment by property owners, social housing landlords in measures to improve the adaptation of the existing housing stock taking advantage of synergies with measures to cut carbon emissions Dissemination of national advice to householders through local authorities and social housing landlords etc.	Use of community networks to target advice on vulnerable groups
	Damage and loss of buildings and contents due to: subsidence in very hot weather flooding high winds and storms coastal erosion / sea level rise	National planning guidance and policies to require new development to incorporate resilience to probable climate impacts. ¹³ Joint initiatives between government and insurance industry to ensure the availability of affordable insurance utilising research by NGOs ¹⁴ Insurance companies to provide positive incentives through premiums for building	Local planning policies to require new development to incorporate adaptation to probable climate impacts. Increased investment by property owners, social housing landlords in measures to improve the resilience of the existing housing stock ¹⁵ Building owners need to ensure adequate insurance cover and install improved resilience measures Local contingency planning to include provision of long-term support for	Dissemination of advice to vulnerable groups about the need for buildings and contents insurance via community

¹³ This might also include technical guidance by professional bodies such as RIBA and CIBSE

¹⁴ E.g. Research by New Economics Foundation into insurance products for the financially excluded

¹⁵ This might be based on advice on appropriate improvements coming from regional bodies such Business in the Community North East

¹⁶ E.g. Environment Agency's *Build Trust with Communities Toolkit*

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
		<p>owners who install resilience measures</p> <p>Regional contingency planning for the provision of temporary housing for flood/storm victims</p> <p>Address social impacts in developing flood prevention strategies</p> <p>Address through Coastal Zone Management Plans and Housing Strategies</p>	<p>homeless flood/storms victims living in temporary accommodation</p> <p>Ensure social impacts are addressed in development of plans for flood management and coastal defences utilising advice from national agencies¹⁶</p> <p>Review flood and coastal defences consider relocating housing/buildings away from areas at risk.</p>	<p>networks</p> <p>Involve vulnerable groups in development of flood prevention/management strategies</p> <p><i>Involve vulnerable groups in development of Coastal Zone Management Plans e.g. residents in mobile home parks</i></p>
	Employment and business opportunities in sustainable construction and design	Support through economic development policies and funding	Business advice services employ adaptation tools, particularly for SMEs	
	Pressure on housing due to inward migration of 'climate change refugees' from other countries	<p>Address through Housing Strategies, planning and immigration policy</p> <p>Increase support for social housing in line with level of immigration</p>	Address through policies on housing provision and allocation	
Energy	<p>Disruption to electricity supplies due to:</p> <p>increased cooling demands in very hot weather</p> <p>damage to power stations, transmission/ distribution system during flooding / storms/ extreme heat</p>	<p>Address through regional emergency / contingency planning in co-operation with the electricity supply industry</p> <p>Electricity generators and National Grid address through power supply and demand planning.</p> <p>Increased investment by electricity supply industry to improve resilience of electricity supply and distribution system.</p>	<p>Address through emergency / contingency planning</p> <p>Planning policies to encourage passive forms of cooling in new development.</p>	<p>Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience</p> <p>Support and resources for communities developing small-scale sustainable energy supply and reducing electricity demand particularly in areas at the extremes of the transmission / distribution system</p>
	Employment and business opportunities in improving infrastructure, developing decentralised energy supply and energy efficiency	Support through economic development policies and funding	Business advice services employ adaptation tools, particularly for SMEs	Support and resources for communities developing small-scale sustainable energy supply
Education/ training/ jobs	Opportunities for education, skills and jobs relating to climate changes e.g. decentralised energy supply, sustainable construction to improve resilience of building, civil	<p>Support through economic development policies and funding</p> <p>See also Food, Housing and Buildings, Water, Energy, Leisure</p>		

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
	engineering of flood defences	Recreation and Tourism		
	Opportunities for raising awareness of climate change through direct experience of heat waves, floods and storms		Formulate a Local Climate Impact Profile (LCLIP) with advice from UKCIP and use to raise awareness of adaptation response to climate change impacts on vulnerable groups	Community groups collect news media coverage and personal accounts of climatic events in the locality to raise awareness and to contribute to LCLIP
	Loss of jobs amongst disadvantaged groups in agriculture and tourism due to business failure following extreme weather events / flooding/ storms	Joint initiatives between government and insurance industry to ensure the availability of affordable and appropriate insurance for SMEs in at risk areas Availability of relief funding through RDAs and devolved administrations		
	Loss of concentration amongst children and students in education due to heat stress		Awareness raising among building managers on regimes to keep buildings cool Increased investment in measures to improve cooling in buildings and provide extra shading	
	Loss of pupil/teaching days due to flood and storm damage to educational buildings	Expanding the provision of distance learning such as that provided by the OU and the University of the Highlands	Increased investment in improved resilience of school buildings Long-term planning for the relocation of schools in areas of extreme risk Ensuring appropriate insurance is in place	
	Pressure on education services due to inward migration of 'climate change refugees' from other countries	Address through education and immigration policies	Increase resourcing of education services in line with level of immigration	
Leisure/ recreation/ tourism	Increase in outdoor recreation and water based activities due to warmer weather	Support for development of market and new facilities to take up new opportunities	Business advice services employ adaptation tools, particularly for SMEs Expand provision of facilities for water based activities	
	Opportunities for tourism and leisure industry due to warmer weather lengthening of the season	Address through economic development / tourism policies giving support for development of market and new facilities to take up new opportunities	Business advice services employ adaptation tools, particularly for SMEs	

