Birmingham

Climate Change Adaptation Action Plan 2012+

Preparing Birmingham for Climate Change Impacts

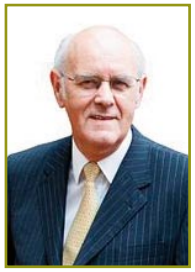
birmingham environmental partnership

Birmingham City Council

MAKING BIRMINGHAM GREEN

Contents

Foreword



Councillor Paul Tilsley –
Deputy Leader of the Council and Chairman of the Cabinet Committee on Climate Change and Sustainability

All of us can see that our weather is becoming more uncertain. And we are also living through one of the most challenging economic periods in modern times. It is therefore essential that developing a resilient and sustainable City will be one of the vital components in growing and strengthening our city's economy - but without losing sight of our environmental responsibilities.

This Action Plan highlights the challenges that Birmingham faces both now and in the future from climate change. Importantly, it also demonstrates the significant opportunities that are available as we adapt to these impacts, which will improve the quality of life for all who live, work and visit our great global city with a local heart.

As Chairman of the Climate Change and Sustainability Cabinet Committee, I am pleased to publish this Action Plan. It is our commitment to ensure Birmingham is preparing for climate change and I welcome your views on the Plan as we need to keep this under review.

Councillor Timothy Huxtable –
Cabinet Member for Transport, Environment and Regeneration
Chair of *Birmingham Environmental Partnership*

As the Chairman of Birmingham Environmental Partnership I am delighted that Birmingham is at the forefrnt of adapting cities to climate change. This is demonstrated by the innovative work which we have undertaken over the past three years through Birmingham Environmental Partnership.

A better and more informed understanding of the impacts from a changing climate will help us to plan the actions that are required and the Council is committed to ensuring that climate change adaptation and the opportunities it presents is at the heart of people's everyday lives.

This Action Plan will help Birmingham to sustain itself as a vibrant and thriving economic hub. I will ensure that adaptation and sustainability is at the heart of planning and regeneration, to make Birmingham a sustainable, resilient city that is prepared for the impacts of climate change. The Action Plan itself will be progressed through the work of the new Green Infrastructure and Adaptation Delivery Group.

Summary

Birmingham's Climate Change Adaptation Action Plan has been developed to help the City prepare for the impacts of climate change.

The Climate Change Adaptation Partnership, 2008-11, lead the way by developing an evidence base to understand the impacts of climate change that will inform practical decision-making.

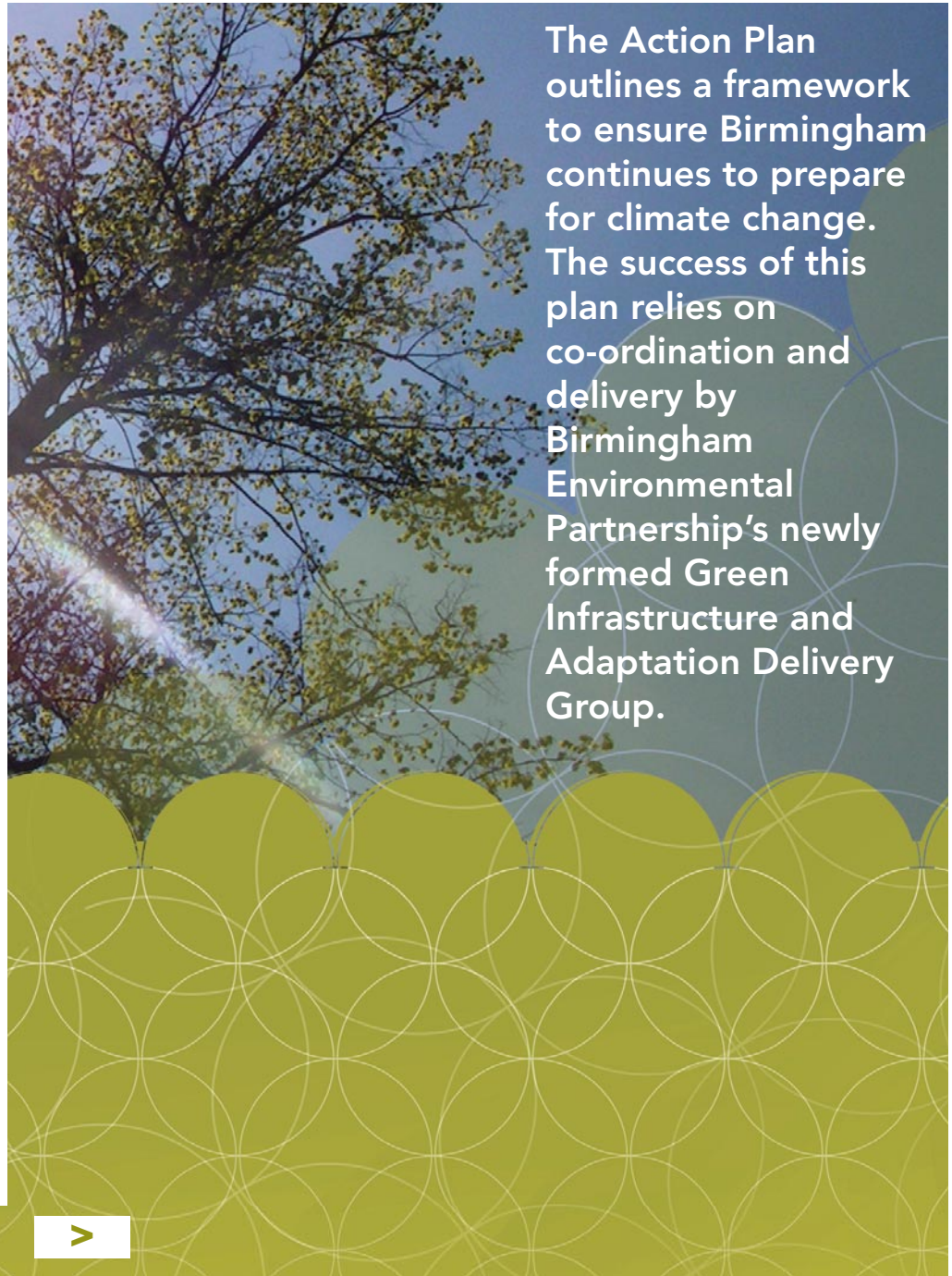
The heatwave of 2003, the floods in Selly Park in 2004, the Birmingham tornado in 2005 and the unusually cold weather during the winter of 2010-2011 remind us of our vulnerability to extreme weather.

Projections indicate that a changing climate will also bring more frequent and intense extreme weather events, including heatwaves, storms and gales, cold, ice and snow. Birmingham's significant urban heat island will further exacerbate the impact of heatwaves in the future. It is therefore essential that we better understand and plan for the future impacts of extreme weather and climate change.

This Action Plan shows how Birmingham has developed an evidence base which highlights the places and communities that are most at risk from climate change. The risk management approach will ensure that Birmingham is able to minimise risk, maximise opportunity and deliver socioeconomic and environmental sustainability.

The key messages from the Action Plan are:

1. IMPACTS: Climate change is happening now and the evidence of impacts on different parts of the city is developing rapidly.
2. EVIDENCE: We are in a position to start identifying priority areas vulnerable to different risks – and identifying the responses that need to be taken.
3. ACTION: By doing this we can ensure the necessary investments and actions are taken to account for future risk and we can target services so that those most at risk are targeted in the most efficient way.
4. OPPORTUNITY: Adapting to climate change presents many opportunities, such as ensuring business continuity, saving money, improving health and attracting new businesses and investment to the city.



The Action Plan outlines a framework to ensure Birmingham continues to prepare for climate change. The success of this plan relies on co-ordination and delivery by Birmingham Environmental Partnership's newly formed Green Infrastructure and Adaptation Delivery Group.

Vision

Birmingham understands, and has responded to, the risks and opportunities that climate change presents and continues to develop and evaluate its evidence base. Through strategic spatial planning and intervention, communities, businesses and the environment are more resilient to extreme weather events and future climate change impacts.

Climate change is one of the greatest challenges we all face. If it is not addressed it has been calculated that the costs to the world's economy will be greater than the cost of the 20th Century's world wars and the Great Depression combined. *(2006 Stern Review on the Economics of Climate Change)*

Birmingham is already making strong progress towards reducing its reliance on fossil fuels through mitigation. However, even if we were to completely end our carbon emissions today the climate would continue to change for about 30 years, thanks to our historic emissions and a lag in the climate system.

The earth's climate is changing so that there will be more frequent and intense extreme weather events than we have been used to in the past. Current extreme weather will no longer be exceptional but will become the norm and Birmingham needs to be aware of this and prepared to adapt to new circumstances.

Birmingham Climate Change Adaptation Partnership

From 2008-11, Birmingham's Climate Change Adaptation Partnership, made up of public private and third sector organisations lead the way by developing an evidence base to understand the impacts of climate change that will inform practical decision-making. This research looked at:

Flooding:	the risk of flooding, how this has increased in the recent past, the key locations for flooding and the projections for the future.
Temperature:	the differences in temperature across the city, known as the urban heat island effect, caused by development, transport and industry, the current extent and future projections
Air quality:	differences in air quality in different parts of the city

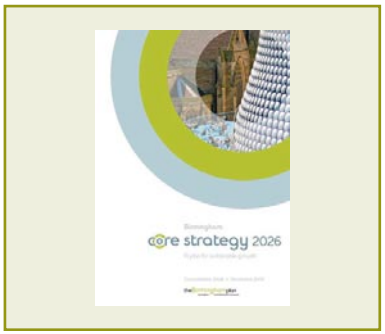
Climate change impacts will affect deprived communities disproportionately and disempower people who lack the awareness of risks and the capacity to adapt. The most vulnerable in society are often less well supported by family, friends and agencies and often do not realised themselves that they are vulnerable. To address this, research has looked at the distribution of vulnerable groups in Birmingham identify communities, businesses and infrastructure that are particularly vulnerable.

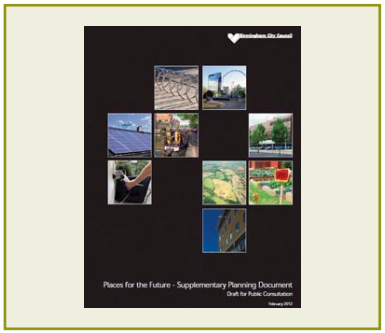
This approach is of vital importance in light of the *UK Climate Projections 09* which suggest that temperatures of the 2003 heat wave that caused over 30,000 excess deaths in North West Europe, England and Wales could be the norm by 2040. Similarly, the flood events of 2007 are expected to become more regular occurrences as our climate changes. Extreme weather events have significant implications which are exacerbated by the vulnerability of urban areas. In order to ensure that Birmingham is resilient, it is essential to adapt to the changing climate.

Climate change adaptation also provides us with many opportunities. The rapidly developing research on the impacts of climate change on critical infrastructure, our utilities and transport systems, for example, along with the investments being made in monitoring equipment to test models, could develop a unique selling point for business and commerce of being able to demonstrate proven resilient networks.

Birmingham's innovation in this field was recognised through the LARIA (Local Authorities Research and Intelligence Association) Award in 2010 for risk mapping research - a project between BCC and the *University of Birmingham* to understand the Urban Heat Island (UHI) effect and to identify vulnerable communities.

Adaptation policy has been included in the following key City Council documents;





The Birmingham Climate Change Adaptation Action Plan

The Birmingham Climate Change Adaptation Action Plan (CCAAP) outlines the recent developments on this agenda and provides an implementation framework to allow Birmingham to make the most of the opportunities whilst addressing the risks. Its production in 2011 was a commitment in the City's 2010 Climate Change Action Plan and is the responsibility of the Cabinet Committee for Climate Change.

