

Preparing for a changing climate in Northern Ireland



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It is widely recognised that the climate in Northern Ireland is already changing and the resultant impacts will represent a major challenge to this and future generations. If we are to adapt to the inevitable impacts of a changing climate over the next few decades, public bodies, organisations and individuals must work together to understand the challenges and plan how we will respond to them.

This study, funded by a partnership between SNIFFER, the Department of the Environment and the Environment & Heritage Service, identifies the potential impacts of climate change across a range of sectors and having investigated what adaptive activity is currently underway, makes recommendations for adaptive strategies to prepare for the unavoidable impacts of climate change in Northern Ireland. I welcome the adaptation strategies recommended in this report together with the inception of a NI Climate Change Impacts Partnership to ensure that they are taken forward on a co-operative basis.



A handwritten signature in black ink that reads "David Cairns".

David Cairns MP
Minister of the Environment

Northern Ireland's climate is already changing and we should expect these changes to accelerate over the coming century.

Air temperature and the number of hot days are rising; rainfall is increasing in winter, but decreasing in summer. These changes will have impacts good and bad, for all areas of society and environment in Northern Ireland.

What are we to do?

There are two basic responses. We can try to reduce future climate change by stabilising or reducing greenhouse gas emissions into the atmosphere. Strategies to reduce emissions can be pursued at international to regional levels, but even with action now, there will still be some unavoidable climate change due to past emissions. Therefore alongside mitigation efforts we also need to introduce measures (plans, policies and procedures) that will allow us to adapt and prepare for changes in the climate. This report is a summary of the technical report, Scotland & Northern Ireland Forum for Environmental Research (SNIFFER) examining the ways in which Northern Ireland must prepare to meet both the opportunities and threats presented by the impacts of a changing climate. Specifically, this study sets out to examine where the public sector in Northern Ireland is in relation to adapting to a changing climate and makes initial suggestions as to what is needed to prepare.

The study aims to review the current understanding of climate change in relation to the impacts on Northern Ireland. It identifies those sectors of Northern Ireland society where public bodies play a pivotal role and examines how a changing climate will affect them. Finally the report identifies gaps in understanding or actions, and provides recommendations for adaptation which would help ensure that Northern Ireland is prepared for the challenges of the future climate.

The report has drawn on consultation with key stakeholders to build our understanding of the potential impacts on public services, the key risks, resource implications and identification of responses.

The more detailed technical report from which this summary has been derived may be found at www.sniffer.org.uk under project code UKCC13.

Northern Ireland is an area of strong contrasts, in its physical geography and its economic performance, with a diverse yet strong cultural and natural heritage.

Geographically, the area is known for its vast range of different features, from rivers, lakes, bog lands and uplands to a coastline of exposed rocky shores and calm sea loughs. Amongst these varied areas, natural habitats are found which are extremely important in a local, national and international context.

Approximately 1.7 million people currently live in Northern Ireland. The economy on which the population relies has been through difficult times due to the decline in traditional heavy industries, a decline in manufacturing and changes to the agricultural sector. These changes have led to various parts of Northern Ireland suffering high levels of unemployment and associated social deprivation. However, in recent years, thanks to a dramatic increase in the 'knowledge led' economy, such as software development, a turnaround has taken place in Northern Ireland's economic outlook resulting in it being among the best regional performers in the United Kingdom and unemployment levels are now at historic low levels.

Employment levels have further benefited by a growing service sector built around an increase in the number of tourists, many of whom are attracted to Northern Ireland by its natural landscape and built heritage. These have arisen from the delicate balance between human influence and the climatic conditions in this corner of Northwest Europe. Future changes in climate will disrupt this balance. It is vital to prepare now.



Northern Ireland has escaped many of the severe weather events that have affected other parts of the UK and Europe in recent years. Nonetheless, it is not immune to weather extremes, especially heavy rain and gales.

Recent events (see **Table 1**) show the impact weather can have - on transport, energy supply, homes and health. Some of these events are likely to become more common in future, while other changes in climate, for example heatwaves and sea level rise, may have new impacts.

Table 1. Severe Weather-Related Events in Northern Ireland, 1996 to 2006

Date	Event	Consequence
6 November 1996	Severe gales	Fallen trees caused disruption to road and rail users - one motorist was injured after a tree fell on car. Ferry sailings to Great Britain were cancelled or delayed - injuries were caused to crew and passengers on one ferry that sailed. 4,000 homes were without electricity. Television services were also disrupted.
29 December 1998	Severe gales	10,000 homes without electricity - 500 electricity poles broken, with water supplies hit due to electricity failures at power stations. Water mains burst due to trees uprooting.
19 September 1999	Heavy localised flooding	Heavy rainfall caused the Three Mile Water to burst its banks close to Whiteabbey village. Extensive flooding resulted, needing a number of days to dissipate fully.
21 June 2002	Heavy localised flooding	Exceptionally heavy rain fell as a result of a localised thunderstorm. Due to coincidence with a high tide, low lying coastal areas in Carrickfergus and the village of Whiteabbey suffered severe flooding.
17 August 2004	Heavy localised flooding	The worst flooding in decades in Derry City, Co. Londonderry resulted in people being trapped in cars and extensive damage to property. Large parts of the city were under two feet of water for several hours.
22 September 2006	Strong gales	100,000 homes were left without power as the remnants of Hurricane Gordon brought strong gales. Worst hit areas included Craigavon, Mid-Ulster and Newry. Roads were blocked by fallen trees in a number of locations.