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
	Loss of utility of ecosystems for tourism due to drier weather		Monitor vulnerable ecosystems Manage public access to restrict damage and prolong utility	
	Loss of tourism based on winter sports relying on snow cover	Address through economic development/ tourism policies giving support for diversification and alternative enterprises.	Business advice services employ adaptation tools, particularly for SMEs	
	Reduced access to water recreational opportunities due reduced water quality caused by heat		Monitor water quality Restrict public access to safeguard public health	
	Disruption to sports events and recreational activities due to flooding/storms	Address through economic development/tourism policies giving support development for new all-weather sport and recreational venues outside flood-risk areas. Liaison with insurance industry to reduce financial losses.	Increase local provision of new all-weather sport and recreational venues	Funding for sports clubs and community groups to upgrade their facilities
	Reduced access to leisure, cultural facilities and historic buildings and sites due to short-term flood / storm damage and long-term loss to coastal erosion and sea level rise	Address through Coastal Zone Management Plans	Review flood and coastal defences consider relocating some facilities away from areas at risk.	<i>Involve vulnerable groups in decision making on adaptation strategies such as Coastal Zone Management Plans e.g. owners of static caravans in seaside parks</i>
Landscapes / nature	Reduced access to ecosystems, biodiversity, historic and cultural landscapes, green spaces and gardens due to damage and loss due to: heat stress flooding /storms coastal erosion/ sea level rise	Major landowners of key landscapes under threat to develop joint long-term strategy supported by regional government and national agencies Address through Coastal Zone Management Plans Raising awareness of climate impacts on coastal areas ¹⁷	Address through management plans for landscapes under threat including: where appropriate strengthening flood defences limiting public access to reduce damage and prolong utility developing alternative sites	<i>Involve vulnerable groups and interest groups in decision making on management plans e.g. anglers</i>
	Opportunities for increasing green spaces in urban areas	Address through national planning policies and guidance on urban design and open spaces (tie in with measures to combat urban heat island effect).	Address through local planning policies and requirements on urban design and open spaces. Discourage sell-off and development on	Local Authorities to provide encouragement and resources for communities to develop and manage green spaces in urban areas

¹⁷ E.g. National Trust awareness campaign

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
		Forestry Commission projects to improve access to woodland in and around towns and in urban areas	green spaces in urban centres	
	Improved access to new wetland habitats created through flood management and managed retreat in coastal zones		Address through management plans for new wetland areas	Encourage managers of new wetland areas to work with volunteers, interest groups and local communities
Transport (mobility) & communications	<p>Disruption of transport and communications networks due to:</p> <ul style="list-style-type: none"> heat and subsidence damage to road and railway infrastructure verge/embankment fires along roads and railways damage resulting from floods/storms damage and loss from coastal erosion and sea level rise 	<p>Address acute risks through regional emergency /contingency planning</p> <p>Strategic risk assessment</p> <p>Improved national standards for road and rail construction</p> <p>Transport plans to upgrade or relocate key transport infrastructure away from areas at risk</p> <p>Address through Coastal Zone Management Plans</p>	<p>Address acute risks through emergency / contingency planning</p> <p>Local risk assessment to identify high risk locations</p> <p>Management of the vegetation/ trees on embankments and verges to reduce risks of fires, and wind throw of trees</p> <p>Implementation of long-term infrastructure improvements</p>	Incorporate in Community Risk Register and build into neighbourhood programmes to develop community resilience
	Discomfort on public transport services caused by heat waves	Investment by transport providers in vehicles and rolling stock with air conditioning, and design of transport interchanges with shade and cool spaces.	Training of public transport staff to increase awareness of the need to ensure the comfort of passengers	
	Reduction in delays, disruption and accidents due to warmer winters with less ice and snow		Address through resourcing of transport services	
	Greater demand for walking and cycling due to warmer, drier summers	Promote walking and cycling through national policies on transport and health	<p>Increase budgets for walking and cycling provision.</p> <p>Construct more cycle/footpaths</p>	
ADAPTIVE CAPACITY OF VULNERABLE GROUPS				
Capacity to support vulnerable groups	Lack of understanding of / expertise in how to increase the adaptive capacity of vulnerable groups	<p>Ensure social impacts are addressed in key policies, strategies and regulatory decision-making</p> <p>Commission social science research and</p>	Replication of schemes using community champions and activists such as 'Village Agents' operating in Gloucestershire to work with vulnerable groups	Utilise experience gained through the Transition Towns movement

¹⁸ E.g. The work of the NICVA's work on climate change and social justice issues with NGOs

