



**Comhairle Cathrach
& Contae Phort Láirge**
Waterford City
& County Council

Climate Change Adaptation Strategy

2019 – 2024

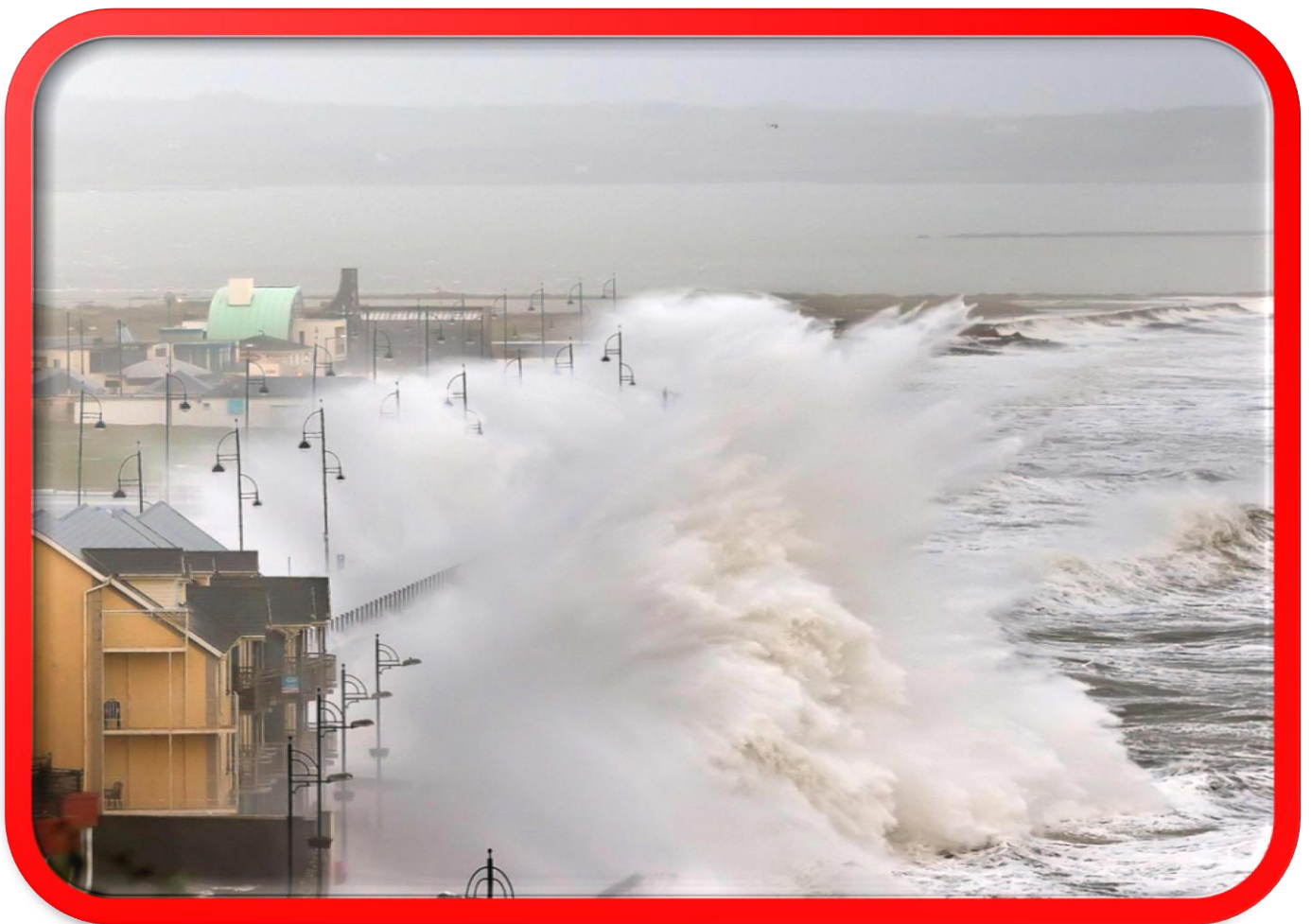


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The adaptation to climate change is one of the greatest challenges that the County of Waterford will have to engage with this century. To date Waterford City and County Council has implemented measures to adapt to climate change, which includes installation of flood barrier, tidal surge protection, rising road levels that are prone to flooding, increase in services provided by the emergency services etc. The effects of climate change including rising sea levels and extreme climatic weather events will have impacts on communities, businesses and on the Local Authority's ability to continue providing its level of services to its customers in the future. The taking of proactive adaptation action to adjust and prepare for a changing climate is critical to increase the resilience of our economy, environment and communities. Local government will play a key role in building climate resilience in our communities in adapting to future climate change events. The role of elected members on Strategic Policy Committees and the Corporate Policy Group will provide an opportunity to help shape this council's response to the challenges and opportunities of climate change.

John Pratt,
Mayor of Waterford City and County



Waterford City and County Council and the previous Local Authorities of Waterford have implemented adaptation measures in a response to climate change.

Climate action is now top of the political agenda in Ireland and guides the principles underpinning the National Planning Framework and National Development Plan. A more coordinated strategy is now required as the effects of climate change are becoming more pronounced. This strategy considers the impacts of recent severe weather events recorded in the county and how we have reacted and managed our services in the most difficult of circumstances and the likely risks that the county will experience from climate change in the future. I welcome the development of this Climate Change Adaptation Strategy, coming at the beginning of a new term of Council and support the implementation of "Goals, Objectives and Actions" over the 2019-2024 strategy period. The actions within the strategy will be delivered throughout the County to allow for adaptation to the effects of climate change and will further strengthen Waterford City and County Council's ability to be climate resilient in day to day operations.

Michael Walsh
CEO Waterford City and County Council

Executive Summary

Climate Change and Adaptation Background

Climate change impacts are already being felt globally and academic research has highlighted that climate change trends being observed worldwide are expected to intensify in the coming decades. The most likely risks to Waterford/Ireland are, but not restricted to, extremes in weather events such as increasing precipitation levels, more intensive storms, heatwaves, coldwaves and periods of increasingly heavier snowfalls. These extreme events and other effects from change climate such as rising sea levels will create many new and difficult challenges which will be faced by Waterford City and County Council and the communities that WCCC serve.

Climate Change requires a policy response in both:

- Adaptation to ensure communities, and society as a whole, become resilient to the impacts and risks of climate change.
- Mitigation to considerably reduce greenhouse gas emissions. (This item will be covered in other policy documents and not this “Adaptation Strategy”).

Reference and guidance was taken in the preparation of this document from the “Local Authority Adaptation Strategy Development Guidelines” which has been published by the “Department of Communications, Climate Action and Environment” (DCCAE). WCCC also received guidance from the Climate Action Regional Office “CARO” in Kildare in the preparation of this strategy. A “Draft Strategic Environmental Assessment Screening Report” (SEA) and an “Appropriate Assessment Screening Report” (AA) have also been prepared and are supplementary to this strategy document.

Document Contents

This strategy subject to adoption by WCCC will run from 2019 -2024 and will be subject to an annual review. A *baseline assessment was undertaken to examine weather data of severe weather events, which occurred as far back in the past as could be reliably sourced.* The assessment included a review on the impact of the seven relevant operational areas of WCCC which include

- Business Operations & Continuity
- Infrastructure & Built environment
- Water services
- Biodiversity
- Land-use & Development policy
- Community health & Well-being

➤ **Coastal & Maritime**

The extreme weather events considered in the baseline assessment for the operational areas included extreme and/or prolonged high/low temperatures/rainfall/wind speeds and severe snowfall events. Also considered are combination events which are meteorological hazards which can be a combination of any two or more of the hazards.

A *climate risk register* details the risks associated with an increasing severity of the listed extreme weather events, along with sea level rises, over the life time of this strategy and on the operational areas of WCCC. As a means to implement the strategy a list of eight high levels *goals* were developed for the operational areas of WCCC and include

- **Business Operations and Continuity,**
- **Infrastructure and Built Environment**
- **Land Use and Development Policy**
- **Water Services**
- **Natural Resources and Cultural Infrastructure**
- **Community Health and Wellbeing**
- **Biodiversity**
- **Marine and Coastal Erosion.**

The goals are further broken down into *objectives* covering specific categories within each operational area, which are further broken down into a total of seventy-five *actions*. The actions detail the role of specific Departments within WCCC and other external agencies to implement the high level goals.

The final section of the document details how WCCC will structure the implementation of this strategy, monitor its progress and evaluate future projects via a Climate Action Steering Group (CASG). The CASG will develop and agree appropriate time frames and mechanism to report on the implementation of the actions of this strategy to various structures within WCCC and to the DCCAE and CARO on an annual basis.

List of Abbreviations

AA	Appropriate Assessment
BIM	Bord Iascaigh Mhara
CARO	Climate Action Regional Office
CASG	Climate Action Steering Group
CCAS	Climate Change Adaptation Strategy
CDP	County Development Plan
CCMM	Climate Change Mitigation Measures
CFRAM	Eastern Catchment Flood Risk Assessment and Management
COP	Conference of the Parties
CSO	Central Statistics Office
DAFM	Dept. of Agriculture, Food & Marine
DCCAIE	Dept. of Communications, Climate Action & Environment
DHPLG	Dept. of Housing, Planning & Local Government
DTTAS	Dept. of Transport, Tourism & Sport
EC	European Commission
ECAP	European Climate Adaptation Platform
ENGO	Environmental Non-Governmental Organisation
EPA	Environmental Protection Agency
ESB	Electricity Supply Board
GHG	Greenhouse Gases
GIS	Geographical Information System
HSE	Health Service Executive
ICIP	Ireland's Climate Information Platform
IPCC	Intergovernmental Panel on Climate Change
IS	Information Systems
LA	Local Authority
LCDC	Local Community Development Committee
LEA	Local Energy Agency
LEADER	Waterford LEADER Partnership Ltd.
LEO	Local Enterprise Office
NAF	National Adaptation Framework
NAP	National Adaptation Plan
NBDC	National Biodiversity Data Centre
NCCAF	National Climate Change Adaptation Framework
NGO	Non Governmental Organization
NMP	National Mitigation Plan
NPF	National Planning Framework
NPWS	National Parks & Wildlife Service
OPW	Office of Public Works
PPN	Public Participation Network
PT	Planning Team
RSA	Road Safety Authority
SAC	Special Areas of Conservation
SEA	Strategic Environmental Assessment
SEAI	Sustainable Energy Authority of Ireland
SLR	Sea Level Rise
SPA	Special Protection Areas
SWAT	Severe Weather Assessment Team
TII	Transport Infrastructure Ireland
UNFCCC	United Nations Framework Convention on Climate Change
WCCC	Waterford City & County Council
WEB	Waterford Energy Bureau
WFD	Water Framework Directive

Waterford City & County Council Vision Statement

Waterford City & County Council recognises that climate change adaptation will be one of the biggest challenges for the local authority this century. Waterford City & County Council will endeavour to implement best practices and incorporate solutions that will meet climate change adaptation requirements and service the needs of the communities.

1 Introduction & Background

1.0 Introduction

The earth's climate is changing. While natural fluctuations in climate are considered normal, emerging research and observational records from across the world show rates of change that are far greater than those experienced in recent history. Global temperatures have risen and are projected to increase further bringing changes in weather patterns, rising sea levels and increased frequency and intensity of extreme weather. Ireland's climate is changing in line with global patterns and these changes are bringing significant and wide ranging economic, environmental and social impacts.

Climate change is now recognised as a global challenge with policy responses required in terms of both mitigating the causes of climate change and in adapting to the now inevitable consequences of our changing climate. Action at a local level is vitally important to help reduce the risks and impacts of climate change across communities.

This **Climate Change Adaptation Strategy (CCAS)** is the start of the process of adaptation planning in **Waterford City and County Council (WCCC)** and is the first step in increasing knowledge and understanding of our changing climate, growing resilience and enabling effective responses to the threats posed by climate change.

1.1 Purpose of this Strategy

This adaptation strategy forms part of the **National Adaptation Framework (NAF)** which was published in response to the provisions of the **Climate Action and Low Carbon Development Act 2015**. As the level of government closest to local communities and enterprise and as first responders in many emergencies, WCCC are uniquely placed to effect real positive change with respect to delivery of the national transition objective to a low carbon society and a climate resilience future.

This **local authority (LA)** adaptation strategy takes on the role as the primary instrument at a local level to:

- (i) Ensure a proper comprehension of the key risks and vulnerabilities of climate change.
- (ii) Bring forward the implementation of climate resilient actions in a planned and proactive manner.
- (iii) Ensure that climate adaptation considerations are mainstreamed into all plans and policies and integrated into all operations and functions of the LA.

This adaptation strategy serves WCCC in its main capacities namely:

- As an organisation with an obligation towards customer service, a focus on effectiveness in business, improving efficiencies and maintaining staff welfare.
- In the delivery of services and functions across the administrative and geographical area of Waterford city and county.
- In accordance with the provisions of the Climate Action and Low Carbon Development Act 2015 this adaptation strategy is required to be adopted by members of WCCC.

1.2 The Challenge of Climate Change

Climate is described as the average weather prevailing in an area over a period of time. Climate change is a significant change in weather patterns such as rainfall, temperature, and/or wind, which continue to change over an extended period of time (i.e. over a decade or longer). Climatic fluctuations are known to occur from natural causes including the earth's orbit and tilt, volcanic eruptions, variations in solar energy and other phenomena such as El Nino¹. However, in more recent times, there are growing concerns that natural fluctuations in the climate are being overtaken by rapid human-related activities which are negatively influencing climate variability and giving rise to serious implications for the rate of global warming. Scientific evidence for warming of the climate system is unequivocal. According to the **Intergovernmental Panel on Climate Change (IPCC)**, warming of the climate system is attributable to human activities as a consequence of greenhouse gas emissions from:

- Burning of fossil fuels such as oil, gas, peat, and coal resulting in CO₂ emissions.
- Agricultural activities that lead to methane and nitrous oxide emissions.
- Emissions from changes in land use such as urbanization, deforestation, reforestation and desertification.