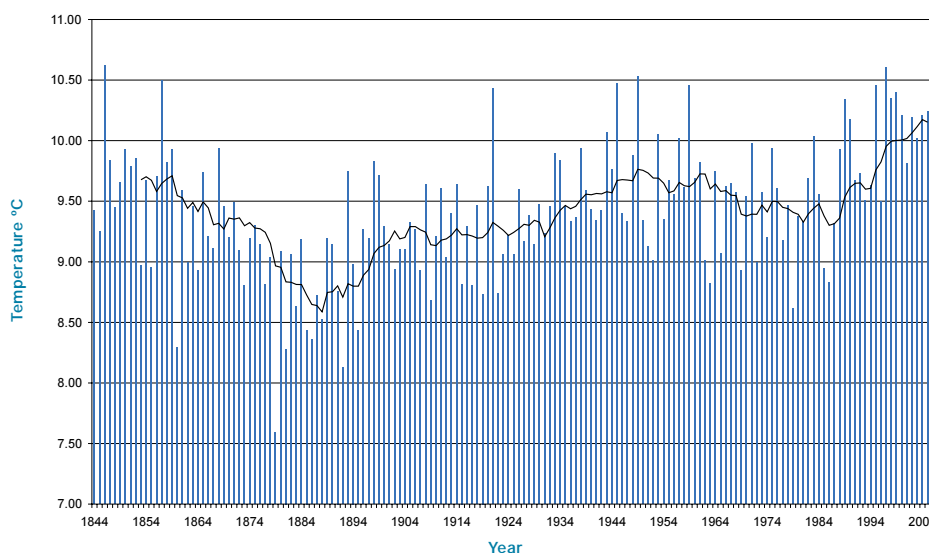
Future climate scenarios, based on climate models using varying estimates of greenhouse gas emissions are produced by the UK Climate Impacts Programme and provide the basis for the assessment of climate change impacts in this report. **Figure 2** and **Table 2** summarise the main changes in climate that we might expect to experience in terms of seasonal changes in temperature and precipitation (rainfall and snow) up to the 2080s. The changes shown are expressed relative to the observed climate for Northern Ireland over the period 1961 to 1990.

Table 2. Overview of expected Climate Changes for Northern Ireland

Climate variable	Likely change
Temperature	<ul style="list-style-type: none"> • Warmer (by between 1.0 and 3.5°C by the 2080s). • Summer and autumn will warm more than winter and spring. • Extremely warm days will become more frequent and heat waves will be more likely. The number of cold days will decline. • Sea surface temperatures will rise (by between 1.0 and 2.5°C by the 2080s)
Precipitation	<ul style="list-style-type: none"> • Drier overall (up to 10% drier by the 2050s). • Wetter springs and particularly winters. • Drier autumns and particularly summers. • Summer will become more reliably dry; precipitation in other seasons will become more variable. • More intense rainfall in winter and spring. • Large decline in snowfall.
Cloud cover	<ul style="list-style-type: none"> • Reduction, particularly in summer.
Relative humidity	<ul style="list-style-type: none"> • Reduction, especially in summer.
Soil moisture content	<ul style="list-style-type: none"> • Drier overall. • Marginal increase in winter and spring. • Significant reductions in summer and autumn.
Wind speed	<ul style="list-style-type: none"> • Wind speeds over land are likely to be similar in winter and spring and may decline in summer and autumn. • Extreme wind speeds at sea will be similar to those experienced at present, although in summer they will be lower. • Changes in wind speed are only predicted with low confidence.
Sea level	<ul style="list-style-type: none"> • Global mean sea level is expected to rise by between 9 and 69cm by the 2080s. Sea level rise in Northern Ireland will be less than this due to isostatic uplift (regional land movement due to the slow readjustment of land surface since the last ice age), but could be half a metre or more. • Changes in storm surge heights are uncertain, though not anticipated to increase much beyond the addition of mean relative sea level.

Figure 1. Mean Annual Temperature 1844-2002 (Armagh Observatory)

Source: EHS (2004a); original data from Armagh Observatory.



Despite significant advances in the science of climate change, there are still a number of uncertainties in the prediction of climate change and interpretation of the impacts. These relate to:

- Our ability to accurately model our climate system.
- Uncertainties in the way our environment may respond to changes in climate.
- Uncertainties in how future social and economic development may affect the emission of greenhouse gases.

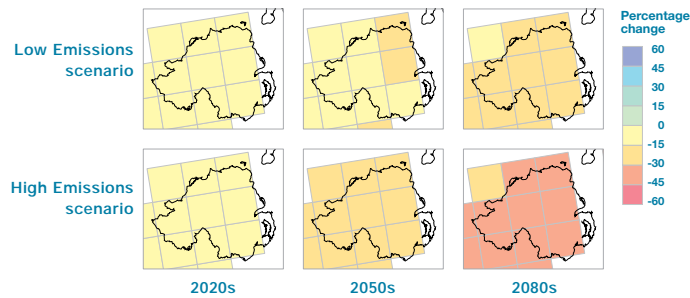
These uncertainties are not an excuse for inaction; there is now clear evidence that change is already happening (Figure 1).

Figure 2. UKCIP02 Climate Change Scenarios (Temperature and Precipitation)

The UKCIP02 climate change scenarios present a range of alternative descriptions of how climate may change, based on four different emissions scenarios. It is not possible to say which scenario is more likely, as this is mainly dependent upon future greenhouse gas emissions. The sets of climate change scenarios illustrated below indicate either end of the broad range of changes that we may face, the two medium emissions scenarios have not been included here.