¹⁹ E.g. The Health Protection Agency now has a dedicated climate change team

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
		<p>utilise centres of expertise on sustainable behaviour</p> <p>Utilise environmental inequalities mapping being undertaken by the Environment Agency and others</p> <p>Utilise recommendations coming from bodies such as the Roundtable on Climate Change and Poverty</p> <p>Utilise national umbrella bodies for community and voluntary organisations to motivate local action in support of vulnerable groups¹⁸</p> <p>Create dedicated climate change posts in key agencies¹⁹</p>	<p>Utilise resources such WAG's Community Action Pack</p> <p>Utilise the experience and practical tools being developed through NGO projects²⁰</p>	
	Policy response to climate change ignores the needs/potential contribution of vulnerable groups	<p>Ensure key policies on adaptation to climate change address social impacts and the needs/potential contribution of vulnerable groups.</p> <p>Regional and National Climate Change Impacts Partnerships should seek to influence policy makers to ensure recognition of the needs/potential contribution of vulnerable groups.</p>	<p>Ensure Local Strategic Partnerships, Community Planning Partnerships and Community Strategy Partnerships address social impacts of climate change and the needs/potential contribution of vulnerable groups²¹</p> <p>Utilise Local Authority Performance Frameworks²² to drive action to support and engage with vulnerable groups</p>	
Social inclusion/ cohesion	Increased sense of isolation during heat waves		Multi-agency approach to support for vulnerable individuals linking to community networks	Use community networks to identify vulnerable individuals and to provide support
	Dislocation from family and community through evacuation during flood or storm events		Multi-agency approach to support for evacuated households linking to community networks	Involve community networks in support for evacuated households
	Potential for increased sense of community in face of common risks			Ensure local authority support and resources for community initiatives in the face of common risks
Participation in climate change	Vulnerable groups may be excluded, or less able to	<i>Policies to require the involvement of vulnerable groups in decision making on</i>	<i>Seeking advice from those working with or representing vulnerable groups about</i>	Support services provided by NGOs to build local adaptive capacity and ability

²⁰ E.g. NEF tools to develop community resilience and project undertaken by the Stockholm Environmental Institute with the over 50's

²¹ This might include learning from the risk-based community planning approaches now been implemented in Wales

²² In Scotland this might mean utilising the social justice aspects of the Single Outcome Agreement between Scottish Gov. and COSLA

SOCIAL IMPACT	SPECIFIC RISK / OPPORTUNITY	NATIONAL/REGIONAL	LOCAL	COMMUNITY
adaptation strategies	participate in decision-making affecting the development of adaptation strategies and measures	adaptation strategies Development of Community Engagement Strategies	the most effective ways of involving them in decision making on adaptation strategies e.g. mental health workers, youth workers Use existing services such as Sure Start to engage with vulnerable groups	of vulnerable groups to participate in decision-making ²³ Employ vulnerable groups to monitor conditions in exposed locations and to participate in decision making on adaptation strategies e.g. traveller communities participating in Community Resilience Forums

There are three types of measures:

- **Policy** (including strategic risk assessment/evaluation/research and using these to set out high level aims/ objectives/ desired outcomes within policies, costing and budgets for implementation of policy, production of strategic guidance for managers);
- **Management and operations** (including risk assessment, social /health impact assessment and from these devising strategies, local management plans, business and service plans, costings/budgets for implementation of measures, communications/information to communities, monitoring and reporting) and physical measures (enhancements to infrastructure and services);
- **Building social capacity** (including awareness raising/education focussed on vulnerable groups, improving social cohesion/communication, availability of funding and resources to communities).

Below we have provided a few examples of the ways in which they are already being used in the UK to consider the social impacts of climate change and build the resilience of those who are most vulnerable to them. More detail and examples of existing action are contained in the *Workshop Report Annex* and *Literature Review*.

²³ E.g. Services provided by Climate Outreach Information Network (COIN)

4.2 Policy

- (i) **International climate change policy**, such as the IPCC's AR4 report and the European Commission's Green Paper on *Adapting to climate change in Europe*, provide the framework for, addressing social vulnerability to climate change;
- (ii) **National policy** such as the UK Adaptation Programme, the Climate Change Bill and devolved administrations' respective adaptation strategies provide opportunities for considering the social impacts of climate change;
- (iii) **Strategies** for heat waves, flooding and storm damage, as well as social policy (relating to health, employment, crime, tourism or the natural environment etc) should all consider how they can reduce the impacts of climate change on the most vulnerable in society and how action can build communities' capacity to adapt.
- (iv) **Policy appraisal tools**, such as Impact Assessment, Sustainability Appraisal, Strategic Environmental Assessment, Health Impact Assessment, Equality Impact Assessment and Social Appraisal, all, to varying degrees enable the social impacts of climate change to be considered within decision-making;
- (v) **Research** is needed to inform such policy, particularly in relation to the impacts of climate change on crime, employment and education; migration to the UK; the impacts of high winds or storms; and suitable action by business and the voluntary sector;
- (vi) **Surveillance and monitoring** of changes in weather, as well as subsequent impacts on vulnerable people should continue to play an important role, and involve local communities, to help build their understanding of the risks and opportunities that they face;

4.3 Management

- (vii) **Risk assessment** is essential for identifying the social risks of climate change at all levels: nationally (e.g. the UK Climate Change Risk Assessment), regionally (e.g. Strategic Risk Assessment), locally (e.g. by local authorities, statutory bodies, local/community resilience fora and businesses, particularly Small and Medium Sized Enterprises);
- (viii) **Planning** plays a key role in managing the social impacts of climate change, within the context of sustainable development. Planning policy statements such as PPS1 in England, flood risk guidance (PPS25, PPS15, PPS7 and TAN15) and local plans are critical to managing these risks at a local level;
- (ix) **Prioritisation** of adaptation responses and resources will be necessary to take a proportionate approach to managing the social risks and opportunities of climate change, for example in determining funding for flood and coastal erosion management measures;
- (x) **Physical measures**, such as health resources, utilities, infrastructure, development and flood management will also need to consider the social impacts of climate change and help build the resilience of vulnerable people, for example, through changing the type or location of development, or introducing new services targeted at vulnerable people. It will also be important that adaptation measures, such as new

flood defences or cooling and ventilation do not (un) intentionally increase greenhouse gas emissions, and support climate change mitigation and sustainable development;