Emissions from these activities are proven to impact the atmosphere by trapping the sun's radiation and reflecting it back to the earth giving rise to global warming. The term greenhouse effect has been coined to describe this occurrence.

The effects of global warming are observed through reductions in snow and ice in polar regions, increase in global mean surface temperatures, rise in sea levels and changes in some periodic weather events. Scientists state these changes are occurring rapidly, are considerable and will have consequences for this and future generations. Some impacts of global warming such as sea level rise and coastal flooding are already locked in and unavoidable. The full impacts of current warming have not yet been

¹ occurs when sea surface temperatures in the tropical Pacific Ocean rise to above-normal levels for an extended period of time

seen, since ice sheets and oceans take many decades to fully react to higher temperatures. Climate change is one of the most pressing global challenges facing governments and requires immediate commitment to action.

1.3 The Challenge for Ireland

There is evidence that Ireland's climate is changing in line with global trends of climate change. Over the last few decades our climate has warmed, sea-levels have risen, rainfall patterns have changed and we have been impacted by frequent, intense and more extreme weather events. Temperatures have increased by 0.8°C since 1900 and sea level rises of about 3.5cm per decade have been observed since 1990. Climate change has diverse and wide-ranging impacts on Ireland's economic and natural resources including:

- More intense storms and rainfall events giving rise to disruption to society.
- Increased river and coastal flooding.
- Water shortages in summer.
- Increased risk of new pests and diseases.
- Adverse impacts on water quality.
- Changes in the distribution and phenology² of plant and animal species on land and in the oceans.

The impacts of climate change are felt more acutely at the local level.

Nationally, climate projections for the next century indicate that the climate trends observed over the last century will continue and intensify over the coming decade's i.e.

- Increase in average temperatures across all seasons. Heatwaves are expected to occur more frequently.
- Significant reductions are expected in average levels of spring and summer rainfall with a substantial increase in the frequency of heavy precipitation events in winter and autumn
- Decrease in average wind speed and an increase in extreme wind speeds. The number of very intense storms is projected to increase over the North Atlantic region.
- Sea levels will continue to rise for all coastal areas. Sea surface temperatures are projected to continue warming for the coming decade.

This LA adaptation strategy is set against the background of increasing risks associated with climate change and seeks to reduce and manage these risks at a local level through a combination of mitigation and adaptation responses.

All LA's including WCCC provide a wide range of services, many of which are already and will increasingly be affected by climate change. It is most likely that we will continue to play a critical role in responding to the impacts of extreme weather events and other impacts that are likely to emerge over the coming decades through various implementation tools available as a LA.

1.4 What is Climate Adaptation?

Climate adaptation can be best described as planning proactively to take action and make adjustments to minimize or avoid the existing and anticipated impacts from climate change. In 2014 the IPCC, defined climate adaptation as:

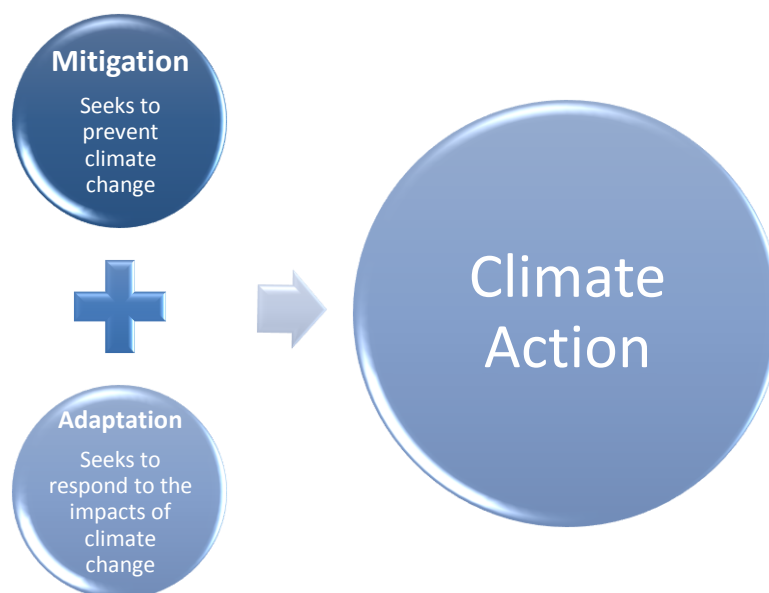
“The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.”

Climate adaptation aims to build climate resilient communities, to protect people, ecosystems, businesses, infrastructure and buildings from the negative impacts of climate change. As a **Local Authority (LA)** we play a pivotal role in planning for, and responding to emergency situations. We are best placed to react faster and more effectively to local climate events given our close relationship with communities and extensive knowledge of the local natural and built environment. This is demonstrated by our prompt and unrelenting emergency responses to varying and more frequent extreme weather events.

Our climate is changing and we as a LA need to ensure that we adapt to climate change. It is crucial that climate change adaptation is mainstreamed into our decision-making processes and implemented proactively in the performance of our duties. In addition, the benefits and opportunities that may arise as a result of climate change must be capitalized upon in respect of cost savings and new ways to foster environmental sustainability.

² the study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life

1.5 Adaption & Mitigation



- **Mitigation** refers to the efforts to reduce the emission of greenhouse gases and reduces the severity of future climate change impacts.
- **Adaptation** refers to efforts to manage the risks and impacts associated with existing or anticipated impacts of climate change.
- **Climate Action** refers to the stepped-up efforts to reduce greenhouse gas emissions and strengthen resilience and adaptive capacity to climate-induced impacts.

Figure 1 - Climate Action

This LA CCAS forms part of Ireland's national strategy for climate adaptation as set out in the **National Adaptation Framework (NAF)** which was produced under the provisions of the Climate Action and Low Carbon Development Act 2015. It is tasked with mainstreaming climate change adaptation over time into all functions, operations and services of the LA. It seeks to inform or 'climate proof' existing plans and policies produced and implemented by the LA. This ensures a considered, consistent and coherent approach, facing head on the challenges of a changing climate. Crucially, it also helps in building resilience within the LA organisation itself as well as across all communities.

While there is strong emphasis on LA's through the NAF to develop and implement adaptation measures and actions, mitigation measures and actions that seek to combat, reduce or eliminate the emissions of greenhouse gases are also hugely important. LA's have a significant role to play in actively implementing mitigation actions through measures including the design and construction of flood defences, retrofitting of building stock, energy efficient projects, promoting sustainable energy communities and encouraging sustainable transport and land use.

There are positive interactions between adaptation and mitigation measures. Employing both adaptation and mitigation measures represents a robust climate action response in addressing the challenges associated with climate change at local level. The actions set out in Chapter 5 of this strategy reflect both adaptation and mitigation measures as a considered, relevant and integrated approach to combating the effects of climate change in Waterford city and county.

1.5.1 Climate Change Mitigation

The implementation of **Climate Change Mitigation Measures (CCMM)** to reduce green house gas emissions will contribute to reducing the effects of global warming and climate change. Key drivers to the implementation of mitigation policies include **United Nations Framework Convention on Climate Change – 1992 (UNFCCC), Kyoto Protocol – 1997, Paris Agreement – 2015** and the **National Mitigation Plan 2017**. The future commitments of WCCC in implementing future mitigation measures will be

included within new policies/strategies to be developed as requested by the regional **CARO** and relevant government departments.

To date WCCC are implementing the following mitigation measures:

- The periodic gas flaring of land fill gas at the regenerated old landfill sites located at Tramore, Dungarvan and Waterford City, where methane is burned significantly reduces green house gasses being emitted to the environment.
- WCCC are committed to reducing energy consumption by 33% by 2020 and 50% by 2050.
- WCCC has commenced the process of retro fitting existing 15,000 public lights with energy efficient led lighting on WCCC roads, housing estate lighting and flood lighting. This retro fit program is projected to be completed by the end of 2021.
- WCCC via **Waterford Energy Bureau (WEB)**, which is a sub-section of the Environment Department is a **Local Energy Agency (LEA)** and is one of 400 throughout the European Union, has sourced funding in excess of €10,000,000 since its formation in 2003 on a range of LA, community energy efficiency/renewable energy projects.
- WCCC has completed a 1st phase of upgrades to over 2,000 social housing units with attic and cavity wall insulation being completed. Deeper energy efficiency measures have been completed in 400 social houses and over 500 vacant houses have been upgraded also.
- WCCC have in excess of 50,000 trees planted and growing in public areas and parks throughout Waterford County along with an active tree management programme.
- WCCC Environmental Education officer continues to work with over 100 schools around Waterford County in implementing “Climate Change Adaptation and Mitigation measures under the Green Schools Programme”.
- WCCC elected members have adopted a “Renewable Energy Strategy” for Waterford, which quantifies current renewable energies generated within the county and projects future energy trends and what levels of renewable energy technologies are required upto 2030 in line with national targets.

1.6 International Context

The UNFCCC is an international environmental treaty adopted in May 1992. Amongst the primary objectives of the UNFCCC is “to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.” The framework set non-binding limits on greenhouse gas emissions and contained no enforcement mechanisms. However, the framework outlined how specific international treaties may negotiate further action towards its key objective. “The Kyoto Protocol is an international treaty, which extends the UNFCCC, that commits state parties to reduce greenhouse gas emissions, based on the scientific consensus that global warming is occurring and it is extremely likely that human-made CO₂ emissions have predominantly caused it. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005”¹. The Paris Agreement 2015 is a protocol set within the context of the UNFCCC (ratified by Ireland on 4th November 2016) and it is aimed at:

- Limiting global warming to less than 2^oC above pre-industrial level and pursue efforts to limit the temperature increase to 1.5^oC.
- Increasing the ability to impact on climate change and foster climate resilience.

The agreement states the need for parties to formulate and implement **National Adaption Plans (NAP)**.

In September 2015, *Transforming Our World*, the **2030 Agenda for Sustainable Development** (the 2030 Agenda) was adopted by all 193 Member States of the United Nations (UN). The 2030 Agenda aims to deliver a more sustainable, prosperous and peaceful future for the entire world, and sets out a framework for how to achieve this by 2030. This framework is made up of 17 Sustainable Development Goals (SDGs) which cover the social, economic and environmental requirements for a sustainable future.

The SDGs represent the most ambitious agreement the UN has ever reached. The Goals are unique, because they apply equally to every country, and are based on the idea that ending poverty, protecting the environment and strengthening human rights are mutually beneficial and reliant on each other for success, and cannot be achieved separately.



The 2030 Agenda is voluntary and not legally binding, but every country has agreed to implement the SDGs and every country is expected to develop a national framework setting out how they will be achieved. Ireland is fully committed to achieving the SDGs. Ireland has adopted the Sustainable Development Goals National Implementation Plan 2018 – 2020.

1.7 E.U Context

The **2013 EU Strategy on Adaptation to Climate Change** encouraged all member states to adopt comprehensive adaptation strategies. It sought for better informed decision making through the identification and addressing of gaps in knowledge about adaptation. The **European Climate Adaptation Platform (ECAP)**, Climate-ADAPT, was developed as a resource mechanism to help users access and share information on adaptation.

The **Global Covenant of Mayors for Climate and Energy** is a voluntary, bottom up, approach for cities and local governments to combat climate change and move towards a low emission, resilient society. The Global Covenant of Mayors for Climate and Energy brought the **Compact of Mayors** and the **EU Covenant of Mayors** under one international body in January 2017 incorporating over 9,000 cities and local governments. WCCC may become a partner LA under the Covenant of Mayors for climate and energy. This is subject to agreement with all structures within WCCC and definite member support.

1.8 National Context

This LA adaptation strategy is set within a policy framework at International, European and National level.

National Adaptation Framework

The Irish government laid out its strategy as to how Ireland will adapt to the impact of climate change over the coming decades in the form of the NAF. The NAF sets out the “diverse and wide-ranging impacts” of climate change for Ireland.

The **2012 National Climate Change Adaptation Framework (NCCAF)** was Ireland’s first step in developing a national policy on adaptation actions to combat the impacts of climate change.

The **National Policy Position on Climate Action and Low Carbon Development 2014** restated the policy position of the NCCAF 2012. Greenhouse gas mitigation and adaptation to the impacts of climate change were to be addressed in parallel national plans under an evolving climate policy to 2050.

The **Climate Action and Low Carbon Development Act 2015** was a landmark national milestone in the evolution of climate change policy in Ireland. It provides the statutory basis for the national transition objective laid out in the **National Policy Position (NPP)** (as per above). Further to this, it made provisions for and gave statutory authority to both the **National Mitigation Plan (NMP)**, published in 2017 and the National Adaptation Framework published in 2018. This Local Adaptation Strategy forms part of the NAF.