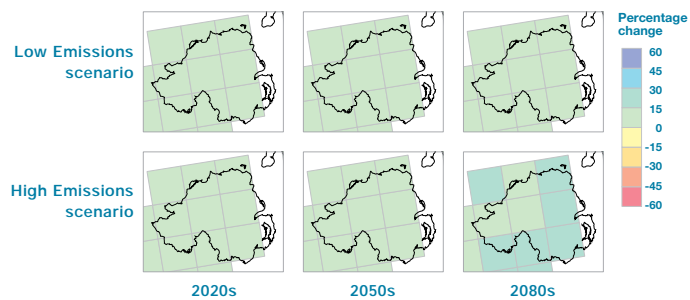
Northern Ireland Percentage change in summer precipitation

Source: UKCIP02 Climate Change Scenarios
(funded by Defra, produced by Tyndall and Hadley for UKCIP)



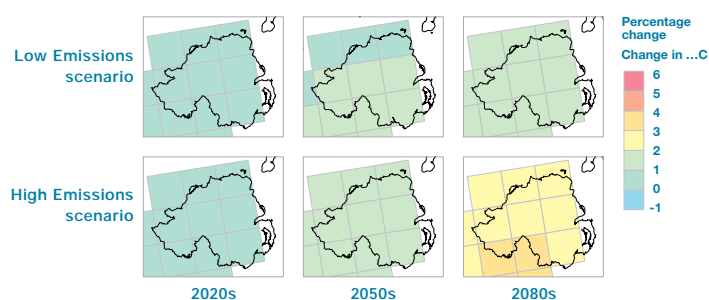
Northern Ireland Percentage change in winter precipitation

Source: UKCIP02 Climate Change Scenarios
(funded by Defra, produced by Tyndall and Hadley for UKCIP)



Northern Ireland Change in annual average daily temperature

Source: UKCIP02 Climate Change Scenarios
(funded by Defra, produced by Tyndall and Hadley for UKCIP)





Part of the great attraction to Northern Ireland is the range and condition of natural environments to be found here. These are contained within a diversity of landscapes, large areas of which are designated as Areas of Outstanding Natural Beauty.

Changes in climate will impact heavily on the natural environment. These impacts could be positive or negative but will result in a different environment in Northern Ireland from that which we know today.

The following identifies the key issues of a changing climate in Northern Ireland for the main sectors of the natural environment.

Conservation, Biodiversity and Habitats

Biodiversity in Northern Ireland includes approximately 20,000 different species distributed through land, air, rivers and lakes. Many of these species have been identified as being of great importance.

Threats

Threats to the conservation, biodiversity and habitats of Northern Ireland include:

- Distribution and species composition of habitats will change in response to warmer winters.
- Increase in range of invasive non-native species may threaten ecosystems, in response to warmer temperatures.
- Inter-tidal habitats, salt marshes and mudflats threatened through flooding and erosion.
- Loss of coastal grazing marsh.
- Estuarine and river ecology threatened by tidal flooding.
- Warmer sea temperatures affecting phytoplankton communities - the resulting decline in sand eel populations would adversely affect a wide range of seabirds.

Opportunities

Unfortunately the opportunities that a changing climate will bring to the conservation, biodiversity and habitats of Northern Ireland (e.g. expansion of one species, wetter winters for some habitats) tend to be accompanied by threats (e.g. loss of another species and drier summers respectively).

Recommendations

The report recommends that the following actions are carried out in Northern Ireland:

- Review of legislation to assess whether it will provide sufficient protection for priority/designated habitats in a changing climate and to identify whether revisions may be required.
- Review of monitoring to assess whether existing systems are sufficiently sensitive to the effects of a changing climate and identify where new systems may be required.
- Education and awareness: particularly focused on the human impact on species and habitats and the scale of the likely impacts of a changing climate.



Agriculture

Within Northern Ireland, agriculture is of major importance, both in a social and economic context. 7% of the workforce is employed directly in agriculture and there are many jobs depending upon related industries. The total value of this economic activity is in excess of £3.0 billion. The attractive and distinctive rural landscape of Northern Ireland is also heavily dependant upon the activities of the agriculture sector.

Threats

Threats to agriculture in Northern Ireland include:

- Field drainage issues in wetter weather.
- Potential impacts on crop yields.
- Potential impacts on animal health.

Opportunities

Opportunities for agriculture in Northern Ireland include:

- Potential for growing new crops.
- Reduced cold weather problems including frost damage and a decrease in time that animals need to be kept indoors.

Recommendations

The report recommends that the following actions are carried out in Northern Ireland in relation to agriculture:

- More detailed assessment of risks and opportunities geographically specific to Northern Ireland agriculture.
- Education and raising awareness: specific to Northern Ireland context and needs to inform and drive new practices.
- Ongoing review of agricultural reform strategies, e.g. CAP reform, to ensure their flexibility in relation to a changing climate.



Forestry

Land cover in Northern Ireland was dominated by woodland in the past, but clearance reduced woodland cover to 1.4% immediately after the First World War. Today forestry covers about 6% of Northern Ireland and makes a small but valuable contribution to the rural economy.

Threats

Threats to forestry in Northern Ireland include the following:

- Hotter, drier summers will increase water uptake by woodlands, restricting planting in areas with limited water availability.
- Risk of increasing frequency of forest fires, dependent on species and age structure of forest.
- Changing incidence of insect pest and disease outbreaks e.g. increasing impact of the green spruce aphid on commercial plantations of Sitka spruce.
- Extended summer droughts leading to widespread tree mortality.