4.4 Building social resilience and adaptive capacity

- (xi) **Community-centred adaptation** is critical to build resilience amongst vulnerable people, and their capacity to adapt and 'bounce back' after an extreme weather event, through, for example, information, communication, skills development, infrastructure and support, as well as wider community health and social network-building;
- (xii) **Communication** of the risks of climate change is one such step, and requires targeted approaches for vulnerable groups, such as the techniques advocated by Futerra (2008) and employed by the Village Agents Project in Gloucestershire and the 'Everybody's Talking About Climate Change' campaign in Derbyshire and Nottinghamshire (see *Workshop Report* and *Case Studies*).
- (xiii) **Empowerment** of communities, through local participatory approaches (such as those used in the fields of community development and regeneration, and through the Transition Towns movement) is essential to building resilience amongst vulnerable communities, and ensuring that top-down government-led adaptation responses met their needs.

5. CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE ACTION

5.1 Conclusions

The climate is changing and is expected to result in warmer temperatures, with hotter, drier summers, milder and wetter winters, more extreme weather events, such as heat waves and rising sea levels. Different parts of the four countries of the UK are likely to be affected differently. More detailed UK Climate Projections will provide smaller-scale data projections and insight into localised climatic conditions.

Changes in the weather and more extreme conditions, such as heat waves, heavy rainfall and flooding and storms will have significant social impacts on UK society. In particular, climate change will affect physical, as well as mental health and wider quality of life. It will also affect people's access to, and quality of, basic goods and services, such as water, shelter and food, as well as other key priorities for human wellbeing, such as education, employment and crime, thereby worsening social deprivation.

The people who are likely to be most vulnerable to the impacts of climate change are those:

- living in places at risk;
- people who are already deprived by the health, level of income, the quality of their homes and mobility; as well as
- people who lack awareness of the risks of climate change, the capacity to adapt and who are less well supported by family, friends and agencies.

Deprivation often increases vulnerability to climate change, and climate change increases deprivation.

Action is needed at all levels: international, national, within devolved administrations and within regions; at a local level by councils and local agencies; but also at a community level, through voluntary and community groups, and with individuals.

There are two distinct ways to consider the differential social impacts of climate change – existing climate change adaptation measures should be tailored to the needs of vulnerable people; and work building the capacity of vulnerable people should consider the impacts of climate change.

This final project report identifies three types of strategic adaptation responses: (i) policy, (ii) management and operational, and (iii) community-led adaptation. It concludes that action is needed at 3 levels within the UK: nationally and regionally (e.g. by government, agencies, regional bodies etc.), locally (including by local authorities), and, most importantly, by and with communities. The *Social Vulnerability to Climate Change Adaptation Framework* sets out the adaptation measures that might be adopted to address specific social impacts of climate change, such as the impacts on health, crime or access to water and the natural environment, with a focus on vulnerable people.

The report finds that climate change adaptation policy within the UK recognises the social justice implications of climate change but offers little in terms of action. There is a myriad of mechanisms and tools which can be used to examine the differential social impacts of climate change within policy and practice. Sector-specific plans, such as in the health sector, are starting to consider these issues but more work is needed to ensure that adaptation responses involve, engage, empower and ultimately build the adaptive capacity of vulnerable people.

The research finds that at a policy level, climate change adaptation policy within the UK recognises the social justice implications of climate change but offers little in terms of action. There is a myriad of mechanisms and tools which can ensure that the differential social impacts of climate change are considered within policy and practice. Sector-specific plans, such as in the health sector are starting to consider these issues, but more work is needed to ensure that adaptation responses involve, engage, empower and ultimately build the adaptive capacity of vulnerable people.

5.2 Principles for addressing differential social impacts of climate change

On reflection, there are a number of principles that can be applied to ensure that climate change adaptation measures and wider decision-making, policy and action considers, and addresses the differential social impacts of climate change. In line with the three principles for the UK Government's Adaptation Programme, we propose that these are:

- (i) **Sustainable** – action should promote sustainable development by ensuring that 'adaptation measures do not disproportionately affect any particular group. Social vulnerability adaptation measures must also be integrated with climate change mitigation and therefore not contribute to greenhouse gas emissions.
- (ii) **Proportionate and integrated** – action should relate to the level of risk and should be focused at a local and community level, rather than nationally. Consideration of the differential social impacts of climate change should become 'business as usual' and integrated into all policy, management decisions, community engagement work, and physical improvements.
- (iii) **Collaborative and open** – actors should seek to work in partnership and work with vulnerable communities, being open and enabling local decision-making about adaptation measures.

5.3 Recommendations for future action

This project aimed to identify the adaptation measures that will need to consider the differential social impacts of climate change. Section 4 outlines the ways in which existing adaptation responses can consider differential social impacts, and how existing ways of working with vulnerable people (e.g. from community development and regeneration) can be applied to build their climate change adaptive capacity. In mapping existing action with stakeholders (identified through research and the workshop) and cross-referencing it with the *Social Vulnerability to Climate Change Adaptation Framework* (presented in figure 6), we have identified a number of gaps and areas for future action.