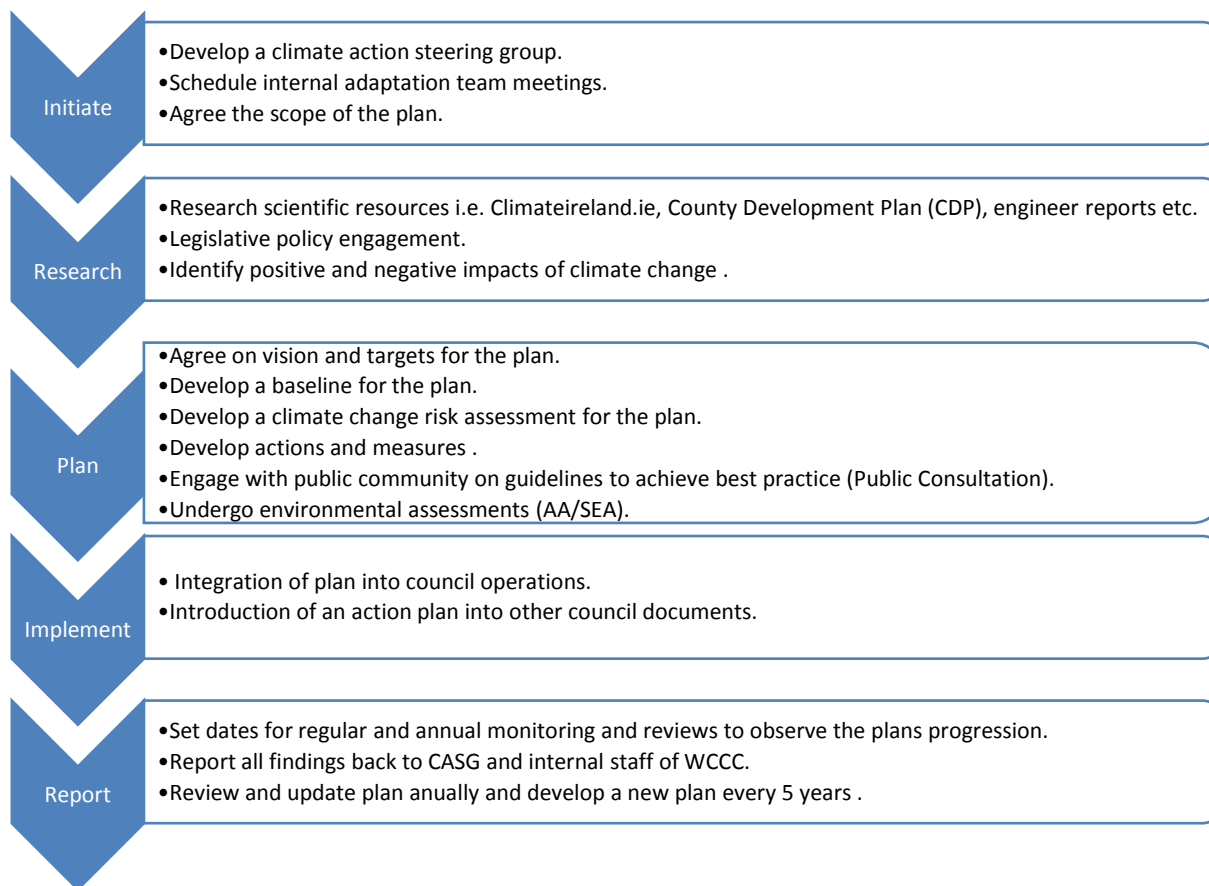
1.9 Methodology

Consultation with prescribed environmental authorities for the purposes of **Strategic Environmental Assessment (SEA)** will be undertaken in accordance with the provisions of the European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004 (S.I. 435 of 2004 as amended by S.I. 200 of 2011).

To develop this CCAS a climate adaptation team was convened, representing all relevant functions of WCCC. A series of interdepartmental meetings were held to assess WCCC’s adaptation baseline and identify vulnerabilities and risks to projected

climatic events. In developing this strategy, the **Waterford City & County Development Plan** was reviewed and climate change information resources, such as Met Eireann, were used to inform the development process.

Consultation with prescribed environmental authorities for the purposes of SEA was undertaken in accordance with the provisions of the European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations 2004 (S.I. 435 of 2004 as amended by S.I. 200 of 2011)



1.10 Environmental Assessment

Screening overview for SEA: Under the European Communities (Environmental Assessment of Certain Plans and Programme’s) Regulations 2004 (S.I. 435 of 2004 as amended by S.I. 200 of 2011), all plans which are likely to have a significant effect on the environment must undergo screening to determine whether a **Strategic Environmental Assessment (SEA)** is required.

“Screening” is the process for making a determination as to whether a particular plan, would be likely to have significant environmental effects, and would thus warrant SEA. This strategy has been screened for SEA and it is determined that full SEA is not required. The screening report accompanies this strategy.

Screening overview for AA: Screening of this draft strategy has been undertaken in accordance with the requirements of Article 6(3) of the EU Habitats Directive (directive 92/43/EEC) to determine if CCAS is likely to significantly affect Natura 2000 sites i.e. (**Special Areas of Conservation (SAC)** and **Special Protection Areas (SPA)**) within or surrounding the Strategy area. It is determined that stage 2 Natura Impact Report is not required. The draft screening report accompanies this Strategy.

2 Regional & Local Context

2.0 Eastern & Midlands Climate Action Region in Context

Waterford is located within the Eastern & Midlands Climate Action Region and is one of 17 LA's in the region. Waterford Council is located in the southern portion of the region. The **Eastern and Midland Climate Action Regional Office (CARO)** has assisted and supported WCCC in the development of this climate change adaptation strategy.

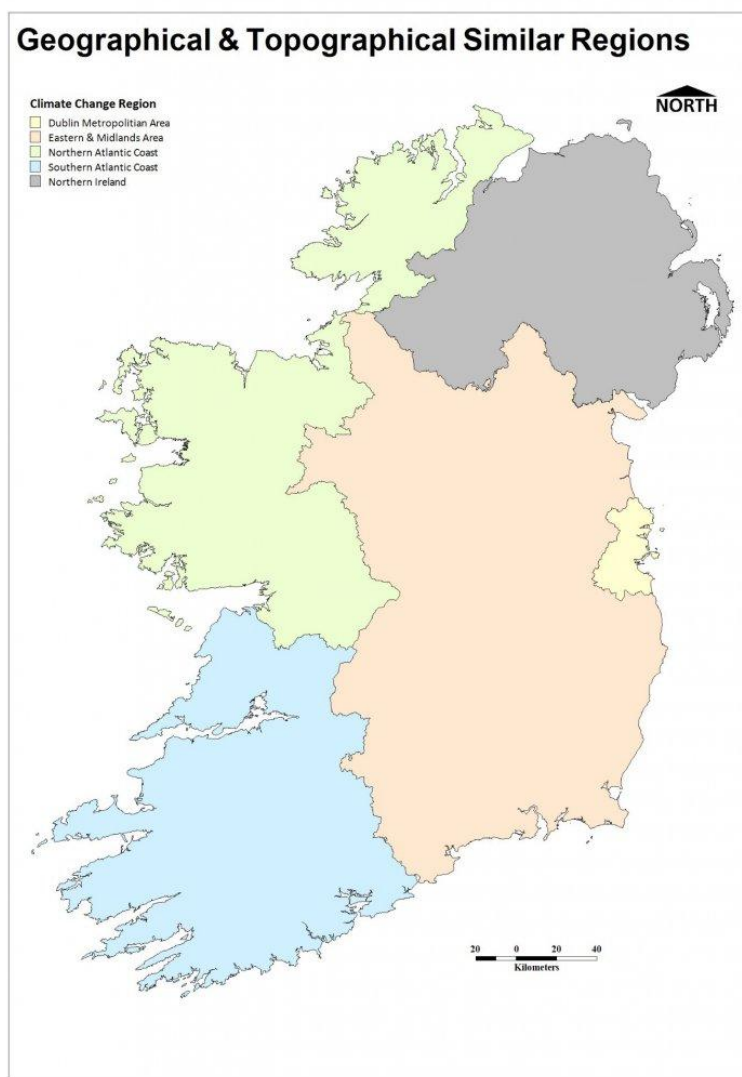


Figure 2 Climatically similar areas within Ireland

2.1 Background to the Eastern and Midlands Climate Action Regional Office

The Eastern & Midland CARO is one of four regional climate action offices set up in 2018 in response to Action 8 of the 2018 NAF – *Planning for a Climate Resilient Ireland*. The four CAROs have been established to drive climate action at both regional and local levels. In recognition of the significant obligation to develop and implement climate action measures, the four regional offices are mandated to co-ordinate engagement across the varying levels of government and help build on experience and expertise that exists in the area of climate change and climate action. The composition of the four **Climate Action Regions (CAR)** has been determined by the geographical and topographical characteristics, vulnerabilities and shared climate risks experienced across LA areas. The climatic risks associated with the Eastern and Midlands Climate Action Region includes fluvial flooding, pluvial flooding, groundwater flooding and coastal flooding.

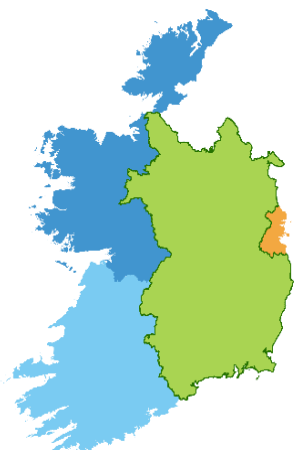
	Climate Action Region	Local Authority function area	Lead Authority
	Midlands and Eastern	Carlow, Cavan, Kildare, Kilkenny, Laois, Leitrim, Longford, Louth, Meath, Monaghan, Offaly, Roscommon, Tipperary, Waterford, Westmeath, Wexford, Wicklow	Kildare County Council
	Atlantic Seaboard North	Donegal, Sligo, Mayo, Galway City & County	Mayo County Council
	Atlantic Seaboard South	Clare, Limerick, Kerry, Cork City & County.	Cork County Council
	Dublin Metropolitan	South Dublin, Fingal, Dun-Laoghaire-Rathdown, Dublin City	Dublin City Council

Table 1 – CARO Description of four CARO regions and constituent LA's

2.2 Profile of the Eastern and Midland Climate Action Region

With 17 local authority areas, the Eastern and Midland region is the largest of the four CARO's in Ireland. The region occupies the eastern and central aspects of the country. The region borders Northern Ireland with counties Louth, Cavan, Monaghan and Leitrim. The River Shannon flanks the western aspect bounding along its course, counties Leitrim, Roscommon, Longford, Westmeath, Offaly and Tipperary. The Irish Sea bounds the region to the east. Counties Louth, Wicklow, Wexford and Waterford are located to the east and south east of the region all with extensive coastlines along the Irish Sea, St Georges Channel and Atlantic Ocean.

The region with its extensive pattern of settlement areas and rural areas and has a population of almost 1.8 million people accounting for 37.7% of the total population of the state and at 32,542 sq.km occupies 46.3% of the area of the state. The region plays a significant role economically to the country hosting a range of sectors inclusive of multinationals, public service, private and small-medium enterprises. Agriculture remains the prevailing sectoral land use in the region.

There is a rich variety of landscapes and topographies across the region. A mostly flat low-lying landscape sweeps through the midland counties. Significant areas of raised bogs occupy this central location in the country as well as the Curragh Plains in County Kildare. The Drumlin Belt



Figure 3 – Map showing extent of Eastern and Midlands Climatic region

across the northern aspect of the region, the Wicklow Mountains, Galtee Mountains and Slieve Bloom Mountains offer variation and punctuation in the landscape of the region.

21 prominent rivers rise and flow (with tributaries) through the region. The most prominent of these include the River Shannon, River Barrow, River Suir, River Nore, River Liffey and River Boyne. Counties Louth, Wicklow, Wexford and Waterford occupy coastal locations to the east and south east of this region while County Leitrim extends to occupy a distance of 4.6km along the western coast of the country.

The region offers an extensive and crucially important network of critical infrastructure.

The road network in the region typically radiates from the metropolitan Dublin Region. The Rail Network is significant with the Dublin-Cork, Dublin-Limerick, Dublin-Waterford, Dublin-Rosslare, Dublin-Sligo and Dublin-Galway/Mayo lines. Rosslare Europort in Wexford is a gateway to Wales and greater Europe through France. Electricity and communications infrastructure is widespread throughout the region.

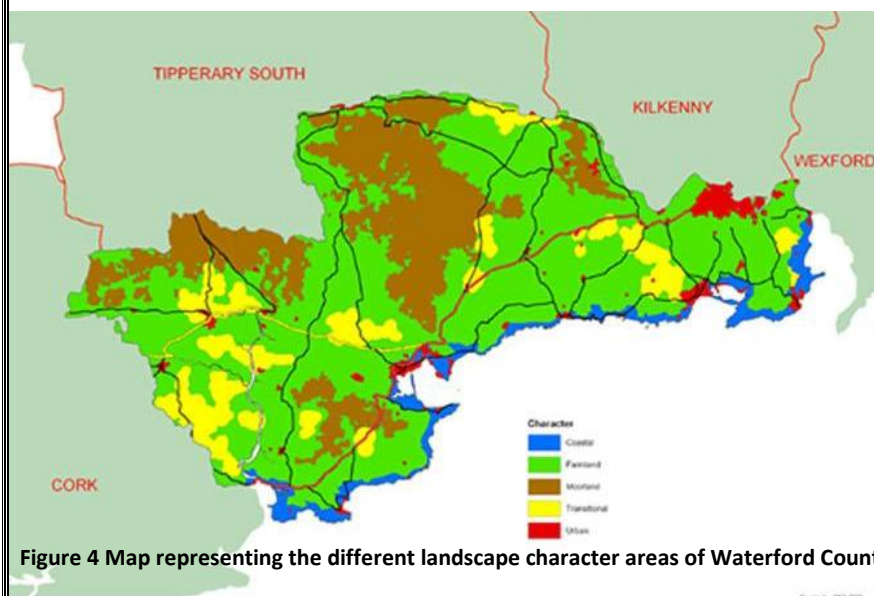


Figure 4 Map representing the different landscape character areas of Waterford County.

The road network in the region typically radiates from the metropolitan Dublin Region. The Rail Network is significant with the Dublin-Cork, Dublin-Limerick, Dublin-Waterford, Dublin-Rosslare, Dublin-Sligo and Dublin-Galway/Mayo lines. Rosslare Europort in Wexford is a gateway to Wales and greater Europe through France. Electricity and communications infrastructure is widespread throughout the region.

2.3 Waterford Regional Profile

Waterford is a coastal county in the south east of Ireland with a total area of 1857 km², its east - west distance being 83km and its north – south distance being 44km. It is bordered by four counties, Kilkenny, Wexford, Cork and Tipperary. The geography of the county is relatively flat with about 10% of the land area being mountainous and the remainder being small hills dispersed throughout the county.