Opportunities

Opportunities for Forestry in Northern Ireland include:

- Higher potential productivity resulting from increased warmth and higher CO₂ levels.
- Changing climatic conditions will alter site suitability of tree species that are currently planted and this may bring benefit in some areas.
- Increased commercial planting as part of a mitigation strategy.
- Expansion of woodland, including riparian woodland, may be required to offset soil erosion and fluvial flooding, to provide shade for fish and amenity for leisure activities.

Recommendations

The report recommends that the following actions are carried out in Northern Ireland in relation to forestry:

- Review of how woodlands may help with adaptation across sectors - for example planting in flood plains can reduce downstream flood flows.
- Further research and identification of a strategy for exploiting potential opportunities provided by climate change (including mitigation) for the Northern Ireland forestry sector.
- Development of the Ecological Site Classification decision support system for aiding species selection under climate change scenarios to Northern Ireland to help in long-term planning.
- Development of Best Practice guidelines to ensure that forestry and woodland management in Northern Ireland is resilient to climate change. Gaps in current research should be addressed. Forestry sector should use risk assessments to formulate an adaptation strategy.



Fisheries

Fishing in Northern Ireland and around its coast is a major recreational and economic activity. As well as an active and important commercial fishing fleet mainly operating out of Ardglass, Kilkeel and Portavogie, many people are economically reliant on fishing, in the Lough Neagh eel fisheries or in the growing aquaculture industry. Added to these people are the large numbers who fish on a recreational basis.

Threats

Threats to fisheries in and around Northern Ireland include the following:

- Increased frequency of flooding could lead to decreased fish egg survival and washing away of juvenile salmon.
- Lower flows, lower water quality and increased temperatures leading to fish kills.
- Increased temperatures can be lethal for some fish such as salmon.
- The melting of the polar ice pack has cooled the northern Atlantic, reducing the extent of thermally attractive habitat for salmon.
- Angling affected by disturbance of breeding season of fish.

Opportunities

Opportunities for fisheries in and around Northern Ireland from a changing climate are limited but warmer waters may provide benefits to aquaculture including higher growth rates and new species.

Recommendations

The report recommends that the following actions are carried out in Northern Ireland in relation to fisheries:

- Further research focussing particularly on:
 - ~ those species more valuable to Northern Ireland for both biodiversity and economic reasons; and,
 - ~ potential advantages of new target species in the marine environment.
- Review of the potential impacts on ports or river structures.



Water Resources

Within Northern Ireland, 630 million litres of drinking water are supplied to the public every day from an infrastructure of 48 impounding reservoirs, 47 major treatment works and 25,000km of water mains. 134 million cubic metres of wastewater are collected and treated each year, along with the disposal of the contents from over 59,000 private septic tanks. The infrastructure to carry this out consists of 13,000 km of sewers and 918 wastewater treatment works.

Threats

Threats to water resources in Northern Ireland include the following:

- Lower flows may cause problems for users relating to abstraction, ability to dilute effluent, aquatic ecology and recreation.
- Increased temperatures may cause problems with river and reservoir water quality e.g. dissolved oxygen depletion, algal blooms, physiological impact on fish.
- Storms may cause more combined sewer overflows, damaging aquatic life.
- Increased rainfall causing erosion of soil and leaching of agrochemical and agricultural wastes with problems for aquatic life, abstractions and river users.
- Reduction in volume of sewer base flow may result in blockages, leading to environmental health and flooding problems.
- Drier, hotter summers will increase demand for water, affecting ability of abstractors to meet requirements.
- Lower summer runoff leading to reduced flushing of estuaries and lakes with implications for shell fisheries, lake ecology and abstractors.
- Higher evaporation and lower inflows leading to reduction in open water storage e.g. Lough Neagh, which may affect marginal habitats and abstraction.
- Increase in pests and change in life cycle of aquatic and land-based organisms.
- Summer storms, following dry periods, may lead to high pollutant loads, damaging aquatic habitats.

Opportunities

Opportunities are limited but increasingly wet winters could provide an opportunity for increased water storage. Business opportunities may arise from increased demand for water efficient products.

Recommendations

The report recommends that the following actions are carried out in Northern Ireland in relation to Water Resources:

- More detailed modelling of impacts on Northern Ireland water resources, addressing long-term impacts on supplies, environment and water quality.
- Further development of adaptive actions already identified, many of which include wider environmental benefits. Some adaptation may be realised through compliance with the Water Framework and Nitrates Directives.
- Ensure risks and adaptation are adequately represented within long-term planning for water resources e.g. in schemes such as reservoirs. Adaptation costs can be minimised by maintaining and improving current infrastructure.
- Changes to the planning processes and regulatory framework for the water sector in Northern Ireland will provide opportunities for the development of adaptive planning.



In Northern Ireland, the built environment has developed over many years and been designed with our climate in mind. Components range from coastal and flood defences that we rely on to protect us, our land and property from flooding, to the buildings in which we live. All these components will be subject to pressure from a changing climate in Northern Ireland.

Coastal and Flood Risk Management

The coastline of Northern Ireland is 650km long and is characterised by stretches of cliffs and rock, tidal inlets and sea loughs, as well as stretches of long sandy beaches and dunes. 26km of this coastline has hard engineering features designed to prevent erosion. Within the river network of Northern Ireland, 6,758km of river and small watercourse are maintained in order to prevent flooding.