In particular, we recommend that:

- (i) The UK Adaptation Programme should provide greater emphasis on, and support for, community-led adaptation. This could be strengthened by:
 - using the experience of community engagement techniques from the regeneration and health sectors to improve community resilience;
 - integrating community engagement into all planning and decision-making processes relating to climate change (e.g. flood risk management);
 - supporting the climate change work of non-governmental organisations, and community and voluntary sector organisations who work directly with vulnerable groups;

- testing community-led adaptation techniques through the development of adaptation strategies for the more contentious issues such as managed retreat and flood/coastal defences;
 - evaluating and improving the effectiveness of local and community resilience fora in involving vulnerable groups in adaptation as well as emergency planning and response to extreme weather events.
- (ii) Existing appraisal, risk assessment and management tools should be used to ensure that differential social impacts of climate change and the needs of vulnerable people are considered in decision-making. Government should monitor and promote their use, e.g. through the National Climate Change Risk Assessment and the review of Impact Assessment Toolkits; and build on the review of *Social justice in the context of flood and coastal erosion risk management* - extending it to other areas of policy and planning.
- (iii) Greater priority and investment should be given to improve the physical environments (such as housing, neighbourhoods and workplaces) of vulnerable people (e.g. the elderly, low-paid, outdoor workers working in tourism and agriculture) and ensure they are more resilient to climate change.
- (iv) Government, regulators and financial institutions should support SMEs in making their businesses more resilient to future climate change and associated economic and social changes, such as increases in fuel prices, and risks to their workforce.
- (v) The new Department for Energy and Climate Change (and partner departments within devolved administrations) should continue to support poverty reduction and build adaptive capacity within developing countries. In addition, greater attention should be given to building understanding of the potentially significant impacts of resulting inward migration into the UK, and affects on UK services, society and resources, such as food security.
- (vi) Government should improve the monitoring and reporting of social impacts of climate change at a local level. New UK Climate Projections and LCLIPs provide opportunities for involving vulnerable people in monitoring the impacts of climate change on their own lives, to help build adaptive capacity.
- (vii) Research providers should explore in more detail:
- the impacts of climate change on key social issues such as crime, employment, educational attainment and migration to the UK;
 - the impact of, and adaptation responses to, high winds and storms;
 - how climate change adaptation responses at a local level are, and can, build communities adaptive capacity;
 - how social policies in the UK indirectly (and directly) help build the resilience of individuals and communities;
 - regular monitoring and data collection of the social impacts of climate change and weather events on specific groups of vulnerable people, in particular, the cumulative impacts of multiple vulnerability factors and climate change 'hotspots' which may affect certain locations and people;
 - actions by non-public sector bodies, such as business and the voluntary and community sector; and
 - the effectiveness of policy and adaptation measures in protecting and improving the resilience of vulnerable people to the effects of climate change.

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ANNEX 1: UKCIP02 SCENARIOS FOR DEVOLVED ADMINISTRATIVE & ENGLISH REGIONS (2050S AND 2080S)

Climate variable		Scotland	Northern Ireland	Isle of Mann	North West	North East	Yorkshire and Humber
Source		Flooding (Werritty with Chatterton, 2004) and Watkiss <i>et al</i> , 2005	Darch <i>et al</i> (2007)	Fealey <i>et al</i> (2006)	Glynn (eds) (2005)	NE Assembly (2003)	WS Atkins (2002)
Temperature	Annual mean	2080s: +2.5 to 4	2050s: +0.5 to 2 2080s: +1 to 3.5	2080s: +2.4	2050s: +1 to 3 2080s: +1 to 5	2080s: +1.5 to 4	2050s: +1 to 2.3 2080s: +1.6 to 3.9
	Winter mean		2050s: +0.5 to 1.5 2080s: +1 to 2.5	2050s: +0.7 to 1.2 2080s: +1.1 to 2		2080s: +1 to 3	2050s: +1 to 1.8 2080s: +1.4 to 3
	Summer mean		2050s: +1 to 2.5 2080s: +1 to 3.5	2050s: +1.1 to 1.8 2080s: +1.6 to 3.1	2050s: +1 to 4 2080s: +2 to 6	2080s: +1.5 to 4.5	2050s: +1.5 to 2.9 2080s: +2.3 to 4.6
	Days >25C						2080s: Large increase
	Days <0C						2080s: Four fold decrease
	Growing season					2080s: +30-100 days	2080s: +45-100 days
Precipitation	Annual mean	2050s: 0 to -10%	2050s: Up to -10% 2080s: Up to -10%				2050s: -0% to 5% 2080s: -0% to 10%
	Winter mean	2080s: Up to +20 to 35% in south, east and north east, 20% west and north west (high emissions scenario)	2050s: Up to +15% 2080s: Up to +25%	2050s: +8.6 to 13.6% 2080s: +12.2 to 3.6%	2050s: +0-20% 2080s: +0-30%	2080s: +5% to 30%	2050s: +8% to 20% 2080s: +13% to 32%
	Summer mean	2080s: - 20-40% in	2050s: -10% to 30%	2050s: -24.4 to 15.5%	2050s: -10% to 30%		2050s: -13% to 32%