The county has two main mountain ranges. The Comeragh Mountains stretch from just north of Dungarvan to beyond the north border and into Tipperary. On the north west border are the Knockmealdown Mountains which also stretch to Co. Tipperary. There are two other smaller mountainous areas, one being between Dungarvan and the Cork border and the other being between the Comeragh's and Waterford City. The highest peak being, Knockmealdown at 792.4m, is located in the north-west region of Waterford.

The main river flowing through Waterford is the River Suir which has a length of 183km and rises in Devil's Bit Mountain in Tipperary. The Rivers Bride and Blackwater are the other two main rivers flowing through Waterford. Waterford City is the largest urban centre situated within the Suir catchment area, which drains a total area of 3,610km². There is circa 26,950Ha of forestry cover which is 14.5% of the total land area of the county. Across Waterford County, the total area of bogland is 905Ha and the total area of peatland is 3446Ha which represents percentage coverage of Waterford County of 0.5% and 1.86% for bogland and peatland respectively.

Waterford has a coastline of circa 100km which includes The Copper Coast Geopark which is 25km of rugged coastline. The coastline also includes seaside resorts of Tramore, Dunmore East & Ardmore. The coastline also has a variety of ecosystems including tidal flats, rocky headlands, shallow blue flag beaches, tidal marshes, cliff faces, shallow bays and estuarine flats. A large percentage of land is arable, and a significant percentage is also used for farming. Waterford also has a regional airport, which is located 3km from Tramore at an elevation of 36m. There is also a shipping port located on the estuary within close proximity to Waterford City.

Quality and Risk identification of all Waterford's rivers can be identified on the GIS Map viewer provided by the EPA <https://gis.epa.ie/EPAMaps/>

2.4 Population & Settlement patterns

The population of Waterford County has risen from 78,562 people in 1926 to over 116,000 in 2016. The population figure here was broken up into three categories, under 20yrs of age, 20 to 64 yrs. of age and 65 yrs and above. The three age groups include male and female and are listed in table 3

	Male	Female
<20years of age	16,540	15,690
20 to 65 years of age	32,921	33,654
>65years of age	8,190	9,181
Total Population (gender)	57,561	58,525
Total	116,086	

Table 2 Population data of Waterford County by age and gender

Town / Region	Male	Female	Total
Waterford City	26,310	27,194	53,504
Tramore	5,093	5,288	10,381
Dungarvan	4,558	4,669	9,227
Other	21,600	21,374	42,974
Total	57,561	58,525	72,842

Table 3 – Population data for Waterford County by settlement area

County Settlement Hierarchy	
Primary (County) Service Centre	Waterford City
Secondary Service centre	Dungarvan
District Service Centres	Ardmore, Ballyduff Lower (East), Cappoquin, Cheekpoint, Crooke, Dunhill, Dunmore East, Kill, Kilmacthomas, Kilmeaden, Lismore, Portlaw, Stradbally, Tallow, Tramore
Local Service centres	Aglish, Ballyduff Upper (West), Ballymacarbry, Bunmahon/Knockmahon, Clashmore, Clonmel Environs, Clonea-Power, Maoil na Choirne, Villierstown
Settlement Nodes	Annestown, Baile na nGall, Ballinroad, Ballylaneen, Bawnfune, Fenor, Heilbhic, Knockanore, Lemybrien, Passage East, Piltown, Rathgormuck, Sean Phobal, Touraneena

Table 4 - Represents the Settlement Hierarchy and its components within Co. Waterford (Waterford County Development Plan 2011-2017)

3 Adaptation Baseline Assessment

3.0 Baseline Assessment Definitionⁱⁱ & Criteria

A baseline assessment is necessary in order to fully understand the impacts that climatic hazards may have on WCCC infrastructure and the population of the county. The baseline examines previous extremes of hazardous weather conditions which have caused disruptions to the LA in the past. This is a necessary starting point from which future costs to WCCC will be calculated. To examine the full range of hazardous climatic events affecting the city and county of Waterford, records were examined as far back as were available due to the fact that hazardous climatic events in the temperate latitudes are extremely unpredictable.

Conducting a baseline assessment involves assessing local level vulnerabilities to the impacts of climatic hazards and identifying the consequences of these hazards on the delivery of services and functions offered by WCCC. This assessment illustrates that the LA's capacity to cope with existing extreme weather events and periods of climate variability may fall short of what might be considered optimal, either in terms of what current policies or legislative instruments stipulate, or simply in terms of internal expectations regarding the resilience of key services to extreme weather events.

3.1 Introduction

Assessing the baseline provides for an understanding of how well adapted WCCC is to current climatic hazards which include extreme weather events and periods of climatic variability. This process is a crucially important first step in developing an adaptation strategy that is relevant and responds specifically to the impacts of climate change experienced locally. This assessment takes account of a range of extreme weather hazards that have affected the Waterford in the past specifically in respect of local level vulnerability and the impacts and consequences for the delivery of services and functions across the county. While past and recent experiences of climatic hazards may not entirely be representative of the longer-term climate reality, it is a useful starting point in the assessment of impacts on WCCC services which can further be examined in the context of the identification of future risk. Conducting this assessment illustrates WCCC's capacity to cope with existing extreme weather events and periods of climate variability and identify the resilience of key services.

3.2 Observed Climate Hazards

Warming of the climate is happening and it is extremely likely that man has been the main cause of global warming since the early 20th century. Observations show that global average temperatures have increased by 0.85°C since 1850. The atmosphere and oceans are warming, and sea levels are rising while the amount of snow and ice is falling. The impacts can be seen on all continents.

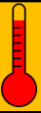



A publication by the EPA entitled *Summary of the State of Knowledge on Climate Change Impacts for Ireland 2017*, advises that research at national level has shown that changes in Ireland's climate are in line with global trends. Even if **Greenhouse Gas (GHG)** emissions fall to levels required to stop the worst impacts of climate change, some changes are still likely to occur. This is because the climate system is slow to react and some changes are already "locked in".

For Ireland, climate change impacts are expected to increase over the coming decades and could include the following:

- Sea level rise.
- More intense storms and rainfall events.
- Increased magnitude of river and coastal flooding.
- Water shortages in summer.
- Increased risk of new pests and diseases.
- Adverse impacts on water quality.
- Changes in distribution and phenology³ of plant and animal species on land and in Ireland's coastal/off-shore waters.

While Ireland has experienced colder than normal periods since 1900 there is an upwards trend in national average temperature with higher temperatures experienced in the middle of the 20th century and from the 1980's to the present day. While an increase in average annual rainfall has been observed, precise changes in spatial patterns of precipitation cannot be determined, with further research required to examine precipitation levels on a seasonal basis. The mean annual sea surface temperature

³ the study of cyclic and seasonal natural phenomena, especially in relation to climate and plant and animal life

Parameter	Observed
 Temperature	<p>Average temperatures have increased by 0.8°C since 1900 (0.07°C per decade)</p> <p>The number of days above 20°C has increased while the number of days below 0°C has decreased</p>
 Precipitation	<p>Increase in average annual rainfall of circa 5% (60mm) from 1981 - 2010 compared to 1961 - 1990</p> <p>Largest increases are in the western regions of Ireland</p>
 Wind speed/Storms	<p>No long-term change in speed and direction has been determined</p> <p>North Atlantic storms have increased in number and intensity by circa 3 storms per decade</p>
 Sea levels/Sea surface temp	<p>Sea levels increase around Ireland are inconclusive, but in S.W England shows a 1.7cm rise per decade since 1916</p> <p>Sea surface temperatures have increased by 0.85°C since 1950. 2007 was the warmest on record for Irish coastal waters</p>

has increased by one degree compared to the long-term average over the end of the 20th century. An increase in annual mean river flows has also been observed including mean flow increases for both the summer and winter periods.

Table 5 Observed Changes in Irelands Climate (Source: National Adaptation Framework 2018)

3.3 Major Meteorological Events to Affect Waterford

Table 8 shows information in relation to the date, type and description of major climate events which occurred in Ireland from 1807 to 2018. This information is displayed in conjunction with the major climate event timeline shown in Figure 4. The impacts of climate change experienced in Waterford generally reflect the national pattern and trends of observed climate hazards. This review of extreme weather events over the past 211 years has been undertaken using published Met Eireann data, along with information from WCCC and other reliable local sources such as local libraries.

Table 7 visually represents the categories of climatic hazards that have been experienced in Waterford and have had either direct and indirect impacts on the delivery of services and the performance of functions across the Waterford City & County Council. The climatic hazards that are relevant to Waterford are extreme wind events, extreme heat/drought events, extreme rainfall/flooding events and extreme freezing conditions/snow events. Combination events i.e. two extreme climatic events occur simultaneously are noted also. Such combination events give rise to more severe and destructive impacts. While some events such as storm events can and are expected to bring with them extreme rainfall, less frequent combination events such as an extended dry period/heat wave followed by an extreme/prolonged rainfall event may bring about new and significant impacts. With all extreme events and particularly combination events, comes an understanding of the level of unpredictability. Nevertheless, knowledge and experience acquired from past events will benefit future planning and preparedness and a continuous review of extreme events will help build resilience and reduce the associated risk.

Table of Major Meteorological Events 1807 to 2018

Wind events	Flooding events	Heat events	Combination events	Snow/cold events
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Figure 5 – Representation of colour coding for Table 7, Figure 7 & Table 8..

Date of Event	Type of Event	Description of Event
Feb 19 th & 20 th 1807	Blizzard	Severe blizzard swept across Ireland which resulted in several deaths and the wrecking of two transport ships on the Irish Sea.
06 th Jan 1839	Wind	The Night of the Big Wind was a massive hurricane that swept over Ireland on the night of January 6, 1839.
14 th Feb 1853	Snowstorm	A severe snowstorm hit Ireland which resulted in the Queen Victoria sinking in the Irish Sea claiming 55 lives.
25 th Jan 1867	Freeze	The River Suir flowing through Waterford City completely froze over. The Railway Steamboat was used to keep large ice flows impacting the bridge. On the same day the New Ross bridge was swept away by ice flows.
05 th Feb 1869	Tidal Flooding	Most of the lower lying regions of Waterford City were submerged due to extreme flooding.
02 nd Feb 1873	Snowfall	Extremely heavy snowfall resulted in circa 120cm of snow falling in a short period.
Jan 1881	Snowfalls	"Remarkable" snowfalls recorded throughout this month.
7 th – 10 th April 1886	Blizzard	A "great" blizzard with snow depths of up to 60cm.
Summer 1887	Heat wave	The highest temperature ever recorded in Ireland was 33.3 °C on June 26th 1887.
Winter 1891/92	Snowfalls	Greatest snowfalls recorded since 1855. Serious disruption in late Feb to rail traffic.
Feb 1895	Snowfall	Extremely heavy snowfalls observed.
26 th / 27 th Feb 1903	Storm	Many thousands of trees were uprooted countrywide. There was also extensive damage to large amount of buildings and infrastructure.
Apr 1908	Snowfall	Extremely heavy snowfall observed.
Winter 1909/10	Snowfall	The snowfall in Jan was very severe with several counties covered with up to 33cm for several days.
Jan to Feb 1917	Combination event	Rain, sleet & snow accompanied a S.E gale. Melted snow had a depth of 52mm rainfall. Drifts of 3m reported. Large portion of rail traffic was disrupted. Low temperatures prevented snow thawing.
01 st Apr 1917	Snowfall	Many places were cut off for several days. Snow lay to a depth of 1.3 m with drifts of 3m.
28 th Oct 1927	Storm	A storm which had an extremely low pressure of 976hPa claimed 45 lives of the west coast.
23 rd Feb 1933	Snow	Widespread snowfalls with strong winds lead to drifts up to 3m.
Mid Jan – mid March 1947	Combination event	The severe conditions disrupted communications' and transport facilities for several weeks.
Dec 1954	Combination event	Rainfall was 50% above the normal levels for the last quarter of the year resulting in the sinking and running a ground of several ships on Irish coasts in what was described as "mountainous seas". On Dec 9th a railway bridge was destroyed by flood waters which then created a "dam". There was also widespread power outages and further disruptions caused by severe snowfalls.
16 th Sept 1961	Storm	Hurricane Debbie is the most powerful cyclone on record to strike Ireland in September, and possibly the only tropical cyclone on record to ever strike Britain and Ireland while still tropical.
Winter 1962 / 63	Cold	The coldest winter on record in Ireland and the UK since records began.
Nov/Dec 1973	Rain / Flood	This deluge of rain lead to extensive flooding in the south region with a max of 195.1mm being the highest amount recorded over the four days.
Summer 1976	Heat wave	On June 29th, 1976, a weather station in Boora, Co Offaly, recorded a temperature of 32.5 degrees. This heat wave occurred at the end of the driest period in 150years. This period began in October 1974.
25 th Aug 1986	Hurricane Charley	Most of Ireland took a pounding from storm force winds resulting in traffic chaos, disruption of vital services, damage to buildings and trees, and the tragic loss of life.
Summer 1995	Heat wave	The recording had been a report of 31.1 degrees in Athy, Co Kildare, on June 29 th 1995.
Winter 2009/10	Snow	Coldest winter since 1963 with 30 days of snow in many places.
Winter 2010/11	Snow	Extensive snowfalls and extremely low temperatures with daytime averages being below freezing.
September 2011	Hurricane Katia	Met Eireann, issued an extreme weather warning amid predictions of storm gusts of up to 128 kph.
12 th Feb 2014	Storm Darwin	Hurricane gusts, mass destruction, widespread blackouts, millions of euro worth of damage to infrastructure.
16 th Oct 2017	Storm Ophelia	Storm Ophelia made landfall over Ireland as an "extra-tropical storm" on the morning of October 16th, 2017 with wind speeds of up to 156km/h.
28th Feb to 4 th March 2018	Storm Emma	This was one of the most significant snowfall events of recent years with temperatures barely rising above freezing and severe snowfalls country wide. This caused widespread disruptions to road, rail and air travel. It also resulted in the majority of businesses and schools being closed.
Summer 2018	Heat wave	The heat wave this summer saw Met Éireann record the highest June temperature in Ireland in more than 40 years, at Shannon Airport weather station, Co Clare.