Threats

Threats to coastal and flood risk management in Northern Ireland include the following:

- Increase in winter fluvial flooding, with impacts on: settlements; farms and agricultural land; natural heritage; transport infrastructure; the economy; and health.
- Increase in flash flooding, with impacts on: urban infrastructure, buildings (including built heritage), utilities and transport; businesses; the economy; and health.
- Increase in flooding and erosion at the coast, with impacts on: coastal habitats; coastal settlements; coastal transport infrastructure; and agricultural land.

Opportunities

No opportunities or benefits have been identified in relation to coastal and flood risk management; however, there may be opportunities in related areas e.g. new habitat creation projects.

Recommendations

The report recommends that the following actions are carried out in Northern Ireland in relation to coastal and flood risk management:

- More specific modelling of the impacts on flood risk in Northern Ireland.
- Strategic assessment of flood and erosion risks, and specific risk assessments for individual sites and infrastructure projects.
- Evaluation of options such as upstream source control, flood storage and flood protection, as well as non-structural methods such as flood warning and insurance.
- Specific focus on options for managing coastal change, including construction of sea defences and managed realignment.
- Cross-sector implications: overlaps with biodiversity provide both opportunities and threats that will need further specific risk assessment and adaptive planning.



Buildings, Construction and Planning

Towns, cities and the structures within them are artificial environments designed to mitigate past and current climatic conditions for human comfort. Where future weather and climate departs from those conditions, structures and facilities may prove unfit for purpose.

Threats

Threats to buildings, construction and planning in Northern Ireland include the following:

- Increase in winter flooding, with impacts on: settlements; buildings and built heritage; transport infrastructure; water infrastructure (supply and drainage); the economy; health and comfort; urban green spaces; and construction.
- Increase in summer temperatures and drought, with impacts on: buildings and settlements; infrastructure; green spaces and soil moisture; construction; urban heat island; and waste management.
- Sea level rise leading to an increase in flooding and erosion at the coast, with impacts on: settlements and buildings; infrastructure (transport, water, communications, waste); and coastal urban green spaces.

Recommendations

The report recommends that the following actions are carried out in Northern Ireland in relation to buildings, construction and planning:

- Strategic actions: research, raising awareness, consideration of longer-term plans and seeking changes to planning policy.
- Location and urban design actions: adaptation of infrastructure at risk, reduction of flood risk, use of green spaces and sustainable urban drainage systems.
- Building design: Reducing heat gain within buildings, use of green roofs, opportunities for energy and water-efficient new-build houses.
- Historic buildings: Improved management and maintenance of current buildings, development of strategies to adapt to changing climatic conditions.
- Waste management: assess potential impacts, sites at risk and options for effective planning.
- Review regulatory framework and incentives provided for adaptive planning within Northern Ireland.



Economic infrastructure is vital to Northern Ireland. Business, insurance, transport and energy are key elements in our everyday working and domestic lives, for the purpose of channelling flows of goods, services, people and energy within Northern Ireland and beyond.

Recent extreme weather events have demonstrated the vulnerability of transport and energy systems and the knock-on implications for business. Tourism relies heavily on a good infrastructure, and is itself the second most important indigenous industry in Northern Ireland. It has enormous potential for future growth, which may benefit from future changes in climate.

Business

The economy of Northern Ireland is strong and growing. There has been a decline in traditional heavy industry but a dramatic increase in the 'knowledge led' economy and unemployment is at a record low. However, there remain economic variations within Northern Ireland with some areas still suffering high levels of unemployment and associated social deprivation.

Threats

Business is sensitive to generic impacts such as flooding as well as weather-related effects on product demand. Threats to business in Northern Ireland include:

- Wetter winters leading to damage of stock and premises, supply chain problems, loss or reputation and insurance and investment issues.
- Problems of exposure to outdoor workers in hotter summers.
- Decline or shift in demand for certain seasonal goods.

Opportunities

However, there will also be opportunities for businesses which can adapt, for example:

- Boost to sales of summer goods e.g. water retention products, drought tolerant plants.
- Opportunity for business growth in outdoor activities and al-fresco retail.
- Increased demand for cooling products.

Recommendations

The report recommends that the following actions are carried out in Northern Ireland in relation to business:

- Increase awareness of climate change threats and opportunities.
- Address the lack of priority given to climate change due to short-term business and economic pressures.
- Develop specific tools, guidance and climate data for risk assessments that match business needs, which vary across the sector.
- Embed climate change adaptation into existing risk management and decision support strategies.



Insurance

The insurance sector will be significantly affected by climate change and is likely to have a major role in influencing responses to climate change across socio-economic sectors. It is largely for these reasons that the insurance industry is one of the most advanced in assessing climate change impacts and in identifying ways in which to adapt.

Threats

Climate change is likely to affect customer needs and the nature of cover, while altering the pattern of claims and risk to which insurers are exposed. Threats to insurance in Northern Ireland include:

- Increase in inland and potentially coastal flooding under wetter winters and rise in sea level, leading to an increase in flood-related property claims and business continuity claims.
- Increase in subsidence claims in hotter, drier summers.

Opportunities

No opportunities or benefits have been identified for the sector overall, although there will be opportunities for new products and a reduction in certain claims (e.g. cold-weather related accidents).

Recommendations

Although the insurance industry is one of the most proactive sectors for climate change research, little research has examined Northern Ireland specifically. Insurers are expert at dealing with risk and insurance could be a valuable tool in managing future weather-related risk. However, as insurers rely on sharing the burden of risk, insurance should be employed alongside other adaptation measures.