		north and - 40% in south (high emissions scenario)	2080s: -20% to 50%	2080s: -42.4 to 22%	2080s: -10 to 60%	2080s: -15% to 50%	2080s: -23% to 52%
	Snow	2080s: - 50%, with – 70-100% in east	2080s: -40% to 100%		2050s: -30% to 60% 2080s: -40% to 100%	2080s: -45% to 100%	
	Extremes	Precipitation intensity might increase in winter	More intense rainfall days in winter				2080s: Increase in winter extreme rainfall
Cloud cover		Slight decrease in summer over Scotland, except extreme north and north-west Slight increase in winter cloud in north west and north east, but not extreme north	Reduce in all seasons				2080s: -10% to 20%
Relative humidity			Reduction in summer				
Soil Moisture		2080s: - 10-40% in summer and autumn in all Scotland except Highlands Winter soil moisture will increase by 0-10%	2080s: -20%		2080s: -20% to 50% in summer		2080s: Large reduction in summer
Wind / Storms			No change				
Sea Level		2080s: +9-69 cm Storm surge heights will increase		2050s: +5.1-29.1 cm 2080s: +8-54 cm	2050s: +7-36 cm 2080s: +9-69 cm		2080s: Humber Estuary +6-82 cm

Climate variable		Wales	SW England	SE England	London	East of England	West Midlands	East Midlands
Source		NAW (2000)	Metcalf <i>et al</i> (2003)	Climate South East	LCIP (2002)	LUC (2003)	SWM (2004)	Waters (2004)
Temperature	Annual mean	2080s: +1.1 to 2.9	2050s: +1 to 2.5 2080s: +1.5 to 4.5	2080s: +1.2 to 3.4		2080s: +2 to 4.5	2050s: +1 to 2.5	2050s: +0.9 to 2.3 2080s: +1.1 to 3.2
	Winter mean		2050s: +1 to 2 2080s: +1.5 to 3.5		2050s: +1 to 2 2080s: up to +3.5			
	Summer mean		2050s: +1.5 to 3.5 2080s: +2 to 5.5		2050s: +1.5 to 3.5 2080s: up to +5	2080s: +2 to 5		
	Days >25C				Daily max of 33 occurring 10 days / summer			2050s: from 2 to 7
	Days <0C							50% reduction by 2050s
	Growing season					2080s: +45 to 100 days		
Precipitation	Annual mean	2080s: +2% to 9%				2080s: -0% to 10%	2050s: Less than +10%	2050s: +1% to 2% 2080s: +1% to 6%
	Winter mean	2080s: +7% to 24%	2050s: +5% to 15% 2080s: +10% to 30%	2080s: +6% to 22%	2050s: +10% to 20% 2080s: Up to +30%	2080s: +10% to 35%	2050s: +20%	2050s: +6%to13%
	Summer mean	2080s: -7% to 14%	2050s: -15% to 30% 2080s: -25% to 55%	2080s: -8% to 23%	2050s: -20% to 40% 2080s: Up to -50%	2080s: -20% to 60%	2050s: Up to -30%	2050s: -4%to18%

	Snow		2080s -70% to 90%		-50% to 100%			
	Extremes	2080s: More intense rainfall events	More frequent		2080s: Doubling of heavy winter rain	2080s: +0.25 to 1.25 days of intense winter rainfall	More frequent	
Cloud cover			Reduction in summer and autumn		2080s: -18%		2050s: -10% in summer	
Relative humidity			Specific humidity increases Relative humidity decrease in summer				2050s Relative humidity -2% to 8% in summer	
Soil Moisture			Decrease in summer		2080s: -50%	2080s: -10% to 50% in summer	2050s: -5% to 35% in summer	
Wind / Storms		2080s: More storms, +1-4% wind speeds	Winter depressions more frequent		2080s: Mean winter wind +10%	2080s: Mean winter wind +10%	2050s: Mean winter wind +4%	No trend
Sea Level		2080s: +18-79cm		English Channel 2080s: Mean +54 cm	Thames estuary 2080s: +26-86 cm	2080s: +22-82 cm		2050s: +22-83 cm

ANNEX 2: SOCIAL IMPACTS OF CLIMATE CHANGE FRAMEWORK

SOCIAL IMPACT	WARMER WEATHER - HEAT WAVES	INCREASE PRECIPITATION - FLOODING	HIGH WINDS - STORMS
Likelihood of future trends ²⁴	Virtually certain / very likely	Very likely	Likely
HEALTH AND WELLBEING			
Physical e.g. injury, deaths, chronic	<p>Increased heat related mortality and morbidity, particularly elderly due to heat waves²⁵</p> <p>Increased risks to public health from food poisoning, pests, legionella, vector-borne diseases, and respiratory problems due to warmer temperatures</p> <p>Increase in cases of skin cancer and cataracts due to increased UV exposure</p> <p>Increase in alcohol consumption due to warmer temperatures</p> <p>Pressure on health services due to inward migration of 'climate change refugees' from other countries</p> <p>Improved health due to physical activity in warm weather</p> <p>Reduced cold related mortality and morbidity due to decline in frequency of very cold days</p>	<p>Increased injuries and deaths due to flooding / high winds/ storms</p> <p>Increase in infectious diseases and illness such as skin, stomach and respiratory complaints due to the aftermath of flooding and living in damp conditions</p> <p>Reduced access to health care due to disruption from floods and storms</p> <p>Chemical exposure due to damage to pipelines and storage from floods and storms</p> <p>Pressure on health services due to inward migration of 'climate change refugees' from other countries</p>	<p>Increased injuries and deaths due to high winds/ storms</p> <p>Reduced access to health care due to disruption from storms</p> <p>Chemical exposure due to damage to pipelines and storage from storms</p> <p>Pressure on health services due to inward migration of 'climate change refugees' from other countries</p>
Mental health	<p>Anxiety, stress and other mental health problems due to heat/dehydration</p> <p>Pressure on mental health services due to inward migration of 'climate change refugees' from other countries</p>	<p>Anxiety, stress and other mental health problems due to flooding and aftermath</p> <p>Disruption to mental health care due to flooding</p> <p>Pressure on mental health services due to inward migration of 'climate change refugees' from other countries</p>	<p>Anxiety, stress and other mental health problems due to storms and aftermath</p> <p>Disruption to mental health care due to storms</p> <p>Pressure on mental health services due to inward migration of 'climate change refugees' from other countries</p>
Safety and crime	<p>Risk of fire from natural causes and arson in drought conditions</p> <p>Risk of social unrest, crime, violence, and excessive consumption of alcohol due to heat waves</p>	<p>Increased risk of social unrest and violence due to disputes over allocation of resources (e.g. water / housing) following flooding</p> <p>Potential for looting following floods and storms</p>	<p>Increased risk of social unrest and violence due to disputes over allocation of resources (e.g. water / housing) following storms</p> <p>Risk of damage to property and infrastructure and risk</p>