Table 6 Major Meteorological Events 1807 To 2018

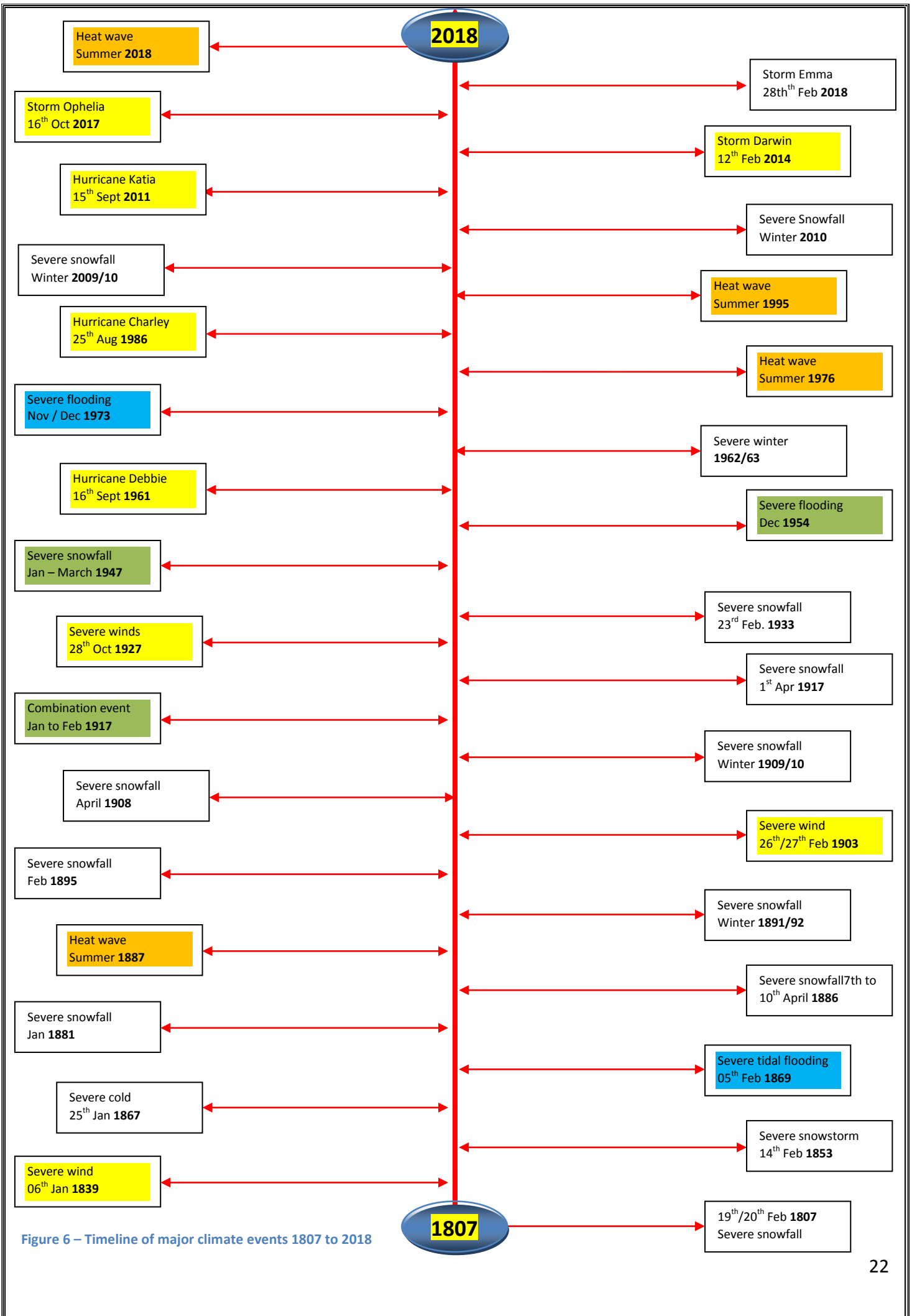


Figure 6 – Timeline of major climate events 1807 to 2018

3.4 Meteorological Events by Category






Extreme weather events	Date of Occurrence			
Extreme Rainfall / flood 	<ul style="list-style-type: none"> ➤ Oct 1886 ➤ Nov 1916 ➤ Dec 1925 ➤ Jan 1926 ➤ Aug 1946 	<ul style="list-style-type: none"> ➤ Oct 1949 ➤ Dec 1960 ➤ Oct 1961 ➤ Dec 1979 ➤ Dec 1981 	<ul style="list-style-type: none"> ➤ Aug 1986 ➤ Feb 1990 ➤ Jan 1996 ➤ Nov 1997 ➤ Dec 1999 	<ul style="list-style-type: none"> ➤ Feb 2002 ➤ Oct 2004 ➤ Nov 2009 ➤ Jan 2014 ➤ Feb 2014
Wind Storms 	<ul style="list-style-type: none"> ➤ Jan 1839 ➤ Feb 1903 ➤ Oct 1927 ➤ Sept 1961 		<ul style="list-style-type: none"> ➤ Aug 1986 ➤ Sept 2011 ➤ Feb 2014 ➤ Oct 2017 	
Freezing conditions / heavy snow 	<ul style="list-style-type: none"> ➤ Feb 1807 ➤ Feb 1853 ➤ Feb 1873 ➤ Jan 1867 ➤ Jan 1881 	<ul style="list-style-type: none"> ➤ April 1886 ➤ Winter 1891/92 ➤ Feb 1895 ➤ April 1908 ➤ Winter 1909/10 	<ul style="list-style-type: none"> ➤ April 1917 ➤ Feb 1933 ➤ Winter 1962/63 ➤ Winter 2009/10 ➤ Winter 2010/11 ➤ Storm Emma 	
Extreme heat / drought 	<ul style="list-style-type: none"> ➤ Summer 1887 ➤ Summer 1976 ➤ Summer 1995 ➤ Summer 2018 			
Combination events 	<ul style="list-style-type: none"> ➤ Jan/Feb 1917 ➤ Jan – March 1947 ➤ Dec 1954 			

Table 7 Meteorological Hazards by Category (based on table 8 and figure 4)

The impacts of extreme weather events identified in Table 8 experienced within Waterford have varying and far reaching consequences for the delivery of services and functions by WCCC both during and in the aftermath of extreme weather events and as a result of periods of climate variability. These impacts have seen widespread service disruption during past events whereby all services and operations closed/ceased for example, during Storm Ophelia in 2017 and during and after Storm Emma in 2018. For other events such as heavy or prolonged rainfall events or heat wave events as in the summer of 2018, individual services and operations are put under increased pressure i.e. emergency response, area offices, roads etc. The level of disruption to WCCC has been assessed at a very high level against broad categories as set out in the adaptation strategy guidelines.

3.5 Case Studies of Extreme Weather Events Impacts within Waterford County

The five case studies in this report are based on four climatic hazards, flooding looks at Waterford City Flood Alleviation scheme, Storm Emma’s impact on Waterford looks at the extreme snow and cold events, the 2018 Heat wave looks at dealing with extreme heat events and Storm Ophelia looks at dealing with extreme wind events. The fifth case study from 1867 shows that extreme weather events are not just recent events.

Case Study 1 – Waterford City Flood Alleviation Scheme 2014

Waterford City dates back to the late 9th century and the time of the Vikings. The Vikings realising the Strategic and trading importance of the rivers which flow into Waterford Harbour built a “longphort” or dock at the confluence of the St John’s River and the River Suir.ⁱⁱⁱ

The cities geography is dominated by the River Suir and is mostly located on the South bank of the river.

Waterford City has experienced severe flooding on a regular basis due to high tidal and water levels in the two rivers.

The area’s most prone to severe flooding were and are shown in Fig 7:

- The South Quays.
- Scotch Quay.
- Canada St/Newtown Rd/Park Rd.
- Waterside.
- Poleberry.
- Tramore Rd.

Amongst the options considered to alleviate flooding were:

- Flood defence walls & embankments.
- Channel improvement.
- Tidal control structures.
- Combination of the above.

Containment of flood waters within the channel would be the preferred solution which would be achieved by the construction of reinforced concrete flood walls and flood embankments from Grattan Quay to Waterpark on the River Suir south bank and on both banks of the John’s River and its tributary (Lisduggan Stream) from its confluence with the River Suir to the Tramore Road area.

The Tramore Road was raised by approximately 1.5m. The work was carried out in 4 phases as seen in Fig 8.

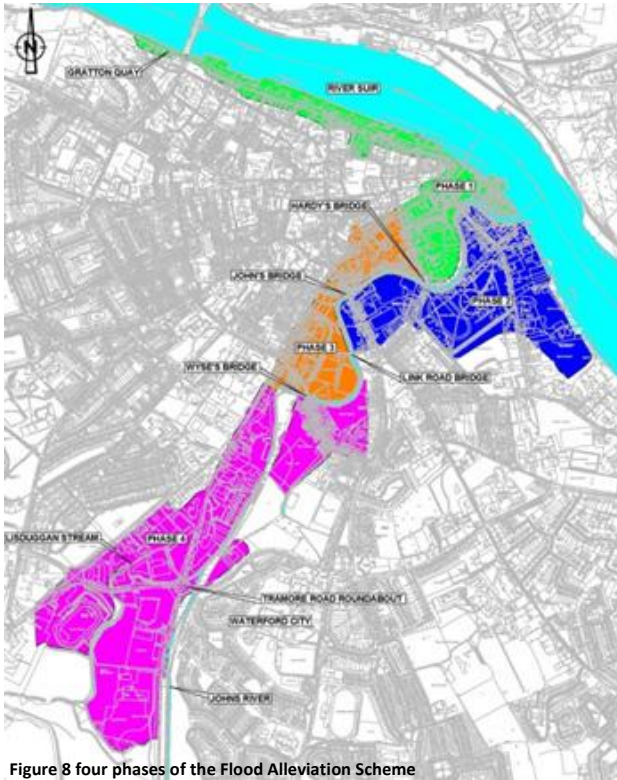


Figure 8 four phases of the Flood Alleviation Scheme

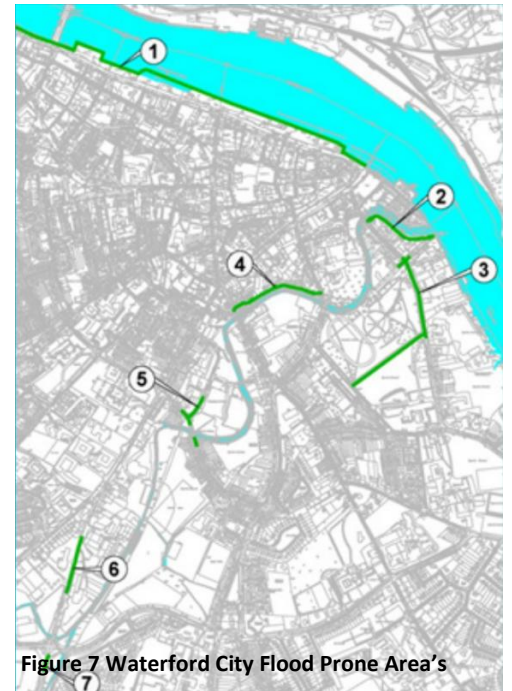


Figure 7 Waterford City Flood Prone Area's

A cost benefit analysis was completed at the time of the Preliminary Report. The recommended option had, at the time, an estimated all-in cost of IR£22.7M (€28.8M) with a corresponding benefit to cost ratio of 1.5 achieved. As a result of the works being undertaken, the flooding within Waterford City has now been almost reduced to negligible levels. As well as protecting the city from flooding from events up to the 200 year return period (tidal areas) the works have provided an added benefit to the city by regenerating areas and improving the public’s association with the cities rivers and it also included the provision of over 2km of new cycling and walking tracks.



Image 1 - The flood alleviation system in action

Case Study 2 – Storm Emma - March 2018

^{iv}Storm Emma resulted in widespread snow, ice and low temperatures causing major disruptions to all services country wide. A combination of high winds and snowfall overnight had led to snow drifts of up to 3m in places around Waterford. A large percentage of roads were completely blocked, and large portions of rural dwelling were inaccessible. In excess of 3,000 tonnes of sand and salt were required to help ensure important routes were kept open. This required circa 200 LA staff and the use of 117 vehicles. This extreme weather hazard was prepared for in 4 phases and was monitored by a specialised severe weather team via a series of 20 meetings throughout the duration of the event. The current trend in climate change indicates the possibility of meteorological events of this magnitude in Ireland will be more frequent than in the past. It highlights the need for a severe weather strategy to



Image 2 Civil Defence during Storm Emma

deal with events like

Storm Emma. A detailed costing for Storm Emma was compiled and it is estimated that the overall cost to Waterford City & County Council was €626,915 including costs accrued by Emergency Services while the estimated long-term repair costs to road network was in excess of €1.15M.



Image 3 Fire Service during Storm Emma

Case Study 3– 2018 Heatwave^{vi} June – August 2018

The heat wave during the summer of 2018 lasted from June to Aug and resulted in the highest temperature recorded in Ireland since 1976. The atmospheric high pressure remained from mid-June to mid-July which resulted in exceptionally warm dry conditions and very light wind. According to Irish Water the water supply schemes at Loskeran, Ballylanean, Portlaw, Kilrossanty, Ardmore and Kealfoun were the worst affected areas in Waterford with supply being managed to many areas by tankering water to reservoirs from less affected schemes, restricting usage at night-time and where necessary setting up emergency water stations. For some of the more rural dwellings, villages, etc. water is provided by small streams and bore holes, and the lack of rainfall left these at risk of temporarily drying up. In spite of the restrictions there was a demand increase of 15% to 20% in water usage. Waterford LA's working in conjunction with Irish Water mobilised extra crews both for repairs and to transport water from larger schemes to where water levels need topping up.