The Action Plan will help to deliver the following outcomes from the Sustainable Community Strategy:

- Birmingham is the first sustainable global city in modern Britain. It is a great place to live, learn, work and visit
- Birmingham people are healthy and enjoy living together
- Birmingham is a safe, clean and friendly city tackling climate change and enhancing the local environment

The Action Plan focuses on the risks and opportunities within various functions that make up Birmingham including;

- Built and critical infrastructure
- Business and the economy
- Community
- Health and wellbeing

By outlining the strategic processes for developing and embedding evidence and taking action, it will improve services, increase resilience and reduce the economic impact. Adapting to climate change now will have a long-term direct economic benefit by ensuring business continuity, decreasing the resources required to help communities and businesses recover and creating jobs and business opportunities. By prioritising the approach the locations, businesses and communities most vulnerable, we can focus on those actions that will lead to the greatest benefits in the short, medium and the long term as well as those that will minimise the risks that we face.

The glossary in Appendix 2 defines the key terms and technical wording used throughout.

Climate Change Impacts in Birmingham – risks, opportunities and overarching strategic actions

The *UK climate projections (UKCP09)* anticipates that there will be:

- Periods of hotter weather and longer periods of hot weather
- An increase in winter rainfall and more intense rainfall
- Periods of colder weather and longer periods of cold weather
- An increase in average annual temperatures
- Changes in the timing of seasons

Weather is the day to day condition of the atmosphere, including temperature, rainfall and wind.

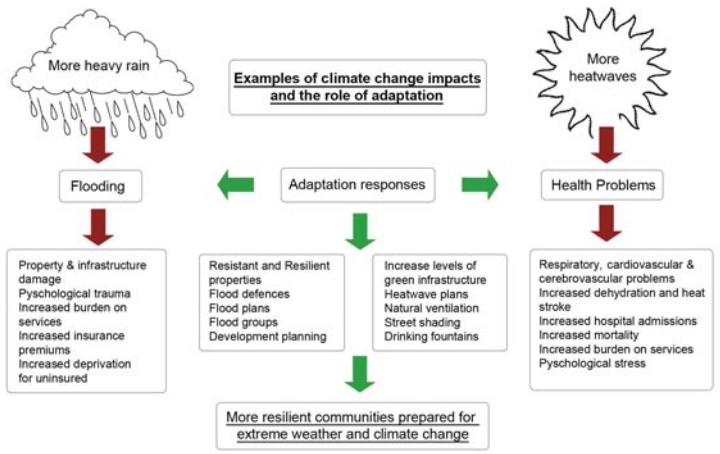
Climate is the average weather conditions of a place usually measured over one year, including temperature and rainfall

Figure 1: An illustration of extreme weather events, their consequences and possible impacts over time for the UK[1]

Source and a sample of consequences	Possible impacts	Potential likelihood		
		0-5 years	5-15 years	Over 15 years
Prolonged or heavy rain *Heavy Rainfall, Flooding, Land instability, Hail, Lightning,*	Property damage (households and business) Infrastructure damage (roads, rail, trees) Transport disruption Business trading losses Increased hospital admissions Long term mental health impacts Deprivation reinforced	Medium	High	High
Gales *Strong winds, Tornadoes, Wildfire*	Damage to buildings Injury Business disrupted Open spaces burnt Loss of biodiversity on heath lands and grasslands	Low	Low	Medium
Prolonged hot weather *Heat, Thunderstorms Drought Dust/Smog/ Haze, Land instability Wildfire, Poor water quality*	Increased mortality and sickness Building damage from soil shrinkage Water shortage Poor water quality damaging aquatic wildlife Air pollution leading to health problems	Low	Medium	High
Excessive cold with snow *Cold, Snow and ice*	Damage to property and infrastructure Increased mortality and injury Losses to business Problems getting to work Fuel poverty	Low	Medium	Medium
Global impacts *More vulnerable food supply chains, Additional migration/ refugees Spread of diseases*	Food shortages and price fluctuations Sudden influxes of refugees New human and animal disease epidemics	Low	Medium	Medium

[1] Derived from Keeping the Country Running: Natural Hazards and Infrastructure – consultation guidance, Cabinet Office 2011 and Adapting Energy, Transport and Water Infrastructure to the Long-term Impacts of Climate Change, 2010 Ref. No RMP/5456 cross-departmental Infrastructure and Adaptation project, URS

Figure 2. Examples of climate change impacts and the role of adaptation



More specific details of the climate for Birmingham and projections for the future are outlined in the *Birmingham Climate Portfolio.*

Flooding

The risk of flooding is increasing and it is anticipated that more people in Birmingham will become at risk as floods occur more frequently and with greater intensity.

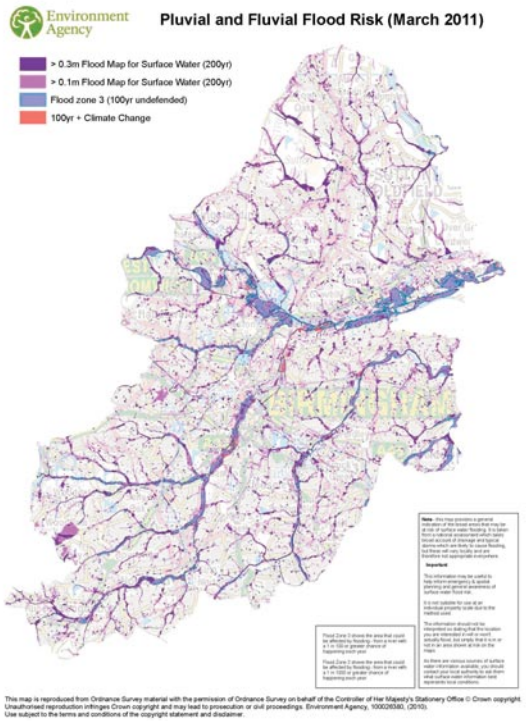
The widespread summer flooding in 2007 affected 55,000 homes in England, killed 13 people and cost the economy £3.2 billion. The *Environment Agency* calculates that the flooding events are likely to be more frequent and intense, with some areas currently free from flooding, at risk in the future. The significance of this risk is reflected in BCC's *Flood Risk Management and Response Scrutiny report 2010,* which highlights actions required to secure resilience.

Flooding results in a whole series of social and economic impacts:

- People suffer shock and grief that can last many months
- Homes and businesses are damaged and it can take months or years to return to normal
- Individuals and communities struggle to engage with the large number of organisations (commercial and public sector) involved, who in turn may be defensive and difficult to engage with positively and creatively
- Agencies and organisations will be concerned to deal with their particular issues, often in isolation from each other and the communities affected

Flooding is caused by any or a combination of rising river water levels, surface water run-off, sewer overflow from flash storms and rising groundwater levels. The *Environment Agency* have produced Flood Zone maps for all of Birmingham and maps are in preparation that show areas at risk of flooding in the future due to climate change. Intermediate Level Strategic Flood Risk Assessments are almost complete and will lead to Surface Water Management Plans. These will identify where we need to focus attention on mitigating actions to reduce the level of risk.

Figure 3. Fluvial and Pluvial Flood Risk map of Birmingham – March 2011



Case Study: Selly Park Flood

On 6th September 2008 heavy rainfall caused flash floods in parts of the West Midlands. During this event it is estimated that 70 properties were flooded in Selly Park South. Over one year later, a group of flooded Selly Park residents were interviewed to find out about the effects, the flood had on their lives. The flood waters entered the resident's houses and ruined many of the ground floor rooms, leading to the majority having to find alternative accommodation for up to six months following the event. Psychologically, the most reported problem was stress - caused by the loss of property and insurance claims, renovation work and displacement. On return to their residence many residents felt uncomfortable and overly cautious of periods of heavy rainfall. Time was taken off work for stress and still, 15 months later, the psychological effects were apparent.

The *Selly Park South Flood Action Group* have since been working with BCC to develop an Action Plan to minimise the impact of future flood events.

Heat

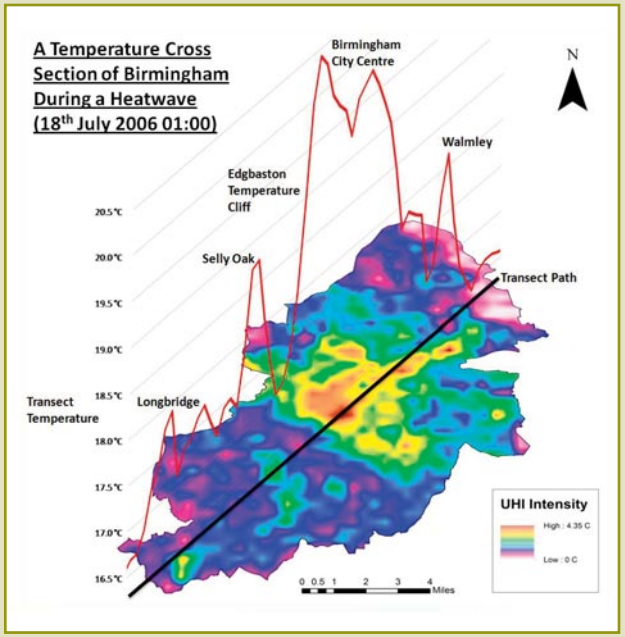
The 2003 European heat wave led to a health crises in several North West European countries with more than 40,000 people dying, including 2,139 excess deaths in England and Wales where temperatures reached 38°c. Climate projections show that more than half of Europe's summers could be this warm by 2040 and there could be an average of 3 heatwaves during July and 2 during August by 2080, leading to an increase in deaths, particularly for the elderly and vulnerable.

The increased mortality rate is largely because heatwaves exacerbate cardiovascular diseases, cerebrovascular diseases, respiratory diseases and heat stroke. The estimated increase in overall mortality during heatwaves is reported to be between 7.6 and 33.6 percent and most of the people affected are over the age of 75.

High temperatures also have a direct impact on road surfaces, railway networks, air conditioning and machinery, as well as creating uncomfortable conditions in houses, factories, offices and public areas. High temperatures are often associated with low water flows and a reduction in water quality in ponds and rivers. During these periods sudden rainfall can flush heavy metals and sooty deposits from roads and sewage from misconnected drains into streams and rivers, killing off fish and other wildlife.

The 2080 projections of a possible 5.2°c temperature rise in the summer daily maximum temperature are further complicated by the impact of the urban heat island (UHI). The UK projections are based upon Birmingham having an agricultural landscape and therefore underestimate the temperature fluctuations caused by the UHI.