²⁴ Based on projects for 21st century using SRES scenarios. Source: IPCC, 2007.

²⁵ Red indicates risks/impacts, green indicates opportunities/benefits

	<p>Risk of intercommunal disputes and violence due to inward migration of people fleeing from climate change impacts in their home countries</p> <p>Increased risk of social unrest and violence due to disputes over allocation of resources (e.g. water / housing)</p>		<p>of injury due to high winds and storms</p> <p>Potential for looting following storms</p>
ACCESS TO, QUALITY AND CHOICE OF GOODS AND SERVICES			
Water	<p>Increased water stress due to reduced rainfall in summer / increasing frequency of droughts and increased demand from new development</p> <p>Threat to access to potable water due to potential for groundwater contamination, reduced efficiency of treatment, dissolved oxygen depletion and algal blooms in rivers and reservoirs due to hot weather</p> <p>Employment and business opportunities in civil engineering and water conservation / efficiency</p>	<p>Threat to access to potable water due to saline intrusion of freshwater aquifers due to sea level rise</p> <p>Threat to access to potable water from contamination of water supplies and disruption of treatment works and supply infrastructure due to flooding and heavy rainfall</p> <p>Risk of sewer overflows as a result of flooding and heavy rainfall</p>	
Food	<p>Reduced availability and increased cost of vegetables and fruit (from UK and abroad) due to water stress, pests and diseases, soil erosion</p> <p>Reduced availability and increased cost of animal/dairy products (in UK and abroad) due to impacts on animal health and increased livestock deaths due to extreme heat, pests and diseases</p> <p>Reduced availability and increased cost of fish/shell fish due to adverse impacts on fisheries (in UK waters and abroad) such as decline in water quality due to reduced water flows in droughts</p> <p>Increased incidence of food poisoning due to heat waves</p> <p>Increased availability of locally grown food crops because of longer growing season and introduction of new crops due to warmer climate.</p>	<p>Reduced availability and increased cost of vegetables and fruit (from UK and abroad) due to soil erosion, waterlogging of soil</p> <p>Reduced availability and increased cost of animal/dairy products (in UK and abroad) due to impacts on animal health and increased livestock deaths due to wet weather and flooding, pests and diseases</p> <p>Reduced availability and increased cost of fish/shell fish due to adverse impacts on fisheries (in UK waters and abroad) such as decline in water quality due to contaminate run-off in heavy rainfall/floods and rising sea temperatures</p> <p>Increased incidence of contamination of food during flooding</p>	<p>Reduced availability and increased cost of vegetables and fruit (from UK and abroad) due to soil erosion, storm damage</p> <p>Reduced availability and increased cost of fish/shell fish due to adverse impacts on fisheries (in UK waters and abroad) of storm damage to fleet</p>
Housing	<p>Discomfort in poorly adapted buildings during very hot weather</p> <p>Damage and loss of buildings and contents due to subsidence in very hot weather</p> <p>Pressure on housing due to inward migration of 'climate change refugees' from other countries</p>	<p>Damage and loss of buildings and contents due to flooding, coastal erosion / sea level rise</p> <p>Pressure on housing due to inward migration of 'climate change refugees' from other countries</p> <p>Employment and business opportunities in sustainable construction and design</p>	<p>Damage and loss of buildings and contents due to high winds and storms</p> <p>Pressure on housing due to inward migration of 'climate change refugees' from other countries</p> <p>Employment and business opportunities in sustainable construction and design</p>