The extreme heat also caused issues for fire departments which resulted in further water shortages as the number in gorse, forest & dry pasture fires increased substantially. Local authorities were also required to issue warnings in respect of road surfaces as prolonged temperatures above the mid 20's can lead to tarred surfaces becoming extremely soft & dangerous (Fig 9^{vii}) and leading to longer braking distances. This requires gritting which increases costs for the LA's. On a city level, the Viking Marathon Race which is usually a full, half and quarter marathon was downgraded to only half and quarter race's due to a risk of heat stroke to participants^{viii}.

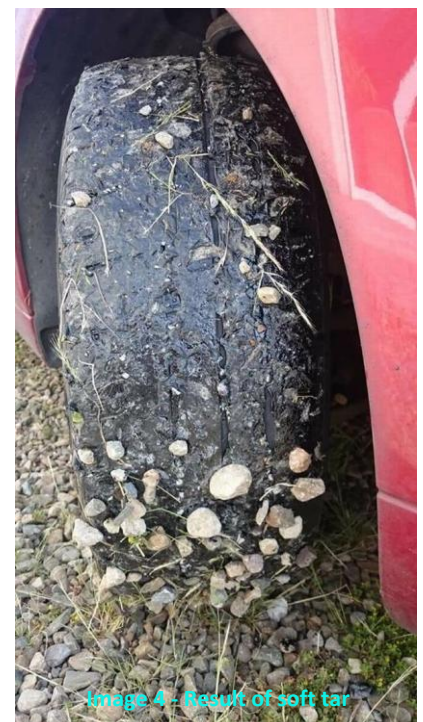
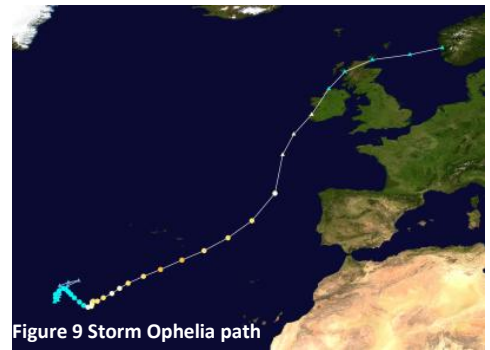


Image 4 - Result of soft tar

Case Study 4 – Storm Ophelia^{ix} October 2017

Storm Ophelia is the farthest east Major Hurricane (Category 3 or higher) on record in the Atlantic Basin. It made landfall over Ireland as an extra-tropical storm on the morning of the 16th October 2017. A nationwide Severe Weather Warning was issued by Met Eireann, such a warning is only used in circumstances where the weather conditions are deemed severe enough to endanger life. A 'Status Red - Severe Weather Warning - Take Action' implies that recipients take action to protect themselves and their properties. The storm caused major power outages which left 20,000 without power and a further 8,000 without water, uprooted almost 2,000 trees, blocked a significant portion of roads countywide, destroyed the roofs on several buildings and caused coastal flooding. All schools and many businesses closed for the day while the nation weathered out the storm. Warnings about the arrival of Storm Ophelia and advice on self-protection were disseminated to the public by the national and local response services. The aim was to prevent serious injury and loss of life during the storm, which resulted in the country shutting down almost completely on Monday the 16th October. The entire Council was also affected in that all departments remained closed during the duration of the red alert. A sustained wind speed of 62km/hr was recorded at Waterford Airport during this storm, while the peak gust of 156km/hr was recorded in Cork at Roche's point. The clean-up cost as a result of Storm Ophelia is estimated to be in the region of €800K.



Case Study 5 – Severe Freeze 19th Jan 1867 (article from Freemans Journal)

THE SUIR FROZEN ACROSS AT WATERFORD.

(FROM OUR CORRESPONDENT.)

WATERFORD, FRIDAY MORNING.—The Suir presents this morning a spectacle unequalled by any since the year 1799. For some time past the tides have been extremely low, and the water deposited on the slob lands several miles up the river has been congealed by the intense frost which has prevailed during the past fortnight. Immediately on the rising of the tide, within the last two days, the accumulated ice has been floated into the current and carried down in the form of icebergs. Meeting with no obstacle until it reached the wooden bridge across the river at this city, it has increased in quantity to an enormous extent, and the snow immediately above the bridge presents just now the appearance of a solid sheet of ice. I am informed that this is more or less the case for several miles further towards the north. The steam tug dragged a lighter from the bridge to the railway, a distance of something more than a furlong, at ten o'clock this morning, and the strength of the ice stove in the side of the lighter. Crowds of people, however, assembled on the bridge to witness the tug forcing its way through the ice for the purpose of detaching the mass and floating it down the river. This proved entirely ineffectual up to the present, as the ice closes in immediately behind the vessel. A tremendous iceberg, extending across the whole breadth of the river, has just floated down the current. Navigation down the bridge is entirely at an end. It is said that nothing of this kind has been seen since 1799, when cannon were fired into the river to break up the solid ice.

Figure 10 –Details of Extreme Cold event to affect Waterford^x

3.6 Method of Assessing Current Baseline

LEVEL	CONSEQUENCE	DESCRIPTION
5	Catastrophic	Widespread service failure with services unable to cope with wide-scale impacts. Irrecoverable environmental damage. Large numbers of serious injuries or loss of life.
4	Major	Services seen to be in danger of failing completely with severe/widespread decline in service provision and quality of life. Severe loss of environmental amenity. Isolated instances of serious injuries.
3	Moderate	Service provision under severe pressure. Appreciable decline in service provision at community level. Isolated but significant instances of environmental damage that could be reversed. Small number of injuries.
2	Minor	Isolated but noticeable examples of service decline. Minor environmental damage.
1	Negligible	Appearance of threat but no actual impact on service provision.

Table 8 Level of severity used to categorise extreme climatic hazardous events

3.7 Baseline Assessment

This baseline assessment examines extreme past climatic hazardous events that had a significant effect on the services provided by WCCC. The following four climatic hazards are being used as the baseline assessment in this strategy:

1. Heat – The heat wave which impacted Ireland during summer 2018 (Extreme prolonged)
2. Flood – Severe flooding in November 2000 (Tidal, prolonged rainfall, severe intensive rainfall)
3. Snow – The coldest winter of the 20th century 1962/63 (Severe prolonged cold and/or intensive prolonged snowfall)
4. Wind – Storm Ophelia which impacted Ireland in October 2017 (Prolonged and intensive)

Climatic Hazard	Heat
Meteorological Conditions	<i>In 2018 Ireland experienced a major heat wave which lasted for almost 3 months with a peak temperature of 32°C recorded on June 28th, which is the 2nd highest temperature recorded in Ireland since records began. It was only surpassed by a reading of 33.3°C on 26th June 1887 in Kilkenny City.</i>

Climatic Hazard	Flood
Meteorological Conditions	On 5 th November 2000 a depression of 972hPa approached Ireland from the west which resulted in rainfall levels reaching 97.8mm, which is the highest recorded since 1944. The highest rainfall was recorded in the Dublin Mountains and central Waterford. This resulted in extensive flooding in the South East and major disruptions to transport network. The flood damage was estimated at over €50m.

Climatic Hazard	Cold/Snow
Meteorological Conditions	The winter of 1962/3 saw the coldest winter of the 20th century hit Ireland, with snowfalls affecting the South-East until mid-March and the deepest ever snow depth of 45 cm was recorded during this event. The cold spell was responsible for up to 500 fatalities country wide.

Climatic Hazard	Wind
Meteorological Conditions	Storm Ophelia was equivalent to a Cat 3 hurricane in the Atlantic Ocean and made landfall over Ireland as extra-tropical storm on the morning of Oct 16 th 2017. It produced wind speeds of up to 156km/hr. It was of intensity such that a nationwide severe weather warning was issued country wide. Major power outages were experienced, roofs lifted from buildings, countless trees felled, three lives were lost and most business, all schools and government authorities shut down until the storm passed.

	Baseline Assessment Impact	Risk level
Operational area	<u>Business Operations & Continuity</u>	
Business operations & Continuity	Financial/economic consequences – flood, cold, heat, wind	1
	Disruption to LA customers – flood, cold	1
	Inability to meet statutory deadlines – flood, cold	2
	Increase in emergency response staff overtime – cold, heat, wind	2
	Reduction in normal operational duties - wind, cold	1
	Excessively high/low interior temperature (LA offices) – heat, cold	2
	Cancellation of LA events – heat, wind, cold	2
	Loss of power & communication interruptions – wind, flood	2
	Increase in utility usage – cold, heat	2
	Closure of LA offices due to weather warnings – heat, wind, cold	2
Pressure on emergency services – flood, heat, cold, wind	3	
	<u>Infrastructure & Built Environment</u>	
Roads/footpaths/bridges	Deterioration of critical infrastructure – flood, heat, cold	2
	Damage to bridges – flood	3
	Blocked roads – flood, wind, snow	3
Construction projects	Impacts on LA construction projects – cold, wind	2
Building stock	Damage to LA offices/listed buildings – cold, flood, wind, heat	2
	Need for heat in LA offices – cold	2
	Need for air-con in LA offices – heat	2
Flood defences	Exceedance of existing flood defences – flood	3
Community infrastructure	Deterioration of community infrastructure – wind, flood	3
	Impact on community amenities – heat, flood	3
	Damage to car parks – heat, flood	2
	Damage to public lighting - wind	2
Culture/heritage	Damage to and loss of cultural/heritage/historically important structures & assets – heat, cold, flood, wind	3
	<u>Water Services</u>	
Storm water	Reduced/unreliable power supply for drains power stations – wind, flood	2
	Changes in peak stream/river flow rates –flood	2
	Damage to drainage network – cold, flood	2
	Exceedance of drainage capacity/blockage of drains - flood	3
Wastewater	Inflow and infiltration to wastewater network – cold, flood	2
	Exceedance of wastewater levels – flood	2
	Cracking of wastewater pipe networks (ground movement) – rain	2
Water supply	Reduced availability of water from supply sources - heat	2
	Increased potential for water contamination - heat	2
	Reduction of water supply for irrigation of parks etc – heat	3
	Uncertainty in water availability – heat, cold	2
Water quality	Run-off from agricultural land contaminating water supply/ground water - flood	3
	Low flow rates resulting in deterioration of water quality from source - heat	2
	Risk of water contamination/water borne diseases - heat	3

	Baseline Assessment Impact	Risk level
Operational Area	<u>Biodiversity</u>	
Aquatic	Algae bloom outbreaks - <i>heat</i>	3
	Riverbank erosion - <i>flood</i>	3
	Reduction in resilience of indigenous land-based ecosystems - <i>heat</i>	2
	Pluvial/fluvial flooding - <i>rainfall</i>	2
	Alteration in breeding cycle of aquatic species - <i>cold</i>	3
Terrestrial	Soil erosion resulting from deforestation – <i>heat, wind</i>	2
	Damage to indigenous woodlands – <i>heat, wind</i>	2
	Landslide/embankment failure – <i>flood</i>	2
	Bog/wildfires – <i>heat</i>	1
	Shift in distribution of plant and animal species – <i>heat, wind</i>	2
	<u>Land Use & Development Policy</u>	
Land use & Development policy	Inappropriate location of urban expansion areas - <i>flood</i>	2
	Uncertainty in long term land use planning and infrastructure design - <i>flood</i>	2
	Changes in floodplains - <i>flood</i>	3
	<u>Community Health & Well-being</u>	
People	Increased isolation of communities through inaccessibility – <i>flood, snow</i>	2
	Risk to public safety at unsupervised water bodies - <i>heat</i>	3
	Risk of injury to public – <i>wind, cold, flood</i>	3
	Risk to public safety near waterways – <i>flood, heat</i>	3
Assets/infrastructure	Damage to properties, streetscapes and community assets – <i>cold, heat, wind</i>	2
	Contamination of waterways – <i>heat</i>	3
	Inaccessibility to rural areas for emergency services – <i>flood, heat, cold, wind</i>	4
	<u>Coastal & Maritime</u>	
Coastal & Maritime	Intensive human activity - <i>heat</i>	2
	Coastal wetlands drying up - <i>heat</i>	2
	Intensive levels of coastal pollution - <i>heat</i>	3
	Coastal flooding/defence breaching – <i>wind, flood</i>	3
	Coastal erosion/infrastructure damage – <i>wind, flood</i>	3
	Deterioration of water quality – <i>heat, flood</i>	3
	Loss of revenue (trawlers moored) - <i>wind</i>	2
	Above average wave heights/higher tides – <i>wind, flood</i>	2
	Damage to coastal wetlands – <i>wind, heat, flood</i>	2
	Loss of beaches – <i>wind, flood</i>	1

4 Climate Risk Register

4.0 Introduction

Identifying the future risks to WCCC of projected climatic hazards is a key element in the development of this CCAS. This process identifies potential future local level vulnerabilities and sensitivities of, and risks to, the LA and is based on the most up-to-date available climate projections. These projections describe a range of possible future climate scenarios from which potential impacts can be identified. It was important to consider the full range of events to ensure all potential risks are considered. Using the information attained in section 3.8 and considering future projections, a future risk analysis is carried out to identify potential future impacts and vulnerabilities to WCCC services.

Climate change projections indicate that:

- Warming in Ireland will continue especially in the spring and summer.
- Ireland will experience more extreme weather conditions including rainfall events and storms.
- There will be an increased likelihood of pluvial/fluvial flooding in Waterford.
- Winters will be wetter and summers will be drier.
- Sea levels around Ireland's coast will rise by 0.5m by 2050

These climate changes will impact the type, distribution and lifecycles of species. These projections signal significant challenges for WCCC and the people of Waterford. Climate change will have further effects on land use including agriculture, forestry and planning. It will also have significant effects on biodiversity, water resources, human health, the economy and society.