Case Study: BUCCANEER



The UHI is caused by the impact of building materials, reduced sky view, additional heat from buildings, people and transport , increased pollution levels and lack of green vegetation, effectively creating a city centre climate all of its own. The BUCCANEER (Birmingham Urban Climate Change and Neighbourhood Estimates of Environmental Risk) Project, a partnership between University of Birmingham, BCC and Birmingham Health and Wellbeing Partnership, has modelled temperature variations across the city, demonstrating additional increases of up to 4°C in summer in the city centre and other areas, over and above existing UKCP09 projections. This will have significant implications for people's comfort and health in the city centre as well as the built and critical infrastructure.

www.birminghamclimate.com

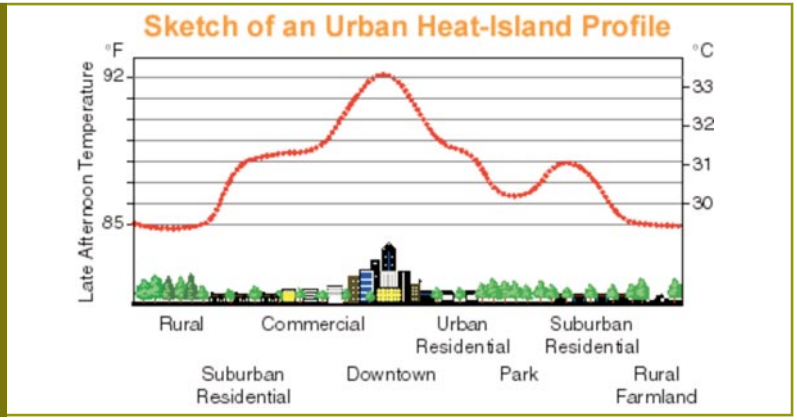


Figure 4. The impact of the built environment on temperatures in the urban heat island

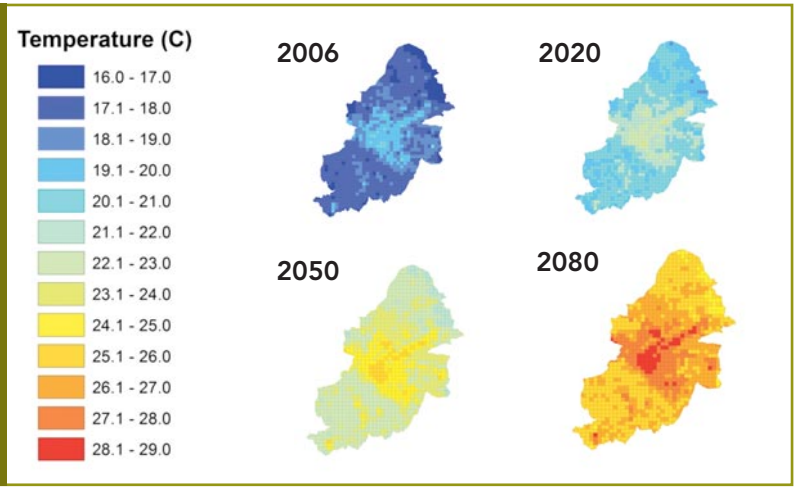


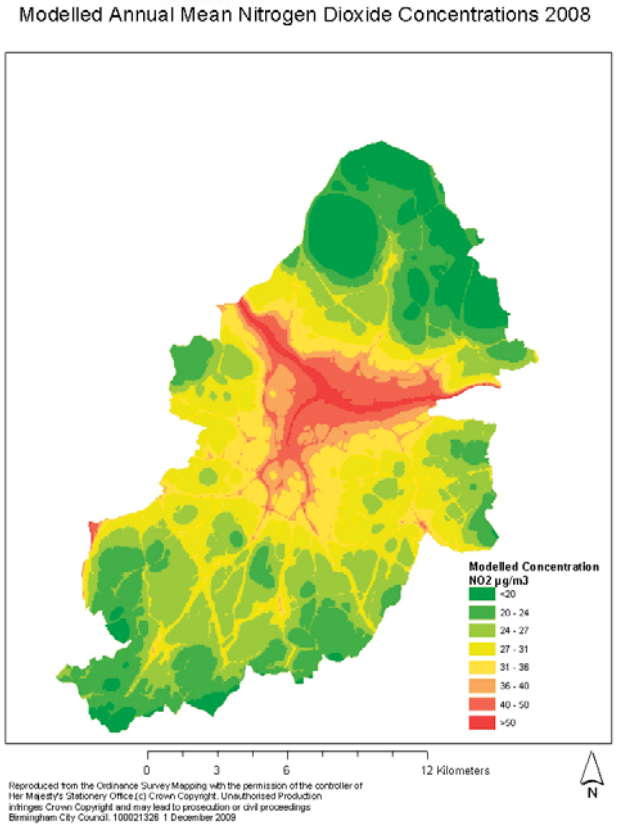
Figure 5. Birmingham's 3am urban heat island with climate change projections

The urban heat island from the 2006 heatwave represents the baseline above. A high emissions scenario has been used to highlight the extent to which Birmingham's climate will change in the future, and how the urban heat island exacerbates that change. The risk of serious impacts to Birmingham from heat is often perceived as a long-term issue, but as many of the investments require long term planning, delivering them now makes practical and financial sense.

Air Quality

Many of the pollutants that have the greatest effect on air quality, such as nitrogen dioxide and particulates are emitted by transport, particularly heavy vehicles and buses. Poor air quality impacts on health by leading to respiratory problems. Modelling shows that hotter summers in the future will exacerbate the issue and will have an impact on people's health.

Figure 6. Annual mean nitrogen dioxide concentrations 2008



Emissions are concentrated in certain neighbourhoods, the city centre and around major transport routes, as the map for nitrogen dioxide emissions below shows. Poor air quality can lead to significant adverse health effects, particularly in those sections of the population that are more susceptible such as the young, the elderly, or those suffering from heart or lung related disease. The societal cost of the health impacts of poor air quality in Birmingham is in the region of £182 million a year (House of Commons, 2010).

Birmingham declared the whole city as an Air Quality Management Area in respect of Nitrogen Dioxide and Particulate matter since 2004. *The Air Quality Action Plan 2011* highlights the detailed assessment of air quality with a package of short, medium and long term actions to tackle air pollution. It also highlights the synergies between air quality and climate change, mainly in terms of the role actions from each discipline will have on the other.

Extreme weather events

Birmingham's Local Climate Impacts Profile systematically recorded weather related incidents such as the tornado in 2005, flooding, droughts, heatwaves and cold events. In addition, *Birmingham Resilience Team* and the *West Midlands Fire Service* record their actions in response to emergencies and liaise with partner agencies. Together, these provide evidence of when and where weather related events occur across the city.

Extreme weather events are projected to increase in frequency and severity. The severe cold spell of winter 2010/11 was estimated to cost the UK economy up to £1.2 billion a day in the run up to Christmas with a total cost of £13 billion. Retailers were particularly badly hit by lost sales with footfall down as much as 30% in the West Midlands.

Case Study: Birmingham Tornado

Balsall Heath is an inner city neighbourhood in Sparkbrook, Birmingham with 16,000 inhabitants. Located two miles south of Birmingham city centre, Balsall Heath is affected by the UHI. In 2005, it was devastated by a 130mph tornado that swept through the neighbourhood, causing damage to 400 properties, injuring 19 people, causing approximately £50 million worth of damage which took 12 months to reconstruct. The conditions can be seen in part to be caused by the UHI effect. The Adaptation Partnership planted 150 trees to replace those damaged during the tornado in order to increase the tree cover and shading as well as reduce the chance of such high temperatures in future.

Critical Infrastructure and cascade failure

Increasingly, cities rely on critical infrastructure networks to function properly, such as telecommunications, water supply and drainage, road and rail, gas and electricity. These are all dependent upon energy (mostly electricity) to operate, and therefore failures in one part of one system can impact on other systems elsewhere, known as "cascade failures". All of these systems can be affected by extreme weather impacts.

Infrastructure UK estimates that an average of £40-50 billion will need to be spent every year between now and 2030. As a substantial proportion of new infrastructure will be in use long after 2030, the risks from climate change should be factored in to the design and location so that adaptation measures are incorporated where necessary to help ensure infrastructure resilience. The report *"Climate Resilient Infrastructure"* has been produced as a commitment from the Government's National Infrastructure Plan.

The ability to demonstrate resilient energy and transport systems could be attractive to businesses that particularly value or rely on continuity. It could also have significant economic advantage to the city. However achieving this will require decisions to address infrastructure pinch points and thresholds by many organisations, some of whom may have priorities elsewhere.

Case Study: Improving Infrastructure Resilience to Urban Heat

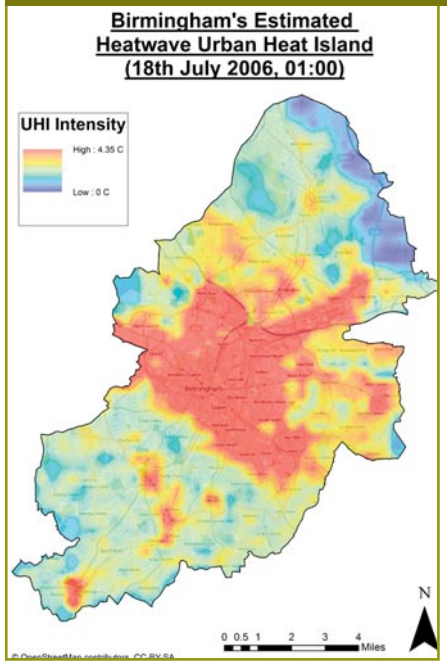
A substantial research programme is underway at University of Birmingham through the *Birmingham Urban Climate Lab* to model the impact of urban heat on critical infrastructure networks across the city. Working with local electricity supplier, Western Power Distribution, this work uses the results of the BUCCANEER project to identify the future resilience of the electricity distribution network across the city. The results will be verified by over 250 temperature sensors to be strategically located across the conurbation by 2013. This sensor network will also be used in due course to investigate the resilience of the transport and energy network to urban heat. Ultimately, this research and the associated sensor network will transform Birmingham into a world class exemplar for urban climate and resilience research.

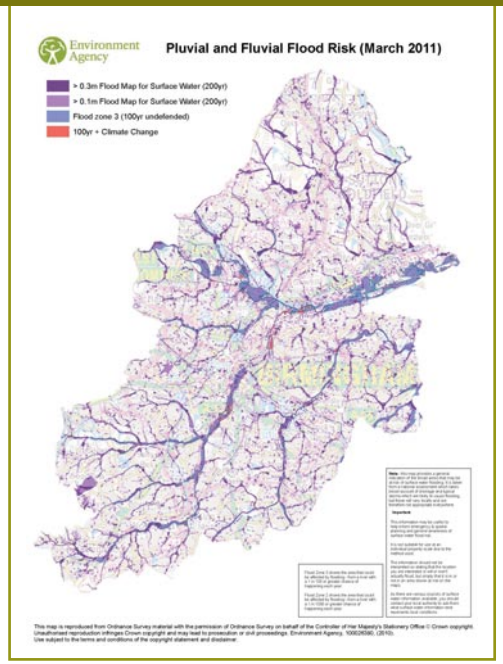
What does this all mean?

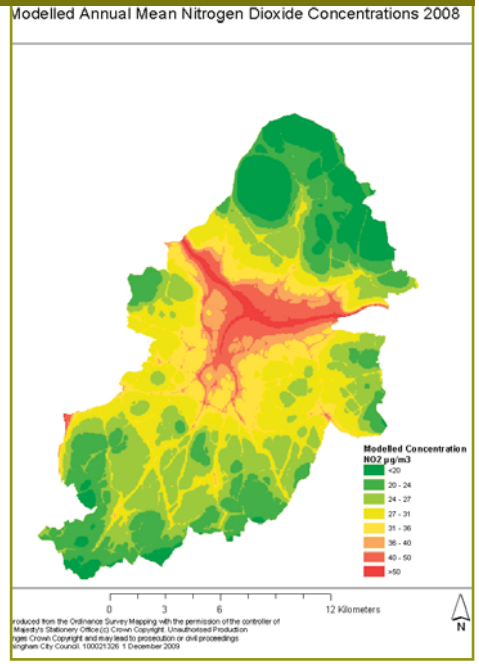
The emerging evidence is at a much greater level of detail than even a couple of years ago. For the first time we are beginning to understand the impacts of climate change at a local level in Birmingham and are therefore in a position to start to identify the places and communities most at risk. By doing this we are also able to identify those issues which are truly cross-city, or wider, in nature and focus on them at the appropriate scale.