Transport

Northern Ireland is almost totally dependent on a road based transport system reflecting the small internal transport market and dispersed settlement pattern. However, there is also a limited rail network, while ports and airports provide key gateways beyond Ireland.

Threats

Transport, and in particular roads, are already vulnerable to extreme weather. Threats to transport in Northern Ireland include:

- Wetter winters and inland flooding, leading to: infrastructure damage; problems for emergency services; delays to users; and road safety issues.
- Wetter winters with increased flooding and scour, leading to destabilisation of bridge/embankment foundations.
- Drier summers with drier soils and vegetation, leading to increased risk of fire and increased risk of subsidence (on clay soils).
- Hotter summers with more extreme temperatures, leading to: increased discomfort/exposure for travellers; economic cost of infrastructure damage e.g. road rutting; and respiratory problems associated with deterioration in air quality.

Opportunities

The main opportunity for the sector will be the likely increase in demand for walking and cycling.

Recommendations

The report recommends that the following actions are carried out in relation to transport:

- Review of current standards for infrastructure such as drainage, earthworks, roads, railways, bridges, sea defences and tunnels and implications of a changing climate.
- New highway infrastructure should include additional capacity to account for climate change, including paying particular attention to storm drainage, culvert sizing and flow attenuation.
- Existing highway infrastructure should be assessed to determine if alterations are necessary.
- Emergency planning should take account of changing climatic extremes.
- Although there are limited railways in Northern Ireland, links should be made with research programmes elsewhere in the UK with regards to adaptation measures such as coastal defences, flood risk and embankment stability.

Tourism

Northern Ireland has excellent natural resources, including unspoilt countryside, some unique natural features and a strong cultural heritage, all enabling diverse tourism opportunities. It has also benefited from increased low budget air transport providing excellent accessibility, which has facilitated more short break and weekend trips.

Threats

Tourism will be affected by and will benefit from climate changes both in Northern Ireland and internationally.

Specific risks for Northern Ireland include:

- Wetter winters, which will affect outdoor tourism activities.
- Coastal changes, which may cause flooding and degrade beaches.
- Dry summers, which may cause water shortages and be detrimental to the natural environment.

Opportunities

Opportunities for tourism in Northern Ireland include:

- Drier, hotter summers, which will increase domestic tourism opportunities.
- Warmer winters, allowing more year round tourism.
- More outdoor and water based activities due to hotter weather.

Recommendations

Tourism tends to have a very short-term outlook that prevents effective planning for a changing climate. The report recommends that the following actions are carried out in relation to tourism:

- Detailed sector-specific research into the impact of a changing climate on tourism in Northern Ireland. This should examine the opportunities for increased tourism that may be provided and the strategies and policies required to develop opportunities and adapt to impacts.
- Education: for tourists and operators of their impacts on climate to ensure there are few barriers to the implementation of new adaptation measures and new opportunities are maximised.

Energy

Northern Ireland has significant energy problems due to its near complete reliance on imported fossil fuels and high levels of fuel poverty in the population. At present there is a major cross border review of the energy supply market on the whole of the island of Ireland, which aims to provide competitive, sustainable and reliable markets in electricity and natural gas at the minimum cost necessary.

Threats

Electricity infrastructure is currently affected by extreme weather and there have been a number of examples where severe storms have left thousands of homes without power. We should also recognise that public services in Northern Ireland are in themselves major users of energy. Threats include:

- Heightened risk of subsidence and heave, leaving structures vulnerable to damage or collapse.
- Greater demand for air conditioning in summer, altered demand profile and operational variations by power suppliers. Health implications for those without access to cool buildings.
- Reduced soil moisture content and heightened risk of subsidence in vulnerable areas.
- Greater levels of damage to power supply infrastructure (e.g. trees coming into contact with power lines).

Opportunities

Benefits under climate change include a reduction in winter heating needs and winter fuel poverty.

Recommendations

There is a major gap in terms of adaptation to climate change in the Northern Ireland energy sector. While some research exists at the UK level, there is no strategy or evidence of adaptation in practice within Northern Ireland. The report recommends that the following actions are carried out:

- Improve the resilience of the electricity transmission network to weather.
 - Undertake a risk assessment of power stations in areas that may be vulnerable to flooding.
 - Ensure that the growing gas infrastructure is climate-proofed.
 - Consider adaptation in the planning of new energy infrastructure, particularly renewables infrastructure, with which there is little experience of weather impacts.
 - Undertake research into demand and consumption of energy with respect to climate change and socio-economic scenarios.
-



Social Wellbeing is considered to be those aspects of life that society collectively agrees are important for a person's happiness, quality of life and welfare. These factors interconnect with each other and consequently, where there is a negative impact on one aspect, there can be a knock-on effect on other aspects. For the purposes of this report we have considered two aspects of social wellbeing - Health and Sport & Recreation and the impact of a changing climate on these in Northern Ireland.

Health

There are large inequalities in the health of the people of Northern Ireland. Economic and social inequalities result in ill health and early mortality having a greater frequency among certain groups, particularly the most economically disadvantaged sections of society. A further complicating factor to health care provision is the impacts - both positive and negative - that a changing climate could bring.

Threats

Threats to health in Northern Ireland include:

- Coastal and riverine floods. Flooding is known to have serious impacts on physical and mental health.
- Hotter summers with increased "heatwave" events, leading to increase in: hospital admissions; respiratory problems; heat-related mortality and morbidity; and occupational heat stress.
- Hotter summers (and milder winters) leading to increased bacterial growth, and activity of pests (flies, rodents).
- Longer summers leading to increased exposure to UV - and its consequent health effects.