4.1 Climate Risk Register

This chapter identifies the hazards that are likely to have severe impacts and consequences for WCCC, the population of Waterford and the infrastructure within the city and county. This chapter also identifies the likely changes of the climatic hazards and associated events such as increase in frequency of the events due to a changing climate and sea level rise.

4.2 Climate Risk Tables

L	M	H
Low	Medium	High

Table 9 – Corresponds to Priority levels specified in sections 4.1.2 to 4.1.6

Operational Area	Climatic Hazard	Risk Statement	Priority L, M, H
Business operations & Continuity	Heat	More frequent and intense heat waves may significantly impact performance operations of daily tasks, exercising statutory duties and organisation of LA events leading to increased costs for maintenance, repair and replacement which adds increasing demand on resources. LA offices will require installation of air-con due to interior temperatures above those of acceptable levels.	L
	Cold/snow	The occurrence of occasional below average or record cold temperatures will see a higher risk of service disruptions presenting difficulties for business continuity and the delivery of projects locally. This will result in closure of LA offices and will interrupt workflow efficiencies, scheduled events and increase costs in dealing with extreme events.	L
	Flood	Increased frequency of flood events in Winter and Autumn periods will increase the demand for emergency services response for the placement of sandbags, use of specialised vehicles and regular check-ins with vulnerable individuals and communities in isolated areas.	M
	Wind	During periods of extreme wind events, affected local authority buildings would likely be forced to close.	L
	Sea-level rise	Increasing average sea-levels will a risk of more frequent flooding of low-lying coastal premises on a regular basis. When combined with onshore winds and high tides, this flooding may result in substantial damage and closure to premises and relocation of WCCC services. Storm damage further in land is also likely due to higher tides & flood events..	H
Infrastructure & Built environment	Heat	More frequent and intense extreme heat events will lead to damage of LA offices, housing stock, equipment and facilities which will give rise to increased repair costs, reinforce, or replace with potential for loss of assets. Financial implications for unscheduled maintenance, repair, upgrade, new construction, disruption to services and staff overtime costs will become an issue.	M
	Cold/snow	Intense cold events will undermine the integrity of critical infrastructure and lead to an increase in costs to repair, reinforce, or replace with potential for loss of assets. Intense cold events will damage LA buildings, housing stock, equipment and facilities (machinery yards, storage facilities etc) giving rise to increased costs for maintenance, repair and replacement and increased demand on resources. Damage to critical infrastructure will impact function of transport routes resulting in increased costs of clean up and maintenance, repair and insurance costs. Concaving and cracking of road surfaces may occur due to colder spells in winter & spring. WCCC will have in place additional machinery capable of salting operations and clearing roads in below average or record cold temperatures including snow plough operations and salting/sanding of roads.	M
	Flood	Extreme rainfall events could affect critical infrastructure through flooding and inundation. Damage to critical infrastructure will impact the function of transport routes, resulting in increased costs of clean up, maintenance, repair and have a wider economic impact. More frequent and intense rainfall events will damage LA buildings, housing stock, equipment and facilities (machinery yards, storage facilities etc). Failure of WCCC's flood defence system and barriers would be likely due to increased rainfall requiring modification and upgrade of the current system along with construction of new barriers in predicted flood prone locations.	M
	Wind	Likely damage to LA offices, housing stock and risk to outdoor staff. Roads blocked/damaged due to fallen trees.	L
	Sea-level rise	Rising sea levels will quite likely see more extensive damage of low-lying coastal roads and an increase in flood plain areas both coastally and in land. Many low-lying buildings will likely be exposed to more intense storms resulting in coastal erosion which will require coastal protection measures to be implemented. Coastal infrastructure such as piers / harbours will require additional protection	M
Water services	Heat	Heat waves and/or sustained drought conditions may result in significant and serious impact to water supply and quality, which will increase the challenges of the LA to meet requirements of the WFD, in addition to causing service disruptions. There will also be a significantly higher risk of water borne diseases such as WNV.	M
	Cold/snow	Decreased number, but increased intensity, of frost and cold days will reduce risk of burst pipes and associated water leakage, but may result in pipes becoming more brittle. Infrastructure may be subjected to brittle breaks due to the adverse impact of climate extremes therefore increasing costs of maintenance staff and repairs.	M
	Flood	With a higher risk of flooding and inundation and more impactful storm surges, this will result in significant impacts on property, land and critical infrastructure affecting the economic viability of certain areas and increasing further the vulnerability of communities. Extreme rainfall events will increase the risk of impacting water quality and the ability of the LA to meet the requirements of the WFD.	L
	Wind	Water drains/sewage drains blocked due to debris blown from waste sites, foliage blown from trees during summer into reservoir and streams which will reduce water flow.	M
	Sea-level rise	Rising sea levels will affect coastal region water supplies due to the infiltration of sea water into ground water aquifers as the barrier between sea and freshwater is diminished, resulting in salinization of the groundwater supply. Flood water drains would likely become completely submerged with rising sea levels requiring existing drain systems to be elevated.	L

Operational Area	Climatic Hazard	Risk Statement	Priority L, M, H
Biodiversity	Heat	Increase frequency of heat events will increase the risk of invasive species and impact the natural ecosystems causing an increase in demand for monitoring staff resources and increased risk of LA being unable to meet objectives to protect and conserve important habitats which will result in the loss of indigenous species and native eco-systems.	L
	Cold/snow	Cold events may see a reduction in breeding, growth and development of indigenous plant and animal species, resulting in seasonal growth reductions and their distribution due to habitat loss.	L
	Flood	Extreme rainfall events will increase habitat flooding and leaching of nutrients and sediment into watercourses resulting in changes to geomorphology and an increased risk of contamination to watercourses. Landscape may become more vulnerable, ecologically sensitive resulting in loss of important habitats. Frequency and intensity of flooding will increase resulting in expansion of current flood plains and the possibility of new flood plains forming. An alteration in precipitation will impact indigenous species, encourage diseases and invasive species.	M
	Wind	Likely increase in plant coverage and new plant species being introduced to local area. Removal of soil layers which will lead to exposed bedrock thus destroying localise eco-systems and leading to exposed plains. Severe wind may lead to damage of avian nesting sites	L
	Sea-level rise	Currently sea-levels are predicted to rise by up to 0.5 m this century which will drastically alter coastal habitats. Many low-lying habitats will be completely submerged by even a 0.5 m rise in sea levels which would likely have a detrimental knock-on effect on many symbiotic eco-systems such as maritime bird populations.	L
Land use & Development policy	Heat	Increased frequency of hot weather will give rise to the uncertainty in long term land use planning and infrastructure design to withstand such temperatures increasing pressure on planning and design staff as well as economy of WCCC.	L
	Cold/snow	Extreme cold temperatures will have an impact on infrastructural developments, increasing the risk of early retirement of capital infrastructure and as a result increasing maintenance, repair costs and need for new design developments.	L
	Flood	Increase in extreme precipitation events will shorten the lifespan of many infrastructural developments, causing a loss of capital infrastructure and increasing insurance costs.	M
	Wind	Increased risk of damage from severe wind events to exposed locations.	L
	Sea-level rise	A rising sea level would quite likely make many such areas of land uninhabitable due to increasing higher tides, storm surges and increasing maritime storms leading to areas further inland which had previously been considered safe now being put at risk.	L
Community health & Well-being	Heat	Higher temperatures and more hot days would likely result in heat exhaustion, risk of skin cancer increased, risk of drought related diseases and increased heat-related stress within communities increasing the need for emergency response.	M
	Cold/snow	Cold temperatures will result in significant impacts on property, land and critical infrastructure affecting the economic viability of certain areas and increasing further the vulnerability of communities.	M
	Flood	Extreme rainfall events will increase the risk of property damage within communities and contaminate community water supplies which will result in loss of popular tourist areas (economic impact) and will increase clean-up, maintenance and monitoring staff costs.	M
	Wind	May lead to isolation for elderly people who would be house bound and risk of extensive road blockages etc.	L
	Sea-level rise	Risk of tidal flooding may result in contamination of groundwater supply and an increase of damage to coastal communities	M
Coastal & Maritime	Heat	Rising average temperatures will likely lead to an increase in human activities which will lead to increased costs in the upkeep of coastal regions, increase in number of lifeguards and likely increase in civil defence/fire service call outs (missing persons/drowning/sea rescue's etc).	M
	Cold/snow	Freeze-thaw process can lead to rockslides which will likely damage local infrastructure and residential properties. Prolonged reduction in temperatures will likely lead to shallow bays eventually freezing over.	M
	Flood	Extreme or continuous rainfall may lead to erosion on areas of soft coastline.	M
	Wind	Increase in on-shore winds would result in higher tides and possibly lead to flooding of low lying coastal communities, damage to harbours and fishing vessels resulting in loss of catch and revenue. Increase in off shore wind velocity could result in loss of sand dunes and reduction in beach sizes due to erosion.	L
Emergency services	Heat	Increase in frequency of extreme and above average averages temperatures leading to increase in wildfires which results in higher fire service callouts and increasing LA expenses.	H
	Cold/snow	Extreme cold spells, occasional below-average and record cold temperatures will likely have a severe impact on emergency services during such events due to an increase in road accident's & household fires, however a general decrease in the number of frost days and cold periods should reduce pressure on emergency response throughout the year.	H
	Flood	Extreme rainfall/tidal flooding will require additional fire/civil defence resources to be put in place to assist with evacuations and or sandbagging.	H
	Wind	Extreme sustained wind speed can result in major accidents which increases the risk of accidents on roads, damage to property including injuries to persons within the structure.	H
	Sea-level rise	Requirement of emergency services to prepare additional resources due to increase in responses caused directly by rising sea levels.	M

5 Goals, Objectives & Actions

5.0 Introduction

The information and data set out in this strategy combine to give an improved understanding of climate change and the risks and impacts associated with an anthropologically changing climate. This chapter sets out the identification of a range of appropriate adaptation actions to enhance the capacity of both WCCC and the wider community to address climate change impacts and work towards a greater level of climate change resilience. The adaptation framework described further below sets out actions in a thematic format using identified objectives and high-level goals to support WCCC in achieving and realizing climate change resilience.

5.1 Role of Waterford City & County Council

Adaptation requires practical action to reduce vulnerability to the negative impacts of our changing climate and enhance opportunities or benefits. Adapting to climate change does not have to be an overly complex task. Within WCCC, a significant number of adaptation actions are already advancing. The steps taken by this strategy helps to change the scale and focus on existing efforts being pursued to orientate towards a greater level of understanding of the vulnerabilities and risks and to inform on a considered approach to climate change resilience.

WCCC is well placed and mobilised to focus on and drive adaptation actions through having an influence in areas such as housing, transport, land use, biodiversity and sustainable economic development. It has an obligation to manage resources as efficiently as possible in the interest of the population of Waterford, as not doing so will result in loss and damage to critical assets, increased costs and the uneconomic use of resources.

In terms of climate adaptation and as is represented through all actions of this strategy, WCCC assume responsibility for:

- Ensuring the effective and efficient delivery of functions and services under changing climatic conditions to reduce risk and increase resilience.
- Integrating climate change and adaptation considerations into policies and decision-making processes.
- Responding effectively to emergency situations to extreme weather events.
- Managing climate change risks to public assets owned or managed by WCCC (on behalf of or in partnership with other bodies/agencies).
- Translating and implementing national adaptation policies and cross-sectoral adaptation initiatives at a local level e.g. CFRAM mapping.
- Ensuring access to up to date and relevant climate change data and information to maintain an understanding of risks/vulnerabilities that the changing climate presents to local communities, local economic development, the natural environment and opportunities arising to support adaptation actions.
- Working with communities and local organisations to build resilience and adaptive capacity.
- Collaborating through partnerships with other agencies to achieve effective climate adaptation for Waterford.

5.2 Adaptation Actions and Framework for Waterford City & County Council

The adaptation framework has been informed by an understanding of the vulnerabilities and the risks from the impacts of climate change. In recognition that adaptation responses require collective responsibility within the organisation to develop capacity and build resilience, the adaptation framework is designed with appropriate objectives and actions that encompass all services, functions and operations of WCCC.

There are several adaptation actions set out under eight high level goals. Each high-level goal contains a suite of relevant actions directed by specific objectives, all working towards a clear vision. These actions are tabulated in section 5.7. Actions have been identified for all functional/operational areas of WCCC who have a role in their implementation and delivery of this strategy. In addition, some actions have been translated to this strategy for implementation by WCCC from relevant sectoral adaptation strategies including biodiversity and flood risk management.

Adaptation responses can take the form of:

- “grey” engineered measures to reduce climate hazards, such as the construction of flood defences;
- “green” ecosystem or nature-based adaptation measures, such as catchment attenuation, upgrading and conserving of existing sea defences and harbour infrastructure, the restoration of dune systems and wetlands to buffer against sea-level rise;

- “soft” adaptations that aim to alter the behaviour of the public through policy or economic instruments, such as reusing buildings and reducing demolition, sourcing environmentally sustainable building materials for major infrastructure, offering discounted insurance on homes that retrofit flood defences or early warning systems that communicate directly and effectively to vulnerable communities and enable appropriate local actions in response to limit exposure and damage.

5.3 Summary of High-Level Goals for Waterford City & County Council

1 Business Operations & Continuity

Climate Change adaptation considerations are mainstreamed and integrated successfully into all functions and activities of the local authority ensuring operational protocols, procedures and policies implement an appropriate response in addressing the diversity of impacts associated with climate change.

3 Land Use and Development Policy

Sustainable policies and measures are devised influencing positive behavioural changes, supporting climate adaptation actions and endorsing approaches for successful transition to a low carbon and climate resilient society.