The map of flooding, the urban heat island and air quality show a number of coincident areas of risk, including the city centre and the River Tame/M6 corridor. These may therefore be useful areas to pilot the "priority areas at risk" approach.

Figure 7. Birmingham's urban heat island 18th July 2006, pluvial and fluvial flood risk 2011, annual mean Nitrogen Dioxide concentrations 2006







Certain groups of people can be more vulnerable to the impacts of weather events than others. This vulnerability has been defined as:

Place	people living in areas at risk, such as flooding or excessive heat due to environmental conditions or poor building quality
Deprivation	people who are already deprived by health, level of income, quality of their homes and mobility, the elderly and the very young
Disempowerment	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. Factors include restrictions on housing tenure, lack off financial capacity and lack of information because of old age, language or isolation or lack of access to services

(Sniffer, (2009), Project UKCC22, Differential Social impacts of Climate Change in the UK

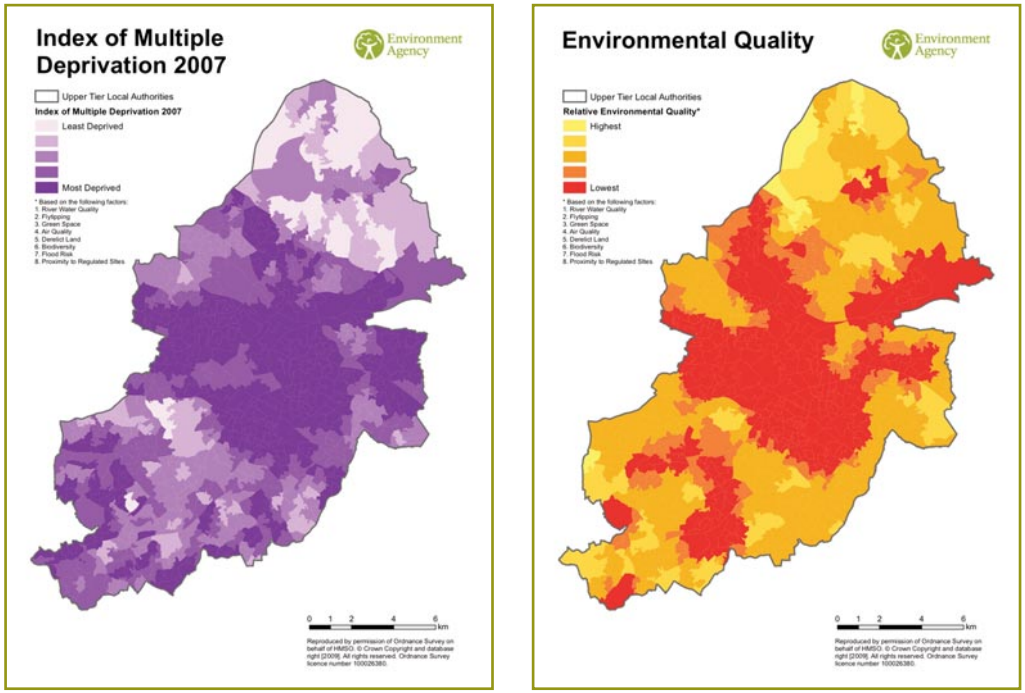
A fourth category may be individuals who are vulnerable due to their own decision making and priorities, such as risk takers and those who are apathetic in spite of good information being available about easy responses to take.

Why is a strategic approach needed?

A problematic characteristic of weather related events and environmental issues is that those who would bear the costs of adaptation measures are not always the same organisations or individuals that would benefit from them:

- A building with better thermal mass will protect vulnerable or elderly tenants from temperature extremes, but requires the landlord to make a capital investment. Health and social services may incur additional treatment and support costs if the investment is not made
- Developers are responsible for installing appropriate infrastructure such as culverts and drains from the outset. As the risk of flooding increases over time, the responsibility for any mitigation will be with the landlord rather than the developer of the site some decades in the past. The local authority and *Environment Agency* may use their powers to make improvements through the planning process
- Respiratory problems can be exacerbated by poor air quality, but because treatment has an immediate effect and is within the control of health services, improving air quality through reducing emissions and enhancing green infrastructure is less prioritised, even though the approaches may be more efficient and cost effective in the long term
- The downsides of not adapting to a particular issue may become more grave and more probable several decades into the future. Decision takers whose employment, share holdings and/or terms of office will have ended by then will discount these costs rather heavily in favour of issues that have more immediate impacts

Figure 8. Comparison of environmental quality and indices of multiple-deprivation for Birmingham



Strategic Outcome 1
Mapping and identifying areas at risk – Identify priority areas, businesses and communities at risk.
Owner – Birmingham Environmental Partnership
Strategic support – Including Birmingham Resilience Group, Environment Agency, University of Birmingham, Health and Wellbeing Partnership, BCC Development Directorate

1.1	Identify priority areas at risk and cross city issues	Q3 2012
1.2	Identify communities and businesses at risk	Q3 2014
1.3	Ensure that emerging neighbourhood level evidence for the impacts of weather events over the next five years are incorporated into community risk registers.	Q3 2012
1.4	Outline areas for further improvements in the evidence base to underpin decision making processes	Q4 2012
1.5	Use evidence to support Core Strategy SP6 Adapting to Climate Change	Q4 2012
1.6	Review data sharing between agencies, including use of new data	Q4 2012

Strategic Outcome 2
Planning action for areas at risk – Evaluate risks and opportunities for each priority area at risk. Coordinate input of communities and service areas to develop options and adaptation action plans.
Owner – Birmingham Environmental Partnership.
Key strategic support – Including Environment Agency, University of Birmingham, Birmingham Resilience Group, Health and Wellbeing Partnership, Community Resilience Forums, Birmingham Improvement Districts, Constituencies, Birmingham Strategic Flood Risk Management Board, Birmingham Water Group, Severn Trent Water, BCC Development Directorate, Highways and Resilience, Natural England.

2.1	Pilot adaptation approaches in areas such as the city centre and the River Tame/M6 corridor	Q3 2013
2.2	Options and plans for first tranche of areas and city wide approaches completed. Identify what actions will be undertaken and by whom.	Q1 2014
2.3	To consider what additional actions are needed to strengthen the evidence base to support specific actions and places	1st review Q4 2012

As each circumstance is likely to be unique, the delivery of plans will need to be undertaken by a range of partners, according to the specific issues and solutions that prevail to minimise the risk and maximise the opportunities.

Section 3- Built and Critical Infrastructure

Built and critical infrastructure consists of the physical and organisational structures required for a society and economy to function, including:

- the built environment – homes, offices, factories, hospitals and schools
- the transport network – roads, railways, cars, buses and trains
- the energy network – electricity and gas supplies
- the water and drainage network
- the communication network – telephone, broadband
- green and blue spaces – gardens, parks, street trees, rivers and canals, green roofs and walls

Cities are built and developed with increasing dependence on the successful operation of the built and critical infrastructure. As all of these forms of infrastructure are susceptible to extreme weather events, strategic planning for future climate change is essential, particularly where long term investment is required.

Infrastructure, Engineering and Climate Change Adaptation, ensuring services in an uncertain future – Engineering for the Future 2011, (The Royal Academy of Engineering), and many other reports, have highlighted the increasing vulnerability of society to the impact of weather events on interdependent systems, leading to "cascade failures". The failure of one piece of infrastructure, such as flood defences can have a knock-on effect, for example to electricity substations, leading to power cuts that affects telecommunications networks, air conditioning systems, traffic lights, and so forth.

Research at *University of Birmingham* has been investigating the detailed impacts on transport and energy networks (Page 13, Case Study). Finding the pinch points in the critical infrastructure is increasingly important to ensuring that the City is resilient and able to function efficiently in the future.

This research has led to significant capital investment in the installation of monitoring systems across the city, with more planned, which will give Birmingham the densest heat sensor network in the world. As a result, Birmingham is becoming an ideal place to develop and test theoretical models which increase our understanding of risks from climate change. This is potentially a unique selling point for business, if no other UK city has the same level of proven resilient networks.

Green infrastructure

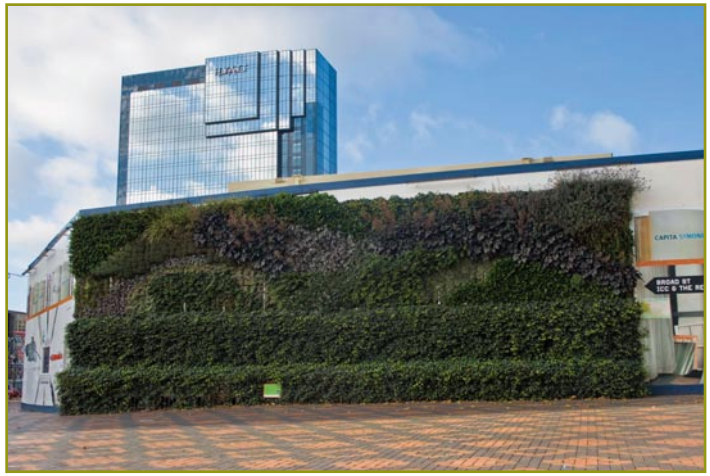
"Green Infrastructure is a network of multi-functional green space, both new and existing, both rural and urban, which supports the natural and ecological processes and is integral to the health and quality of life of sustainable communities" (PPS12, DCLG 2008)

It provides a wide range of benefits to society, including:

- Shade and cooling for urban centres
- Reducing the impact of heavy rain by absorbing water and slowing run-off
- Improving air and water quality by absorbing pollutants
- A positive effect on property prices and perceptions of an area
- Increased wildlife and biodiversity
- Improved wellbeing, through promoting good health and aiding recovery from illness

Having high quality green infrastructure is therefore important in all areas, but especially where there are particular risks. However, multifunctional benefits frequently get overlooked by organisations because they do not provide the primary means of dealing with problems and challenges for any one sector. But together they have the potential to offer huge benefits.

Investing in the natural environment helps to manage and reduce risks from extreme weather. Birmingham's emerging Green Infrastructure Strategy will set out a coherent city wide approach to creating green space and networks.



Case Study: New Parks in Lee Bank

Sunset & Moonlit parks are two contemporary parks created to be at the heart of the 25ha Park Central mixed-use regeneration project adjacent to Birmingham City Centre. The two parks were designed by The Landscape Practice Group at Birmingham City Council in conjunction with lead developer Crest Nicholson, joint land owners Optima community association and local residents.
Completed in 2007, the two award-winning parks together with the surrounding development have been recognised as exemplars of good practice in open space design and have transformed a previously neglected and run down city centre estate into a sustainable community where people want to live.
[The Landscape Practice Group, Birmingham City Council]

Regeneration and Development

Regeneration and development is critical to Birmingham's success as a leading city; as an engine of economic growth and for the wellbeing of our communities. The renaissance of the city centre in recent years has produced wide ranging benefits across Birmingham through attracting inward investment, encouraging business and creating jobs and prosperity as well as an attractive environment and services for the community.

The climate change challenge is to maximise the opportunities that climate change presents and minimise the risks. Warmer summer temperatures, particularly when the UHI effect is taken into account, may lead to more opportunities for the leisure industry, but offices, commercial buildings and street environments will need to be designed to remain pleasant working environments in these temperatures.

New developments in Birmingham should take account of anticipated changes in the frequency and intensity of weather events over time as the decisions made now will have consequences for several decades. The research highlighted in Section 2 should be incorporated into a masterplanning approach, both on new sites and in areas of multiple ownership to ensure climate change impacts are minimised and opportunities maximised.