Opportunities

Opportunities for health in Northern Ireland include:

- Reduction in cold weather-related mortality and morbidity.
- Potential improvement in public health related to increased opportunities for physical recreation.

Recommendations

The report recommends that the following actions are carried out in Northern Ireland in relation to health:

- Sector specific policy review looking at the impacts of a changing climate on health and wellbeing in Northern Ireland and their relation to competing considerations in the Northern Ireland health sector.
- Consideration given to Northern Ireland being included within the UK Heatwave Plan.
- Infectious disease surveillance should be strengthened.
- Registries of extreme events and their impact on the public health should be set up for monitoring purposes.



Sport and Recreation

Sport and recreation provide numerous tourism opportunities in Northern Ireland and also an important social and economic function for residents of Northern Ireland. There is a wide range of sports and recreational activities undertaken in Northern Ireland, from traditional sports like Gaelic football and hurling, through to universal sports such as football, hockey, rugby and golf. The majority of the population of Northern Ireland participate in some sport or recreational activity.

Threats

Threats to sport and recreation in Northern Ireland include:

- Wetter winters will affect outdoor sport and recreation (adverse conditions for play).
- Dry weather may be detrimental to local habitats and species which are vital for nature based recreation.
- Reduced soil moisture will affect pitches and sports grounds.
- Increase in storm intensity and frequency may cause the cancellation of outdoor activities.
- Damage to sporting and recreation facilities, for example through flooding and drought.

Opportunities

Opportunities for sport and recreation in Northern Ireland include:

- Drier, hotter summers will allow increased outdoor sport and recreation.
- Increase in water based recreation and sports.
- Warmer winter weather will allow more year round outdoor sport and recreation.

Recommendations

Sport and recreation tend to be reactive and strongly dominated by social factors, which make it difficult to effectively plan for climate change. Although generic impacts can be identified, there is a need for further basic research incorporating climate change and socio-economic scenarios, from which future policies can be developed. There are significant opportunities for this and related sectors such as health; these will need to be realised through a coordinated approach involving education, transport, health and sector-specific agencies.



Cross-sector Impacts

Impacts may affect several sectors and the knock-on consequences for those sectors will have implications for adaptation to climate change. A number of potential cross-sector impacts have been identified, relating to the reduction in summer rainfall, warmer summers (see box) and increasing winter flood risk.

Example cross-sector impacts of a changing climate

A significant reduction in summer rainfall will have particular consequences for the natural environment, although public water supplies may also be affected. Impacts include species and habitat loss, increased fire risk, freshwater eutrophication, increased irrigation needs, oxidation of peatlands and increased susceptibility of trees to disease. These impacts are highly inter-connected, not least because of the competition for water between habitats, species and human uses. Adaptation measures will need to take the whole rural environment into account to ensure that actions to reduce impacts in one area do not adversely affect another. However, carefully planned actions can provide multiple benefits e.g. winter storage reservoirs could be used to benefit agriculture as well as local habitat.

Warmer summers and more extreme hot weather may provide a mixture of opportunities and threats, requiring different responses. Warmer weather provides the opportunity to enjoy a more outdoor lifestyle, with benefits to tourism, sport and recreation, and health. However, in realising these opportunities we will need to be careful to avoid negative impacts e.g. shade may be required to mitigate risks of heat-stroke and longer-term issues associated with skin cancer. Buildings and transport may also become more uncomfortable and may require adaptation, and this could have implications for greenhouse gas emissions (e.g. through air conditioning).

The accompanying technical report, *'Preparing for a Changing Climate in Northern Ireland'*, Arkell, B., Darch, G., and McEntee, P. (eds), *SNIFFER UKCC13 (2007)*, documents the implications of climate change impacts on public services and identifies the public bodies responsible for adaptation. For most impacts there is more than one area of the public sector involved and at least one responsible public body, which means that a cross-sector, multi-agency approach to adaptation is required. Planning (and therefore the Planning Service) has a role in several sectors. The Department of the Environment needs to continue its co-ordinating role, to include leadership on raising awareness, monitoring and managing implementation. Strong links will also be required with the Office of First Minister and Deputy First Minister, the lead office on Sustainable Development.

Climate change is likely to make achievement of the Government's priority themes more difficult (see [Table 3](#)). This is recognised in the Sustainable Development Strategy, which itself must consider the impacts of climate change in the delivery of each target. By considering climate change impacts now, policies can be 'future proofed' by planning adaptation. In this respect sustainable development can be a useful tool for promoting wider adaptation to climate change.

Table 3. Impacts of Climate Change on Climate-Sensitive Outcomes related to Government Priority Themes as set out in Priorities and Budget 2005-2008.