	Employment and business opportunities in sustainable construction and design		
Energy	<p>Disruption to electricity supplies due to increased cooling demands in very hot weather and damage to power stations, transmission/ distribution system during extreme heat</p> <p>Employment and business opportunities in improving infrastructure, developing decentralised energy supply and energy efficiency, particularly solar energy</p>	<p>Disruption to electricity supplies damage to power stations, transmission/ distribution system during flooding</p> <p>Employment and business opportunities in improving infrastructure, developing decentralised energy supply and energy efficiency, particularly tidal power</p>	<p>Disruption to electricity supplies damage to power stations, transmission/ distribution system during storms</p> <p>Employment and business opportunities in improving infrastructure, developing decentralised energy supply and energy efficiency, particularly wind energy</p>
Education/training/jobs	<p>Opportunities for education, skills and jobs relating to climate changes e.g. decentralised energy supply, sustainable construction to improve resilience of building, civil engineering of flood defences</p> <p>Opportunities for raising awareness of climate change through direct experience of heat waves</p> <p>Loss of jobs amongst disadvantaged groups in agriculture and tourism due to business failure following extreme weather events</p> <p>Loss of concentration amongst children and students in education due to heat stress</p> <p>Pressure on education services due to inward migration of 'climate change refugees' from other countries</p>	<p>Opportunities for education, skills and jobs relating to climate changes e.g. decentralised energy supply, sustainable construction to improve resilience of building, civil engineering of flood defences</p> <p>Opportunities for raising awareness of climate change through direct experience of floods</p> <p>Loss of jobs amongst disadvantaged groups in agriculture and tourism due to business failure following extreme weather events / flooding</p> <p>Loss of pupil/teaching days due to flood damage to educational buildings</p> <p>Pressure on education services due to inward migration of 'climate change refugees' from other countries</p>	<p>Opportunities for education, skills and jobs relating to climate changes e.g. decentralised energy supply, sustainable construction to improve resilience of building, civil engineering of flood defences</p> <p>Opportunities for raising awareness of climate change through direct experience of storms</p> <p>Loss of jobs amongst disadvantaged groups in agriculture and tourism due to business failure following extreme weather events /storms</p> <p>Loss of pupil/teaching days due to storm damage to educational buildings</p> <p>Pressure on education services due to inward migration of 'climate change refugees' from other countries</p>
Leisure/recreation/culture	<p>Increase in outdoor recreation and water based activities due to warmer weather</p> <p>Opportunities for tourism and leisure industry due to warmer weather lengthening of the season</p> <p>Loss of utility of ecosystems for tourism due to drier weather</p> <p>Loss of tourism based on winter sports relying on snow cover</p> <p>Reduced access to water recreational opportunities due reduced water quality caused by heat</p>	<p>Disruption to sports events and recreational activities due to flooding</p> <p>Reduced access to leisure, cultural facilities and historic buildings and sites due to short-term flood damage and long-term loss to coastal erosion and sea level rise</p>	<p>Disruption to sports events and recreational activities due to storms</p> <p>Reduced access to leisure, cultural facilities and historic buildings and sites due to short-term storm damage and long-term loss to coastal erosion and sea level rise</p>
Landscapes / nature	<p>Reduced access to ecosystems, biodiversity, historic and cultural landscapes, green spaces and gardens due to damage and loss due to heat stress</p> <p>Opportunities for increasing green spaces in urban</p>	<p>Reduced access to ecosystems, biodiversity, historic and cultural landscapes, green spaces and gardens due to damage and loss due to flooding, coastal erosion/ sea level rise</p>	<p>Reduced access to ecosystems, biodiversity, historic and cultural landscapes, green spaces and gardens due to damage and loss due to storms, coastal erosion/ sea level rise</p>

	areas	Improved access to new wetland habitats created through flood management and managed retreat in coastal zones	
Transport (mobility) & communications	<p>Disruption of transport and communications networks due to heat and subsidence damage to road and railway infrastructure and verge/ embankment fires along roads and railways</p> <p>Discomfort on public transport services caused by heat waves</p> <p>Reduction in delays, disruption and accidents due to warmer winters with less ice and snow</p> <p>Greater demand for walking and cycling due to warmer, drier summers</p>	Disruption of transport and communications networks due to damage resulting from floods and damage and loss from coastal erosion and sea level rise	Disruption of transport and communications networks due to damage resulting from storms and damage and loss from coastal erosion and sea level rise
ADAPTIVE CAPACITY OF VULNERABLE GROUPS			
Social inclusion/ cohesion	Increased sense of isolation of during heat waves	<p>Dislocation from family and community through evacuation during flood event</p> <p>Potential increase in sense of community in face of common risks</p> <p>Potential community conflict over resources and relief efforts.</p>	Dislocation from family and community through evacuation following storm damage
Participation in climate change adaptation measures	Vulnerable groups may be excluded, or less able to participate in decision-making affecting the location and management of development and services	Vulnerable groups may be excluded, or less able to participate in decision-making affecting the location of development and flood risk management	Vulnerable groups may be excluded, or less able to participate in decision-making affecting the location and management of development and services

ANNEX 4: ACKNOWLEDGEMENTS

CAG Consultants wish to thank all those people who helped with the research for this project:

The steering group

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 Nuala Gormley, Scottish Government
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 Angela Mawle, UK Public Health Association
 Michael McCallion, Northern Ireland Department of Environment
 Nigel McMahon, Department of Health, Social Services & Public Safety
 Craig Mitchell, Welsh Local Government Association
 George Morris, Public Health, Scottish Government
 Noel Nelson, Royal Commission on Environmental Pollution
 Priscilla Netto, Welsh Assembly Government
 Susan Roaf, Heriot Watt University
 Gulab Singh, Central Lancashire Primary Care Trust
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Fiona Mulholland, Northern Ireland Environment Agency
Laurie Newton, UK Climate Impacts Programme
Archie Prentice, Highlands and Islands Enterprise
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