The planning system is at the heart of this approach and Birmingham is already working to ensure that its key policies are appropriate. *The Emerging Core Strategy* policies SP6 Adapting to Climate Change, SP10 Managing Flood Risk and SP11 Green Infrastructure Network for example are specifically designed to address this.

Supplementary Planning Document, Places for the Future will provide developers with guidance on sustainable development by building upon policies dealing with sustainability in the Emerging Core Strategy 2026 and provides additional guidance for applicants seeking to develop in the City. It will also be used by Birmingham City Council planners who are assessing development proposals. It is critical that the emerging evidence base and the appropriate adaptation and green infrastructure guidance is captured within Places for the Future. A draft of the *Places for the Future SPD* was released for public consultation in February 2012 with an intended adoption in autumn 2012.

As the Land Drainage Authority, BCC has completed innovative pilot projects on the River Cole and Wood Brook as part of a Surface Water Management Plan and has completed a Strategic Level Surface Water Management Plan, to ensure the city is becoming more resilient to flooding.

Birmingham's critical infrastructure, regeneration and development will need to incorporate these planning policies and approaches if it is to ensure that communities and businesses are resilient in the future and that deprivation is not encouraged through poor design. In particular it will need to actively consider floodplain management, Sustainable Urban Drainage Systems (SUDS), predicted discharge rates to water courses, culverting policy, street scene and green infrastructure. Planning and development needs to take account of more frequent extreme weather events to help ensure that their impact on buildings and services are minimised, and implications further downstream in the City and region are taken into account and planned for.

The Flood and Water Management Act will lead to new duties for the City Council as a Local Flood Authority, including responsibilities for managing third party assets and producing and delivering local flood management plans, as well as establishing and managing Sustainable Urban Drainage Approval Boards. The Council has recognised this and through its Scrutiny Committee on Flood Risk Management and Response has already started to address some of the issues. For example, it is delivering a five year programme of work to ensure that Birmingham's reservoir dams continue to be safe to the communities below them.

Management of existing infrastructure

The *Housing Plan 2008+* vision is that housing will enable people to thrive and choose to live in Birmingham. With a rising and ageing population, the demands for good quality private and public sector housing will increase. Therefore identifying those neighbourhoods that are vulnerable to the impacts of climate change and factoring this into delivery programmes will be important.

BCC manages a range of assets in the built environment, including offices, leisure facilities, all local authority schools and educational buildings (training, behaviour, office, support, youth centres) and housing. The management and maintenance programme, and the building and refurbishment programme demonstrate an increasing number of features designed to cope with a changing climate. All new

Case Study: Library of Birmingham

The development of the Library of Birmingham project is already underway and considers the future climate of Birmingham. An underground attenuation tank will store, dispose of and use excess rainwater from the site and can account for a 1-in-30 year rainfall event. The tank is designed for a 20% increase in rainfall due to climate change in accordance with Environment Agency requirements. The building design also features green and brown roofs and an underground cooling system that runs in conjunction with natural ventilation to maintain the internal temperature of the building at 14-22 °c for the majority of the year.

schools, for example, will have shading as standard, with other features, such as green roofs, rainwater harvesting and recycling being increasingly used. Colborne Primary School has a green roof for example. The new Sustainable Schools Programme will ensure that adaptation awareness and measures are embedded in the curriculum, on the campus and in the community.

BCC also has responsibilities for helping vulnerable communities, such as the fuel poor, reflected in the Birmingham *Private Sector Housing Strategy 2008+*. A range of programmes have been delivered, such as *Decent Homes*, *Challenge 100* and *Birmingham Energy Savers*. Programmes that deliver better insulation, for example, will protect at risk groups from temperature extremes. However, where communities are particularly vulnerable to specific risks, programmes could be tailored to specific needs. Properties at risk of flooding, for example, could include measures to protect them.

Adaptation should be proactive rather than reactive; anticipating climate change impacts at the beginning of programmes and projects will avoid adding bureaucracy and costs when damage has been done.

Transport

150,000 people commute in to Birmingham on a daily basis using the road, rail and metro networks. Failure to get to work has an economic impact through loss of work time and business disruption. Therefore transport and workplace resilience is a key issue. With a transport network at near capacity single problems, such as train breaking down, can rapidly cascade into multiple events, with huge impacts on people moving around the city.

Birmingham also has a key role in the national road and rail network providing economic opportunity for businesses based here with a resilient location.

Ninety-one organisations are required to report on how they are adapting to the impacts of climate change, under the *Climate Change Act 2008*. Risks identified in the DEFRA press release, *Changing climate, changing infrastructure*, 28th January 2011 include:

"Increased flooding of rail tracks, stations and depots; tracks buckling in high temperatures, train failure in the heat and maintenance hindered by adverse weather. *Network Rail* is investing better drainage at priority locations, and will develop specific plans for each rail route. Roads deteriorating more quickly due to higher average temperatures and more frequent extreme weather, resulting in more repairs and the need for more expensive and robust road designs."

Case Study: Rail Industry

The annual cost to the rail industry of rail buckling during an average year is estimated at £4.84 million. The current extreme is represented by the summer 2003 heatwave, which is estimated to have cost £12.1 million. An average summer will cost the industry £23 million by 2080 unless adaptive strategies are put in place over the coming years.

In January 2010, extensive snowfall forced the closure of New Street Station for five hours during the morning rush hour, forcing the caretakers of the railways, Network Rail, to pay £2 million in compensation for lost revenue to train operators.

What is Birmingham doing already?

Amey have a contract to replace all of Birmingham's road surfaces within 5 years and maintain them until 2035. Amey are also undertaking a baseline survey of street trees that will form the basis of a long term management programme.

Network Rail has a national research programme based around Birmingham looking at the critical infrastructure issues on a route by route basis.

Birmingham International Airport is producing a climate change adaptation action plan which details the on-going risk assessment work. The *BUCCANEER tool* is included as a future method of assessing the airport's risk to climate change.

Birmingham's Low Carbon Transport Strategy and *Bike Birmingham: A Sustainable City's Cycling Strategy 2011* take into account the need for pedestrians and cyclists to move around areas such as the city centre.

A draft Green Infrastructure Strategy is currently being developed and will seek to identify, maintain and enhance the City's green infrastructure network. An Ecosystem Services Assessment and an "I-Tree" Assessment are also to be completed to provide a quantitative valuation of green infrastructure in Birmingham.

Strategic Outcome 3
Develop Birmingham's understanding of resilience to "cascade failure" of infrastructure systems, including energy, telecommunications, transport and utilities.
Owner – University of Birmingham.
Strategic support – Including, Development Directorate, Birmingham Environmental Partnership, University of Birmingham, Local Enterprise Partnership, Chamber of Commerce, Housing, Transport Policy, utilities, Health and Wellbeing Partnership, Birmingham Resilience Group.

3.1	Develop research programmes and monitoring to identify critical infrastructure and cascade failure problems in Birmingham associated with a changing climate. Quantify whether interventions have made a difference at city scale and what interventions are required in future	Q4 2012
3.2	To present to Birmingham Environmental Partnership, Birmingham Resilience Group and others the emerging evidence for the impacts of climate change	Ongoing

Strategic Outcome 4
Identify the risks and opportunities from climate change for planning and regeneration. Use this to shape planning and delivery of development projects at a range of appropriate scales, from masterplanning to site specific design.
Owner – BCC Development Directorate.
Strategic support – Including, Environment Agency, BCC Air Quality Team, BCC Corporate Asset Management, BCC Housing, Health and Wellbeing Partnership, BCC Highways, (including Drainage Team), University of Birmingham, CYPF, Business Improvement Districts.

4.1	Use the emerging evidence on climate change impacts to inform the Core Strategy and Places for the Future Supplementary Planning Document on adaptation and green infrastructure guidance	Q3 2012
4.2	Complete the Green Infrastructure Strategy and Ecosystems Service Assessment and I-Tree Assessment	Q4 2012
4.3	Create comfortable environments for people and pedestrians, especially in areas affected by the UHI through measures such as green infrastructure, benches and drinking water fountains	First review Q4 2012, and ongoing
4.4	Deliver the functions of the Flood and Water Management Act as they are enabled	Determined by Government
4.5	Develop an Intermediate Tier Surface Water Management Plan	Q2 2012
4.6	Encourage the Local Government Association and Buildings Research Establishment to produce engineers' briefing notes on adapting to the impacts of climate change, with specific data for transport, buildings and critical infrastructure. To be supplemented with specific information about climate change impacts in neighbourhoods in Birmingham. Owner – Birmingham Environmental Partnership	Q4 2012
4.7	Develop an evidence based approach to asset management and the impacts of climate change. Owner – BCC Corporate Asset Management. Key support – BCC Children Young People & Families	1st review Q4 2012
4.8	Include requirements on developers to address climate change risks when Birmingham City Council sells land. Owner – BCC Corporate Asset Management	Q4 2012

Section 4 – Business and the economy

Two aspects of climate change impacts are particularly relevant to the 44,000 businesses of Birmingham that makes up the City's economic success and prosperity:

1. The direct impact of the weather on businesses and the economy
2. The opportunities that climate change impacts may present

Direct impact of the weather on businesses and the economy

In 2007, 28% of UK businesses were disrupted by extreme weather. The floods of that year took an average of 26 weeks to return to normal operating capacity, with some small businesses taking up to two years to recover. Some did not survive at all. *(Weathering the Storm – Saving and Making Money in a Changing Climate A Practical Guide for Small Businesses in the West Midlands)*

The impact on business is likely to become more severe as our climate continues to change if we do not adapt. 73% of managers report that business continuity management is important in their organisation yet 66% of small businesses have no continuity plan. Small and medium enterprises (SMEs) are potentially the most vulnerable businesses as they have fewer resources to plan for and cope with incidents. This is exacerbated as only 26% of small businesses think that climate change is a threat to them

Different extreme weather events will impact adversely on different sectors, for example, the 2010 heavy snow impacted specifically on retail and logistics.

Other weather impacts on business (all of which have financial implications) can include but are not limited to:

- Contamination from flooding of waste storage and bunded areas
- Loss of manufacture/trading time during a flood. Adverse weather or flooding makes on-site working conditions difficult and delays the project
- Flood damage can prevent normal business operations for many months
- Loss of power due to heatwaves leading to downtime, loss and damage to products and systems
- Very high or low temperatures can cause loss of business time, if heating, chilling and air conditioning or ventilation systems are not designed to cope
- The potential disruption to critical infrastructure (Section 3) has a direct impact on the operation and functionality of business employees, distribution networks and premises

These impacts are compounded by:

- Just in time material delivery
- Highly geared and lack of business discontinuity insurance
- Lack of training programmes on adaptation
- Lack of long term planning for climate change

The key messages for businesses include:

- Climate adaptation is likely to become part of insurance criteria
- Well prepared businesses could save money on premiums
- Unprepared businesses may not secure insurance cover
- Adapting will save money in the long term if done effectively

Certain actions that can help businesses adapt, include:

- Understand the risks to business continuity from extreme weather events
- Develop contingency plans to prepare for risks and what to do during extreme weather
- Secure insurance and/or developer terms and conditions ready for extreme events
- Participate in training programmes for staff

What is Birmingham doing already?