Theme	Climate-sensitive outcome	Effect of climate change
Economic Competitiveness	A modern infrastructure to support economic development.	Infrastructure directly affected by flooding and hot weather in particular; adaptation built in now/at routine upgrade will be more cost effective.
	Achievement of a competitive, sustainable and reliable energy market.	New infrastructure must take into account future climate. Seasonal and peak demand will be influenced by future climate.
	Higher productivity and engaging in higher value-added activities with emphasis on creativity, innovation and export.	Opportunities for innovation include development of renewables, new crops and food products, water efficient fixtures and fittings, traffic management systems and new financial products. Tourism could become a more significant earner.
	Developing the agri-food industry.	Threats associated with wetter winters and drier, hotter summers. Benefit of longer growing season; opportunities for new crops and food products.
Building Equality & Community Cohesion	Provision of affordable, energy efficient and fit housing.	Housing should be robust to future climate, including higher peak rainfall intensities and extreme hot weather, and a reduction in water availability.
Better Public Services	Achieving sustainable and long-term improvements in people's health.	Climate change may provide opportunities to improve health e.g. exercise in warmer conditions and there will be a reduction in cold weather mortality and morbidity. Hot weather impacts e.g. fatalities among the elderly will require adaptation.
	Enhancement of water, roads and transport infrastructure to improve quality of life and contribute to sustainable regional growth.	Infrastructure directly affected by flooding and hot weather in particular; adaptation built in now/at routine upgrade will be more cost effective.
	To respond to increasing demand for water, and comply with water quality standards.	Demand from humans and the environment will increase, but supplies may reduce. Adaptation should include demand management and supply development. Lower summer flows are likely to reduce compliance; flow augmentation or more stringent discharge consents (and effluent treatment) will be required.

Adaptation

Current approaches to adaptation vary between sectors and between organisations within sectors. Whilst some organisations are moving towards adaptation, at least in certain functions or with regards to particular strategies, many are delaying, adopting a 'wait and see' approach. A number of constraints to adaptation have been identified, including uncertainty about future climate conditions, funding and human resources and the short timescales over which some sectors plan.

Climate change needs to be given a higher priority across all sectors and within each of the public bodies identified as being responsible for adaptation. This is particularly important in relation to Social Wellbeing and Economic Infrastructure sectors (especially health, sport and recreation, tourism, business and energy), where action is particularly limited at present. For other sectors, particularly Natural Environment, the research that is being undertaken needs to be carried through into policy and strategy development.

The future is inherently uncertain and decision-making will need to incorporate flexibility and look for opportunities to implement no and low-regret solutions. This will be particularly the case for those sectors where high investment, long-term decisions are being made e.g. in relation to large areas of land or infrastructure with a long asset life. Planning for climate change now is likely to yield benefits in the future,

by reducing the need for expensive re-active solutions. In many cases there are opportunities for no- or low-regret solutions, particularly in relation to improving the ability to cope with current weather-related impacts. There are also win-win opportunities to adapt to several impacts with one action e.g. planting of floodplain and riparian woodland to alleviate flooding, provide shade and maintain lower water temperatures, while increasing Northern Ireland's tree coverage.

A rise in the profile of climate change adaptation will need to be accompanied by appropriate resources to undertake detailed impact assessments and to identify and implement adaptation measures. In the short-term, funding will be required to build capacity (e.g. research, staff training) within key sectors, moving over the medium to long-term to the delivery of adaptation measures.

Several general themes in adaptation are apparent from the sector-based review. These can be grouped under the two main elements of the UK's Adaptation Policy Framework:

Building adaptive capacity:

- Raising awareness.
- Increase training and knowledge.
- Contribute to the development and use of climate change scenarios for Northern Ireland, to include comparison of EPA and UKCIP output.
- Development of socio-economic scenarios for Northern Ireland for use alongside climate change scenarios in detailed impact assessments.
- Review of legislation, regulations, policies and procedures with respect to protection from climate change and provision of incentives for adaptation.
- Contingency/emergency planning.
- Improve monitoring and records of extreme weather events.
- Incorporate climate change into existing models.
- Include climate impacts and adaptation in strategies and plans, with scheme specific risk assessments.
- Consideration of cross-sector implications of responses: threats and opportunities.

Delivering adaptive actions:

- Increase resilience e.g. diversification; buffer zones.
- Accept losses where feasible e.g. coastal realignment.
- Avoid losses e.g. by altering building materials.
- Embrace change e.g. new species and maximising opportunities provided.
- Exploiting opportunities provided by mitigation (e.g. woodland/forestry management).
- Planning for risks and opportunities in new infrastructure projects (water, sewerage, flood risk, transport, construction etc).
- Changes to management and maintenance practices to accommodate changes in climate.
- In building design/construction: managing heat gain; energy, water and environmental efficiencies.
- Enhanced health surveillance and heat wave response.

What happens next?

This study emphasises the broad range of impacts that a changing climate could have on our region. We need to plan ahead to take advantage of the opportunities and manage the threats.

The study identifies the main issues that public services in Northern Ireland will need to consider in terms of the impacts and needs for adaptation to a changing climate. More detailed sector or scheme specific assessment of risks and opportunities is needed. However, as we have shown here, the actions we may take for one sector or organisation could significantly affect others. Our success will depend on the development of actions in partnership in the region.

In recognition of the need for partnership working, a Northern Ireland Climate Change Partnership is to be formed. This will provide a platform for cross-sectoral consideration of climate change. It will also be linked to similar partnerships in the UK more generally and the

Republic of Ireland so that Northern Ireland benefits from best practice elsewhere. The immediate task will be to ensure that each responsible public body takes forward actions to implement the adaptation strategies identified in this report. Beyond this there will be a need to monitor and evaluate progress on an ongoing basis. This will provide Northern Ireland with the best chance to be prepared for the inevitable consequences of climate change.

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The document should be referenced as:

Preparing for a Changing Climate in Northern Ireland: summary report, Arkell, B., Darch, G., and McEntee, P (eds), SNIFFER UKCC13A (2007)

The full technical report *Preparing for a Changing Climate in Northern Ireland* may be found at www.sniffer.org.uk (project code UKCC13)

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