Birmingham Resilience Group and the *Chamber of Commerce* both have programmes to help businesses prepare for the impacts of extreme weather. The development of the *Greater Birmingham and Solihull Local Enterprise Partnership (LEP)* provides the opportunity to address climate change adaptation issues in a wider context. This will benefit business and the economy across the LEP, not just in Birmingham, and could include:

- Ensuring that businesses on the River Tame are not affected by upstream regeneration proposals
- Improving the reliability of transport systems for commuters and logistics during extreme weather events
- Reducing the risks of cascade failure affecting businesses by taking an area wide basis to identifying and mitigating pinch points
- Identifying and promoting growth in resilience related business, such as systems management

Case Study: Project Ripple

Run by *Birmingham Resilience Group* promotes business continuity. This offers local businesses at risk from flooding the opportunity to gain an understanding of emergency responders and professional partners involvement prior to, during and after a flood event, consider how their businesses would cope with a flood and what measures they might want to take to make them more resilient. Dedicated advice on preparing for and dealing with emergencies is available on www.birminghamprepared.gov.uk

Birmingham *Chamber of Commerce* also works with individual businesses to help make them more resilient. A major issue for manufacturing industry is storage areas and waste areas that are not bunded sufficiently. They therefore get flooded and contaminated resulting in much more expensive clear up costs.

Case Study: West Midlands Fire service

West Midlands Fire Service has proactively considered the impacts of a changing climate on their business operation. They have worked with the Met Office to profile open grassland fires against climate change. This has allowed them to consider whether they have the right resources (personal protective equipment, vehicles, etc) in the right places.

Opportunities for business and the economy

Birmingham has a unique history of innovation and entrepreneurship dating back to the industrial revolution. Businesses have the opportunity to draw upon this legacy and use their existing skills and knowledge to promote and stimulate the market to locate green technology companies and organisations in the city, providing new additional job opportunities in the process. The transition to a well adapted City presents a number of opportunities for the business sector to both manage their own risk but also provide the services and infrastructure required for the UK to adapt and thrive to changes in the climate. Key to this will be understanding and exploiting the opportunities from the existing expertise in science, manufacturing and engineering that built the Birmingham we see today.

The development community is driven by new building regulations, energy certificates, *BREEAM*, etc., and blue chip customers are driven by corporate social responsibility. Developers can seek to deliver market advantage, such as through BREEAM Excellent ratings, but at least cost. What could Birmingham do over and above national regulations to encourage developers to incorporate adaptation to the impacts of climate change? The opportunity is that it could create a degree of excellence that Birmingham could "sell".

Section 2 outlined our dependence upon critical infrastructure and (Section 3) identified "cascade failure" and how Birmingham has a particular opportunity to develop market advantage, due to its emerging evidence base. Businesses moving to Birmingham would have an evidence based assurance of the level of resilience available.

Strategic Outcome 5
To promote resilience amongst the business community
Owner – Birmingham Environmental Partnership
Key support – including Birmingham Resilience Group. Birmingham Chamber of Commerce, Birmingham Business Improvement Districts, Environment Agency

5.1	Work with businesses in priority areas at risk to build resilience	first review at Q4 2012
5.2	Champion resilience work with business, communicating strategic issues with the business community, bringing in training and advice Owner – Birmingham Environmental Partnership Key support – Birmingham Resilience Group	Q3 2012
5.3	Promote the provision of Birmingham's decentralised energy network as a way of increasing resilience of the energy system to weather events	Ongoing

Strategic Outcome 6
To make the most of the opportunities arising from climate change impacts and promote technological development.
Owner – Birmingham Environmental Partnership
Key support – including Birmingham Science City, Birmingham Business Improvement Districts, University of Birmingham

6.1	Science City to catalyse innovation between academia, public and private sector partners using sector networks to address resilience to climate change impacts	Q2 2012
6.2	Investigate the opportunities to encourage excellent adaptation to climate change in new developments and in doing so confer business opportunity. Owner – BCC Development Directorate	Q4 2012
6.3	Investigate the opportunities to use the Birmingham Procurement Group to pre-procure products that will lead to greater resilience and commercial opportunities	Q4 2012
6.4	At the appropriate time, market Birmingham as a resilient city	Q4 2012

Section 5 – Community

Communities are subject to a whole range of weather impacts, whether they are direct, such as from flooding, hot and cold weather, or storms, or indirect, such as impacts on the availability of food, water and other goods, or increased immigration due to impacts elsewhere. Communities will require information and support in:

1. Increasing resilience by preparing for extreme weather events to reduce impacts
2. Recovering from the impact of weather events when they do occur

Building community capacity and capability involves generating local interest, such as through gathering evidence of certain impacts in specific places (such as in flooded areas). It also involves developing an understanding of where responsibilities for dealing with weather impacts lie; which organisations have what roles and where the responsibility lies with individuals and businesses. Promoting active citizenship through developing local plans will enable individuals and communities to become more resilient and responsive when extreme weather events do occur.

Understanding locally specific impacts can also lead to a more efficient use of public resources and services in communities. For example, understanding the impact of heat on different communities and people can allow the health service and care providers to target messages on staying cool and providing services where they are most required, just as they do during the winter with keeping warm campaigns.

What is Birmingham doing already?

Birmingham is fortunate to have strong community groups already operating to improve their local communities. Some of these are already working on climate change adaptation issues, such as the Selly Park Flood Group (Page 9). Others, such as *Birmingham Trees for Life* are planting hundreds of trees that will improve Birmingham's long term resilience to extreme weather impacts.

About half of the schools in Birmingham have been working on a sustainable schools initiative over the last 5 years. *BASIC 21* helps schools to promote sustainable development in the curriculum, in the school buildings and grounds and in the community. BASIC 21 has been replaced by the Sustainable Schools Programme,

Community representatives prioritise risks and adaptation action

which includes climate change adaptation measures such as assessing risk, creating plans and using shading, water and green infrastructure to adapt.

Birmingham Resilience Group (BRG) is a partnership of BCC's Resilience Team (BRT), the Police, Fire, Ambulance, other NHS agencies and others responsible under the Civil Contingencies Act, 2004 to deliver a multiagency approach to emergency management.

Involving community and voluntary organisations is recognised as a key part of improving Birmingham's resilience. Birmingham Community and Neighbourhood Resilience Group represent a wide range of groups, including faith, disability, carers, community groups, voluntary organisations and the emergency services. The group is a mechanism for public representatives to input to key areas of resilience work (emergency response and recovery arrangements) and additional groups have focused on city centre living, Swine Flu, severe weather events, and flooding.

Case Study:

Birmingham has over 100 volunteer **'Resilience Champions'** who

- Promote sign up to Birmingham Community Alert (free text messaging service) and the *www.birminghamprepared.gov.uk* website;
- Encourage colleagues, neighbours and group members to take a few simple measures so that they are more prepared for emergencies;
- Circulate 'Preparing for Emergencies in Birmingham' booklets, DVDs, 'In Case of Emergency' wallets and other material and posters within organisations;
- Identify local resources e.g. community halls, 4X4 vehicles that might be of use in an emergency;
- Participate in emergency exercises to test current plans and arrangements.

Campaign posters to raise awareness of preparing for extreme weather

Birmingham Sustainability Forum takes place 3-4 times per year and provides community groups and individuals with the opportunity to share activities and discuss opportunities on a wide range of issues.

Strategic Outcome 7
To improve the capacity of vulnerable communities in Birmingham to be resilient and adapt to the impacts of extreme weather events and climate change.
Owner – Birmingham Environmental Partnership
Key strategic support – Birmingham Resilience Group. Health and Wellbeing Partnership, Health Protection Agency, Chamber of Commerce, Environment Agency, Birmingham Environmental Partnership

7.1	Develop the adaptation aspect of the Sustainable Schools Programme, to engage with schools and communities about the impacts of climate change. Owner - BCC Development Directorate. Key support – BCC Children Young People and Families	Q2 2012
7.2	To engage and empower communities with knowledge of climate change impacts and adaptation through the Sustainability Forum and other communications materials	Q4 2012

Section 6 - Health and Wellbeing

Birmingham has a diverse and constantly changing population of just over one million residents. There is a youthful population, with a large number of residents in the 20-24 age group. In 2007, 22.0% of Birmingham's residents were younger than 16 years of age; 3 percentage points above the national average, whilst 15.7% of Birmingham residents were of pensionable age; 3 percentage points below the national average.

In ten years time it is believed that the population of 0-14 year olds in Birmingham will be higher than the current level, with an increasing gap to the England average. The proportion of over 65s in the population is set to move further below the England average. Differing rates of births, deaths and migration both in and out of the city are changing the population profile. Overall, the West Midlands is one of the least healthy regions and compared to the England average England average = 21.5 percent; West Midlands = 23.5 percent)

Life Expectancy

Life expectancy for both males and females has increased over recent years. However the Birmingham average remains below that of the West Midlands and England. The gap to England has widened by 32% for males but narrowed by 10% for females. The life expectancy for those in the most deprived quintile in Birmingham is 4.2 years lower for males and 2.2 years lower for females.

The Birmingham Joint Strategic Needs Assessment report on Winter Mortality identified that 81% of excess winter deaths and 79% of excess summer deaths were due to respiratory and cardiovascular diseases, both sensitive to excessive heat and cold.

Section 2 gave an overview of health impacts. The *Health Effects of Climate Change in the West Midlands* report summarises that "There is a serious risk that climate [change] will increase health inequalities… Deprived communities are likely to face greater impacts because:

- They are more likely to be located in city centre areas where the greatest temperature increases are predicted
- They have the smallest potential to adapt (e.g. cannot move, afford more expensive food, buy air-cooling systems)
- They are more likely to be deprived
- Generally they are less healthy and therefore would be more susceptible, even if exposure was equal."

Figure 9. Population Age Structure for Birmingham 2007

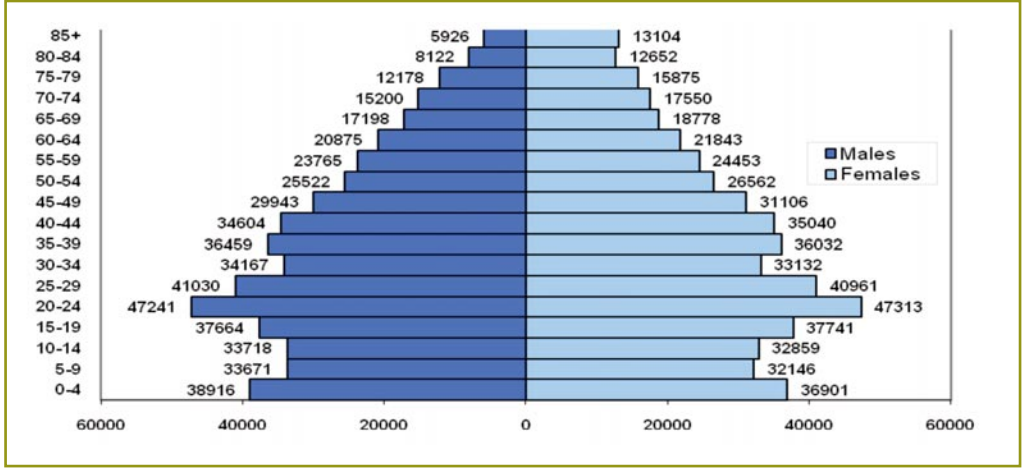
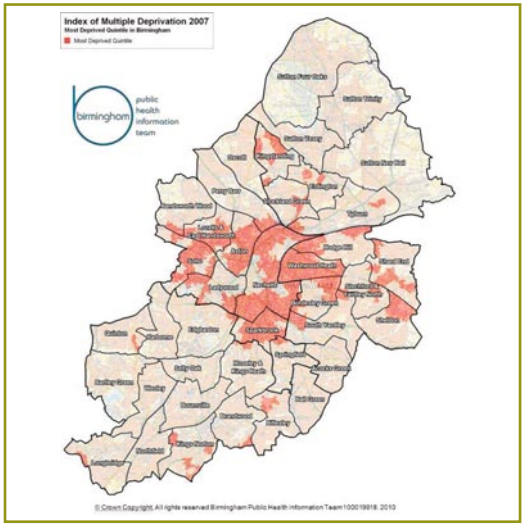


Figure 10.
Areas of Multiple deprivation in Birmingham 2007



The potential key impacts from the report include:

- Up to an 11% increase in summer deaths in the 2080's due to warming, which will be furthered exacerbated by the UHI Effect
- Up to a 10% decrease in winter deaths by the 2080's due to warming
- Increase in the number of people suffering from deaths or morbidity (mentally and physically) due to extreme weather events
- Increases in the frequency of cardio respiratory diseases and allergies from changes in air quality, such as an increase of 53% in the number of deaths resulting from increased exposure to ozone by the 2020's
- An increase in food and waterborne diseases such as E. coli, Salmonella and Cryptosporidiosis

These potential impacts will have repercussions for the health and wellbeing of the population and the delivery of social services. However, the evidence base provides health and social care service providers with the opportunity to prevent where possible and respond when necessary to impacts from an increasing number of extreme weather events. There are implications too for the role of critical infrastructure, particularly green infrastructure in promoting wellbeing and creating comfortable living and working environments for people.

What is Birmingham already doing?

The following actions are already underway:

- The City Council's Adults and Communities Directorate each year runs a "Winter Chills" campaign which addresses fuel poverty and health/care risk due to fuel poverty and extreme cold in older people and vulnerable adults
- A seasonal excess death reduction programme is in place in the NHS in Birmingham, led through the Health Inequalities programme
- The Adults and Communities Directorate and each Primary Care Trust has a heatwave plan to address the needs of those vulnerable to extremes of temperature in hot weather
- The City's *Decent Homes* programme has reached 98.6% decency including good thermal standards for public sector stock
- A private sector housing strategy is in development and the Kick Start programme of loans to vulnerable people in non public/social sector accommodation is continuing
- Health Protection Strategy is under development which will address air quality issues. One of the key recommendations associated with Birmingham's proposed *Natural Health Improvement Zones* will be the designation of a network of 'Quiet Roads' in Birmingham. These roads will be nominated for safe walking, cycling, running and safer routes to school, this will strongly encourage modal shift across the City. An indicator of success for the NHIZ's will be improvements in air quality leading to reduced deaths and a reduced cost to the healthcare in a location.
- The Public Health Information Team have taken part in funding and developing the BUCCANEER tool (Section 2)

Strategic Outcome 8
To improve the ability of health services to prepare for and adapt to extreme weather events.
Owner – Health and Wellbeing Partnership
Strategic Support – University of Birmingham, Birmingham Environmental Partnership

8.1	Health Impact Assessments to routinely include considerations of climate change impacts	Q2 2012
8.2	Public Health to assess the Emerging Core Strategy	Q2 2012
8.3	Build responses to climate change impacts into the provision of health protection, health delivery and social services	Q4 2012
8.4	Joint Needs Assessments routinely include climate change impact considerations identifying priority places and communities	Q4 2012
8.5	Update plans to be able to deliver health and social services in more frequent adverse weather conditions and to provide the additional support that may be needed	Q2 2012
8.6	Develop and pilot the Natural Health Improvement Zones	Q2 2013

Section 7 - Making it Happen and Keeping on Track

Co-ordination

The key actions that have been agreed will allow Birmingham to identify vulnerable neighbourhoods and communities and to start to work towards adapting to the impacts of climate change. The emerging evidence base will ensure that interventions are targeted, appropriate and help communities and businesses to take the actions that they need to make themselves resilient.

This approach also offers the opportunity to deliver better, more integrated services through partnership, which will reduce the impacts, and therefore the costs on communities, businesses and services.

Ensuring that the actions agreed in this plan do happen is fundamental. Whilst BCC's *Cabinet Committee on Climate Change & Sustainability* has overall responsibility for Council policy, the practical delivery lies with various directorates, groups, organisations and partnerships.

In practical terms the lead for many of the strategic outcomes lies with Birmingham Environmental Partnership, supported by BCC's departments including Development, Planning, Transport, Climate Change and Sustainability and Housing.

In July 2011, *Birmingham Environmental Partnership* refreshed its approach, meaning that the Climate Change Adaptation Partnership has retained and expanded its remit to become the Green Infrastructure and Adaptation Delivery Group. The Delivery Group will take forward the work from both the Action Plan and the wider Green Infrastructure agenda. The Green Infrastructure and Adaptation Delivery Group has therefore developed a work program which adopts this Action Plan. Their work programme consists of three key functions which cover nine key themes, shown opposite.

Functions	Themes
Risk mapping	Heat Water management Green Infrastructure Biodiversity Health Community Business Transport & Infrastructure Resilience
Contingency Planning	
Future-Proofing	

Strategic Outcome 9
Ensuring that the Birmingham CCAAP is being delivered and is on track.
Owner – Birmingham Environmental Partnership

9.1	Project manage delivery of the overall Birmingham CCAAP programme	ongoing
9.2	Work through the appropriate neighbourhood structures, including constituencies, to get delivery on the ground	Q4 2012
9.3	Undertake an annual review and evaluation of Birmingham's adaptation work	Q1 2012

Funding adaptation

In the current financial climate, and in the foreseeable future, traditional mechanisms for delivering policies and programmes are unlikely to be sufficient. Directly available public funds will be in short supply. New forms of finance are being developed, such as social impact bonds, biodiversity offsets and the use of municipal banks to invest in infrastructure programmes. Birmingham Energy Savers is a recent example of an innovative approach that uses Feed-In-Tariffs to support investments in home energy saving.

Climate change adaptation issues are particularly challenging because the issues that they raise frequently straddle several sectors and service delivery areas. The required funding does not always have a direct benefit to the investor. For example, green infrastructure can be funded by developers and cool urban area, but the benefit of the investment will be to health services due to lower admission rates during heatwaves. Additionally, the return period on investments can be over a much longer time scale, with higher uncertainty.

There is both a need, and an opportunity, to develop new funding models that will support the essential projects that will prepare Birmingham for climate change impacts.

Strategic Outcome 10
Developing new models, tools and funding opportunities to help deliver actions and horizon scanning for actions that need to be done.
Owner – Birmingham Environment Partnership

10.1	Develop new models of financing interventions that help to build resilience to climate change impacts	Q4 2012
10.2	Identify further requirements for developing the evidence base for the impacts of climate change	ongoing
10.3	Horizon scanning of the climate change adaptation agenda to identify key pieces of work that need to be done	ongoing
10.4	Identify opportunities to construct projects and identify funding to deliver the Birmingham CCAAP through the GIA Delivery Group	ongoing

Appendix 1 Summary of Actions

Strategic Outcome 1
Mapping and identifying areas at risk – Identify priority areas, businesses and communities at risk.
Owner – BEP
Strategic support – Including Birmingham Resilience Group, Environment Agency, University of Birmingham, Health and Wellbeing Partnership, BCC Development Directorate

1.1	Identify priority areas at risk and cross city issues	Q3 2012
1.2	Identify communities and businesses at risk	Q3 2014
1.3	Ensure that emerging neighbourhood level evidence for the impacts of weather events over the next five years are incorporated into community risk registers	Q3 2012
1.4	Outline areas for further improvements in the evidence base to underpin decision making processes	Q4 2012
1.5	Use evidence to support Core Strategy SP6 Adapting to Climate Change	Q4 2012
1.6	Review data sharing between agencies, including use of new data	Q4 2012

Strategic Outcome 2
Planning action for areas at risk – Evaluate risks and opportunities for each priority area at risk. Coordinate input of communities and service areas to develop options and adaptation action plans.
Owner – BEP.
Key strategic support – Including Environment Agency, University of Birmingham, Birmingham Resilience Group, Health and Wellbeing Partnership, Community Resilience Forums, Birmingham Improvement Districts, Constituencies, Birmingham Strategic Flood Risk Management Board, Birmingham Water Group, Severn Trent Water, BCC Development Directorate, Highways and Resilience, Natural England

2.1	Pilot adaptation approaches in areas such as the city centre and the River Tame/M6 corridor	Q3 2013
2.2	Options and plans for first tranche of areas and city wide approaches completed. Identify what actions will be undertaken and by whom.	Q1 2014
2.3	To consider what additional actions are needed to strengthen the evidence base to support specific actions and places	Q4 2012

Strategic Outcome 3
Develop Birmingham's understanding of resilience to "cascade failure" of infrastructure systems, including energy, telecommunications, transport and utilities.
Owner – University of Birmingham.
Strategic support – Including, Development Directorate, BEP, University of Birmingham, Local Enterprise Partnership, Chamber of Commerce, Housing, Transport Policy, utilities, Health and Wellbeing Partnership, Birmingham Resilience Group.

3.1	Develop research programmes and monitoring to identify critical infrastructure and cascade failure problems in Birmingham associated with a changing climate. Quantify whether interventions have made a difference at city scale and what interventions are required in future	Q4 2012
3.2	To present to BEP, Birmingham Resilience Group and others the emerging evidence for the impacts of climate change	Ongoing

Strategic Outcome 4
Identify the risks and opportunities from climate change for regeneration and its impact on surrounding areas. Use this to shape planning and delivery of development projects at a range of appropriate scales, from masterplanning to site specific design.
Owner – BCC Development Directorate.
Strategic support – Including, Environment Agency, BCC Air Quality Team, BCC Corporate Asset Management, BCC Housing, Health and Wellbeing Partnership, BCC Highways, (including Drainage Team), University of Birmingham, CYPF, Business Improvement Districts.

4.1	Use the emerging evidence on climate change impacts to inform the Core Strategy and Places for the Future Supplementary Planning Document on adaptation and green infrastructure guidance	Q3 2012
4.2	Complete the Green Infrastructure Strategy and Ecosystems Service Assessment and I-Tree Assessment	Q4 2012
4.3	Create comfortable environments for people and pedestrians, especially in areas affected by the UHI through measures such as green infrastructure, benches and drinking water fountains	Q4 2012, and ongoing
4.4	Deliver the functions of the Flood and Water Management Act as they are enabled	Determined by Gov
4.5	Develop an Intermediate Tier Surface Water Management Plan	Q2 2012
4.6	Encourage the Local Government Association and Buildings Research Establishment to produce engineers' briefing notes on adapting to the impacts of climate change, with specific data for transport, buildings and critical infrastructure. To be supplemented with specific information about climate change impacts in neighbourhoods in Birmingham. **Owner – BEP**	Q4 2012
4.7	Develop an evidence based approach to asset management and the impacts of climate change. **Owner –** BCC Corporate Asset Management. **Key support –** BCC Children Young People & Families	1st review Q4 2012
4.8	Include requirements on developers to address climate change risks when Birmingham City Council sells land. Owner – BCC Corporate Asset Management	Q4 2012

Strategic Outcome 5
To promote resilience amongst the business community
Owner – BEP
Key support – including Birmingham Resilience Group. Birmingham Chamber of Commerce, Birmingham Business Improvement Districts, Environment Agency,

5.1	Work with businesses in priority areas at risk to build resilience	first review at Q4 2012
5.2	Champion resilience work with business, communicating strategic issues with the business community, bringing in training and advice **Owner –** Birmingham Environmental Partnership **Key support –** Birmingham Resilience Group	first review at Q3 2012
5.3	Promote the provision of Birmingham's decentralised energy network as a way of increasing resilience of the energy system to weather events	Ongoing

Strategic Outcome 6
To make the most of the opportunities arising from climate change impacts and promote technological development.
Owner – Birmingham Environmental Partnership
Key support – including Birmingham Science City, Birmingham Business Improvement Districts, University of Birmingham

6.1	Science City to catalyse innovation between academia, public and private sector partners using sector networks to address resilience to climate change impacts	Q2 2012
6.2	Investigate the opportunities to encourage excellent adaptation to climate change in new developments and in doing so confer business opportunity. **Owner –** BCC Development Directorate	Q4 2012
6.3	Investigate the opportunities to use the Birmingham Procurement Group to pre-procure products that will lead to greater resilience and commercial opportunities	Q4 2012
6.4	At the appropriate time, market Birmingham as a resilient city	Q4 2012

Strategic Outcome 7
To improve the capacity of vulnerable communities in Birmingham to be resilient and adapt to the impacts of extreme weather events and climate change.
Owner – BEP
Key strategic support – Health and Wellbeing Partnership, Chamber of Commerce, Environment Agency

7.1	Develop the adaptation aspect of the Sustainable Schools Programme, to engage with schools and communities about the impacts of climate change. **Owner –** BCC Development Directorate. **Key support –** BCC Children Young People and Families	Q2 2012 Q4 2012
7.2	To engage and empower communities with knowledge of climate change impacts and adaptation through the Sustainability Forum and other communications materials	

Strategic Outcome 8
To improve the ability of health services to adapt to extreme weather events.
Owner – Health and Wellbeing Partnership.
Strategic Support – University of Birmingham, Birmingham Environmental Partnership

8.1	Health Impact Assessments to routinely include considerations of climate change impacts	Q2 2012
8.2	Public Health to assess the Emerging Core Strategy	Q2 2012
8.3	Build responses to climate change impacts into the provision of health protection, health delivery and social services	Q4 2012
8.4	Joint Needs Assessments routinely include climate change impact considerations identifying priority places and communities	Q4 2012
8.5	Update plans to be able to deliver health and social services in more frequent adverse weather conditions and to provide the additional support that may be needed	Q2 2012
8.6	Develop and pilot the Natural Health Improvement Zones	Q2 2013

Strategic Outcome 9
Ensuring that the Birmingham CCAAP is being delivered and is on track. **Owner –** Birmingham Environmental Partnership

9.1	Project manage delivery of the overall Birmingham CCAAP programme	ongoing
9.2	Work through the appropriate neighbourhood structures, including constituencies, to get delivery on the ground	Q4 2012
9.3	Undertake an annual review and evaluation of Birmingham's adaptation work	Q1 2012

Appendix 2 GLOSSARY

Big City Plan
This master plan, forming a key element of the Big City Plan, is about delivering transformational change in Birmingham city centre by supporting sustainable growth, creating new and improved public spaces, giving streets back to pedestrians and bringing the cultural life of Birmingham to the heart of the city.

Birmingham Climate Change Action Plan sets the strategic direction of BCC to deliver on carbon emissions targets, adapt to climate change and make Birmingham greener. A Cabinet Committee will monitor progress.

Climate
Climate refers to the average weather experienced in a region over a long period, typically at least 30 years. This includes temperature, wind and rainfall patterns.

Climate Change
Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity.

Climate Change Adaptation is taking action to deal with the consequences of climate change resulting from increased levels of greenhouse gases.

Climate Change Mitigation is taking action to tackle the causes of climate change, by reducing concentrations of greenhouse gases, such as CO2 in the atmosphere.

Climate Change Risk
Additional risk to investments (such as buildings and infrastructure) and actions from potential climate change impacts. E.g. As winter rainfall increases, many buildings in the UK may be at an increased risk of severe flooding such as that seen in Cumbria in 2009.

Emerging Core Strategy
All future development and investment in Birmingham will be considered against the approach and policies in the Core Strategy. Once finalised it will be the principal strategic planning policy document within The Birmingham Plan, the city's Local Development Framework.

Emissions Scenarios
A plausible representation of the future development of emissions of substances (e.g. *greenhouse gases* and *aerosols* that can influence global climate. These representations are based on a coherent and internally consistent set of assumptions about determining factors (such as demographic and socio-economic development, technological change) and their key relationships. The emissions scenarios used in UKCP09 do not include the effects of planned mitigation policies, but do assume different pathways of technological and economic growth which include a switch from fossil fuels to renewable sources of energy. Source: *UK Climate Projections*.

Environmental deprivation
Environmental Deprivation is the lack of environmental benefits to people in a given area. There is no agreed definition, but the example given in this report uses river water quality, fly tipping, green space, air quality, derelict land, biodiversity, flood risk and proximity to regulated sites. There is often a strong correlation between environmental and other forms of deprivation.

Extreme weather events
Extreme weather events include weather phenomena that are at the extremes of the historical distribution, especially severe or unseasonal weather. Extreme weather events are rare.

Flooding
Flooding is the inundation of land that is normally dry from one of several causes:
Fluvial – overtopping of rivers
Pluvial – surface water run-off due to large quantities of rain in a short time where the drains cannot cope with the flow, water holding areas are not sufficient and seepage into the ground is not quick enough
Groundwater – rising levels of subterranean water
Sewerage – caused by blocked sewers.

Green Infrastructure
Green infrastructure is a strategically planned and delivered network of high quality green and blue spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality of life benefits for local communities. Green Infrastructure includes parks, open spaces, playing fields, woodlands, rivers, canals and ponds, allotments and private gardens. Green infrastructure strategies provide an over-arching vision for developing and managing all green and blue spaces in an area.

Heatwave
A continuous spell of unusually hot weather, where day temperatures reach at least 30°c and night times are at least15°c for at least 3 days.

Index of Multiple Deprivation
The Multiple Deprivation index shows the overall level of social and economic deprivation in an area. It is based on six indicator domains, each consisting of a separate set of indicators. The domains are as follows:

Income Deprivation; Employment Deprivation; Health Deprivation and Disability; Housing Deprivation; Education, Skills and Training Deprivation; Geographical Access to Services.

Infrastructure
The basic equipment, utilities, productive enterprises, installations, institutions, and services essential for the development, operation, and growth of an organization, city, or nation. E.g. Roads; schools; electric, gas, and water utilities; transportation; communication; and legal systems would be all considered as infrastructure.

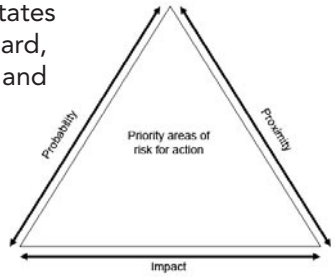
Local Development Framework is the term used to describe the folder or portfolio of City Council planning policies. The LDF for Birmingham is called The Birmingham Plan.

Nottingham Declaration
Acknowledgement that climate change is occurring and commitment to tackling the causes and effects of a changing climate. Birmingham has signed the Declaration to acknowledge that climate change is occurring and commit to tackling the causes and effects of a changing climate *http://www.energysavingtrust.org.uk/nottingham/Nottingham-Declaration/The-Declaration/About-the-Declaration*

Places for the Future
The purpose of this Supplementary Planning Document (SPD) is to provide guidance on sustainable development. It builds upon policies dealing with sustainability contained in Birmingham Core Strategy 2026 and provides additional guidance for applicants seeking to develop in the City. It will also be used by Birmingham City Council planners who are assessing development proposals.

Resilience
The ability of a social or natural system to absorb disturbances while retaining the same basic structure and ways of functioning. The capacity of self-organisation and the capacity to adapt to stress and change. For example, if two towns were hit by the same degree of flooding, the more resilient one may be functioning as normal within a week, whereas the less resilient one may not regain full functionality for a year.

Risk
"Crichton's Risk Triangle" states that risk is a function of hazard, exposure and vulnerability, and all must be spatially coincident for a risk to exist. The advantages of splitting the definition are that it makes the process clear and transparent and easily fits a layering system within a GIS. A hazard is something that may cause a risk; an example could be a flood of a specified height in a defined area. The exposure represents what is exposed to the hazard; an example could be buildings or people. Vulnerability refers to which aspects of the exposed elements are vulnerable to a given hazard, for example, a flood resistant house would not be vulnerable to flooding even if it was within the hazard area of a flood. The final risk layer is generated from the spatial coincidence of the hazard layer and the exposed and vulnerable layer.



Risk Assessment
The structured analysis of hazards and impacts to provide information for decision making. Risk assessment usually relates to a particular exposure unit which may be individual, population, infrastructure, building or environmental asset, etc. The process usually involves identifying hazards that could have an impact, assessing the likelihoods and severities of impacts, and assessing the significance of the risk. Source: UKCIP.

Sustainable Community Strategy: Birmingham 2026
Birmingham 2026 is the long-term sustainable community strategy shaping Birmingham future. It has been developed by BCC and the local strategic partnership, Be Birmingham, which brings together partners from the business, public, community, voluntary and faith sectors, to deliver a better quality of life in Birmingham. Preparing for the effects of climate change is a strand of the "Succeed economically" outcome. It also links to strands of the other outcomes, "Stay safe in a clean, green city," "Be healthy" and "Enjoy a high quality of life."

The UK Climate Impacts Programme (UKCIP) helps organisations to adapt to inevitable climate change. It provides resources to help people understand what the future climate might bring, what impact it could have and provide methodologies to help people and organisations to prepare. It also provides opportunities to learn from the experience of others through adaptation case studies from across the UK.

UK Climate Projections 09
The UK Climate Projections (UKCP09) provide climate information designed to help those needing to plan how they will adapt to a changing climate. The data is focussed on the UK, and is free of charge.

Weather
Weather is the day to day condition of the atmosphere, including temperature, rainfall and wind.

Appendix 3 Resources

Axa, *Business Continuity Guide for Small Businesses,*

BACLIAT: Business Areas Climate Assessment Tool. The UKCIP Business Areas Climate Impacts Assessment Tool (BACLIAT) is a good starting point for exploring the implications of climate change for your particular business or sector. It comprises a simple checklist for assessing the potential impacts of climate change under generic business areas. *http://www.ukcip.org.uk/bacliat/*

Business Continuity Management, Chartered management Institute, 2008 *http://www.managers.org.uk/research-analysis/research/current-research/business-continuity-management-march-2008*

Cabinet Office, Keeping the Country Running, Natural Hazard and Infrastructure, 2011.

Climate Change Act introduced a requirement for a range of organisations to evaluate the impacts of climate change on their work and to develop proposals to incorporate responses into their work programmes. The framework, reposts and summaries can be found at *http://ww2.defra.gov.uk/environment/climate/sectors/reporting-authorities*

Crichton, D., September 2006. *"Climate Change and its effects on Small Businesses in the UK"* Published by AXA Insurance UK plc. ISBN 978-0-9554108-0-2

DEFRA provides a central resource on climate change adaptation policy, with links to a wide range of websites and reports.

Nottingham Declaration website provides a huge range of advice and guidance for local authorities and other organisations on climate change advice.

The Royal Academy of Engineering: *Infrastructure, Engineering and Climate Change Adaptation, ensuring services in an uncertain future - Engineering for the Future 2011,*

Tomlinson, C. J., Chapman L., Thornes J. E., and Baker, C. J., 2010, Derivation of Birmingham's summer surface UHI from MODIS satellite images, International Journal of Climatology. (*www.wileyonlinelibrary.com*)

UK Climate Projections (UKCP09) provides climate information designed to help those needing to plan how they will adapt to a changing climate.

UKCIP: The Government provides advice, guidance and support for businesses and organizations that want to assess and address their climate risks, through the UK Climate Impacts Programme: *www.ukcip.org.uk*

WMCC Business Guide: Weathering the Storm – Saving and Making Money in a Changing Climate *http://www.ukcip.org.uk/wordpress/wpcontent/PDFs/LA_pdfs/Weathering_storm.pdf*

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