5 Natural Resources and Cultural Infrastructure

Fostering meaningful approaches to protecting natural and key cultural assets through an appreciation for the adaptive capacity of the natural environment to absorb the impacts of climate change.

7 Biodiversity

To protect biodiversity from the impacts of climate change and to conserve and manage ecosystems so that they deliver services that increase the adaptive capacity of people and biodiversity.

2 Infrastructure and Built Environment

Increased capacity for climate resilient infrastructure is centred around the effective management of climate risk, informed investment decisions and a positive contribution towards a low carbon society.

4 Water Services

A greater understanding of risks and consequences of flooding and successful management of a co-ordinated approach to drainage and flooding.

6 Community Health and Wellbeing

Empowered and cohesive communities with strong understanding of climate risks & increased resilience to impacts of climate change with capacity to champion climate action at local level.

8 Coastal Flooding & Erosion

Improved understanding of the risks associated with increasing sea levels, coastal erosion and possible loss of coastal/maritime ecosystems and how best to deal with, prepare for and minimise impacts due to increasing sea levels and sea temperatures.

5.4 Summary of High Level Goals and Objectives for WCCC

Goal 1: Business Operations & Continuity.	
1	To support and ensure the successful mainstreaming and practical implementation of climate change adaptation actions into all activities of WCCC.
2	Building resilience and capacity within WCCC to support service delivery and to respond effectively to extreme weather events.
3	To identify and support opportunities that may arise from pursuing climate change adaptation actions through the functions of WCCC.
Goal 2: Infrastructure and Built Environment.	
1	To increase the resilience of roads and transport infrastructure to the impacts of extreme weather events.
2	To increase the resilience of WCCC buildings and housing stock.
3	To ensure and increase the resilience of critical infrastructure and infrastructural assets.
Goal 3: Land use and Development Policy.	
1	To consider and integrate climate change adaptation actions into land use and planning policies.
2	Implementing climate change adaptation action policies to help the transition to a climate resilient low carbon society.
3	To support sustainable future development planning for coastal communities.
Goal 4: Water Services.	
1	To implement adaptation measures to limit the risk and impact of urban flooding.
2	To provide and plan for effective drainage systems.
3	To provide for adequate and high quality water supply in times of extreme drought conditions.
Goal 5: Natural Resources and Cultural Infrastructure.	
1	To protect heritage and cultural infrastructure which may be affected by extreme weather events.
Goal 6: Community Health and Wellbeing.	
1	To build capacity and resilience within communities to help minimise the effects of extreme weather events.
2	To collaborate with external agencies and work with communities to enhance the effectiveness of community programmes related to climate change.
3	To protect and encourage climate change resilient community infrastructure within Waterford.
4	To support climate change adaptation in schools & community groups.
5	To cater for an increase in immigrants displaced as a result of a changing climate.
Goal 7: Biodiversity.	
1	To support biodiversity with the implementation of the All-Ireland Pollinator Plan.
2	Protect and enhance biodiversity to increase the resilience of natural systems to climate change.
3	To promote effective biodiversity management and enhance protection of natural habitats and landscapes.
Goal 8: Coastal Flooding & Erosion.	
1	To adapt to and prepare for rising sea levels and higher tides.
2	To cater for increase in coastal erosion/deposition and coastal protection due to increasing sea level, maritime storms and higher tides.
3	To support the protection of coastal infrastructure.
4	To replace natural wetlands which have been lost as a result of rising sea levels.

Table 10 – Summary of goals and objectives of WCCC

5.5 Aims of High-Level Goals for Waterford City & County Council

Through its eight goals high-Level objectives listed in table 13, this CCAS is designed to guide a planned and coherent response to the effects of climate change. However, four principle aims (guiding principles) thread through and underpin these goals:

5.5.1 Mainstream Adaptation

That climate change adaptation is a core consideration and is mainstreamed in all functions and activities across the local authority. In addition, ensure that local authority is well placed to benefit from economic development opportunities that may emerge due to a commitment to proactive climate change adaptation and community resilience.

5.5.2 Informed decision making

That effective and informed decision making is based on reliable and robust evidence of the key impacts, risks and vulnerabilities of the area. This will support long term financial planning, effective management of risks and help to prioritise actions.

5.5.3 Building Resilience

That the needs of vulnerable communities are prioritised and addressed, encourage awareness to reduce and adapt to anticipated impacts of climate change and promote a sustainable and robust action response.

5.5.4 Capitalising on Opportunities

Projected changes in climate may result in additional benefits and opportunities for the local area and these should be explored and capitalised upon to maximise the use of resources and influence positive behavioural changes. This is detailed further at the end of the document in section 6.

5.6 Goals

Actions required to fulfil goals and associated objectives will also range from short to medium to long term.

S	M	L
> 5 years	5 to 10 years	< 10 years

Table 11 – Table corresponds to the Timeframes specified in Goals 1 to 8 on the following pages.

Goal 1 Business Operations & Continuity

Goal: Climate Change Adaptation considerations are being mainstreamed and integrated into all functions and activities of WCCC ensuring operational protocols, procedures and policies are implemented in an appropriate response in addressing the diversity of impacts associated with climate change.

Objective 1: To support and ensure the successful mainstreaming and practical implementation of climate change adaptation actions into all activities of WCCC.

No.	Action	Lead & Partner(s)	Budgeted	Timeframes S/M/L
1.	Establish a C.A.S.G which will be tasked with managing and overseeing the effective mainstreaming of adaptation measures into all WCCC plans, programmes, strategies and policies.	Management. Corporate Policy Group.	✓	S
2.	Integrate Climate Action into the Corporate Plan and provide for its translation to Team Development Plans and Personal Development Plans to enable actions to be directly pursued per operational area.	Management. Line Managers. HR.	✓	S
3.	Explore the potential of appointing a Climate Action Officer with responsibility for climate related activity within Waterford City & County Council's administrative area.	Management.	X	S
4.	Take on a more robust role in using green products in implementing adaptation measures.	Procurement Dept.	✓	L
5.	Consider changing the title of the Environment Department, and the Environmental Services SPC to include Climate Action (to be reviewed bi-annually).	Management Team. Environment.	✓	S
5a	Building on adaptation planning actions set out in this strategy, support and complement the practical implementation of actions arising from the National Climate Action Plan – to Tackle Climate Breakdown (as revised and updated annually), across the broad range of functions of the local authority to achieve the national climate ambition i.e. decarbonisation targets to 2030 and objectives to 2050.	Management Team	✓	S

Objective 2: Building resilience and capacity within WCCC to support service delivery and to respond effectively to extreme weather events.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
6.	Assess Waterford City & County Council's vehicle policy and undertake vehicle suitability assessments regularly to ensure timely and necessary maintenance for effective operation in challenging conditions.	Management. Health & Safety. Machinery Yard.	X	S - M
7.	In context of Health and Safety (for staff and customers): <ul style="list-style-type: none"> ➤ Update WCCC's Health and Safety Statement to reflect extreme weather event related risks including for staff involved in clean-up activities after extreme events. ➤ Ensure risk statements are completed and operation plans are reviewed in each operational area taking into consideration the potential risks to workers from extreme weather events. ➤ Review the Lone Working policy to consider extreme weather events. 	Health & Safety. Management.	✓	S
8.	Develop an internal communication protocol for extreme weather events to ensure WCCC staff travel only in safe conditions.	S.W.A.T IS.	✓	S
9.	Develop a database, to be evaluated periodically ⁴ , for extreme weather events including incident reports (photographic, cartographic ⁵ , documented evidence etc), costs and impact on services, deployed resources, impact on service delivery and external agencies.	C.A.S.G. S.W.A.T. Director of Services. Finance.	✓	S - M
10.	Encourage external agency and departmental collaboration to increase climate change resilience providing for: <ul style="list-style-type: none"> ➤ Emergency planning and coordination ➤ Coordinating and sharing expertise & experiences around adaptation actions. ➤ Liaison with the relevant Departments and Agencies regarding the 	CARO. C.A.S.G. S.W.A.T. Met Eireann. Army. Farming Sector	✓	S - L

⁴ Post extreme weather event or seasonally

⁵ relating to the science or practice of drawing maps

	implementation of actions set out in sectoral climate adaptation strategies. ➤ Development of a plan to utilize the resources of farmers, agricultural contractors and community groups to clear and keep roads open after extreme weather events.			
11.	Build expertise, capacity and increase knowledge base through relevant training programmes on climate change awareness and its implications on the operations/functions of WCCC.	CARO. WCCC.	✓	S - L

Objective 3: To identify and support opportunities that may arise from pursuing climate change adaptation actions through the functions of WCCC.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
12.	Identify and source funding streams for the implementation of adaptation actions and measures across Waterford with an emphasis on capitalizing on opportunities that may arise.	C.A.S.G. Director of Services. All Section Heads. External Agencies.	×	S - L
13.	Through the work of the LEO, support, encourage and nurture new business ideas seeking to capture opportunities associated with environmental and technological advances that support low carbon transition.	LEO. External Stakeholders.	✓	S - L

Goal 2 Infrastructure and Built Environment

Goal: Increased capacity for climate resilient infrastructure is centred around the effective management of climate risk, informed investment decisions and a positive contribution towards a low carbon society.

Objective 1: To increase the resilience of roads and transport infrastructure resulting from extreme weather events.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
1.	Undertake a Risk Assessment of all major roads county wide to identify vulnerabilities for an understanding of risks posed by climatic hazards described within this strategy. The findings should be integrated into road infrastructure programmes, design & planning for new roads, project budgets and investment.	Roads. DTTAS. TII.	✓	L
2.	Integrate climate change considerations into the design, planning and construction of all roads, footpaths, bridges, public realm and other construction projects. Make provision to incorporate green infrastructure to provide for carbon offset, and provide wider environmental benefits including providing shade to alleviate heat stress, supporting urban biodiversity, water retention and flood alleviation.	Planning. Roads. Architectural Services.	✓	M

Objective 2: To increase the resilience of WCCC buildings and housing stock.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
3.	Apply a risk assessment to LA owned buildings and properties to identify and protect against the key vulnerabilities due to the impacts of climate change and mitigate against service disruption.	Housing. Architects. Facilities Manager.	X	S
4.	Increase the resilience of WCCC buildings, housing stock and infrastructure through: ➤ Identifying and assessing the integrity of old and derelict buildings and any likely threat to public safety via the Derelict Building Register. ➤ Explore the need to regularly assess buildings owned or occupied by WCCC after extreme events, including buildings subjected to soil instability, to ensure structural integrity. ➤ Consider a one off survey of all building stock to assess vulnerabilities to current and projected extreme weather events.	Environment. Facilities Manager. Architectural Office. Housing. D.H.P.L.G	X	S - M
5.	Increase awareness of LA tenants to potential impact on housing from extreme weather events, addressing fuel/energy consumption issues and how best to look after homes to reduce impacts resulting from extreme weather events.	Housing.	✓	S

	This includes updating the tenant's handbook and the online communication and social media plan to provide the necessary climate change resilience information.			
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Objective 3: To ensure and increase the resilience of critical infrastructure and infrastructural assets.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
6.	Annually assess the ICT Strategy 2019 - 2024 which considers the range of potential extreme weather risks in this strategy, and their impacts on works to be carried out on IS infrastructure.	IS.	✓	M
7.	Enhance cooperation and communication between WCCC and external agencies on a national level to ensure that energy infrastructure and services are resilient to the impacts of climate change.	C.A.S.G. ESB/Bord Gais.	✓	L
8.	Undertake a monitoring & inspection programme for vulnerable coastal areas and existing coastal defences, including major harbours piers etc, following extreme weather events.	Roads. Environment. Executive team.	X	L

Goal 3 Land Use and Development Policy

Goal: Sustainable policies and measures are devised and implemented to influence positive behavioural changes, supporting climate adaptation actions and endorsing approaches for successful transition to a low carbon and climate resilient society.

Objective 1: To consider and integrate climate change adaptation actions into land use and planning policies.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
1.	Integrate climate change adaptation as a critical consideration guiding principle and strategic objective within the WCCC County Development Plan to reduce the vulnerability of Co. Waterford to the impacts of climate change while ensuring that CFRAM maps are integrated into relevant aspects of WCCC County Development Plan.	Planning. Environment. D.H.P.L.G/OPW.	✓	M
2.	Continue to promote the integrated planning, design and delivery of green infrastructure (including urban greening) through appropriate provisions in: <ul style="list-style-type: none"> ➤ planning policies of development plans, ➤ development standards and conditions on planning permissions and ➤ infrastructural, public realm and community projects 	Planning. D.H.P.L.G	✓	S
3.	Develop a Green Infrastructure strategy will be included as part of the next Development Plan	Planning.	X	S
4.	The requirements for urban storm water drainage systems for new developments should take into account the potential future impacts of climate change.	Planning. Water Services.	✓	S
5.	The planning and design of future WCCC assets should take into account and be adaptable to the potential future impacts of climate change.	Water Services. Environment. OPW.	✓	S

Objective 2: Implementing climate change adaptation action policies to help the transition to a climate resilient low carbon society.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
6.	Implement a plan to promote Sustainable Transport Networks including road infrastructure and modes of transport across County Waterford as an alternative way of travelling. Encourage the use of Greenway / Blue way routes and other amenity trails.	Planning/Roads. Waterford LEADER. D.H.P.L.G	✓	S

Objective 3: To support sustainable future development planning for coastal communities.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
7.	Ensure sea level change is incorporated into all flood risk mapping in association with the Irish Coastal Protection strategy Study and CFRAM maps.	Planning. Environment. D.H.P.L.G	✓	S

Goal 4 Water Services

Goal: A great understanding of risks and consequences of flooding and successful management of a co-ordinated approach to drainage and flooding.

Objective 1: To implement adaptation measures to limit the risk and impact of urban flooding.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
1.	Proposals submitted under any "Minor Works" programmes or schemes should take account of the potential impacts of climate change to ensure that any measures proposed are adaptable to possible future changes.	Environment. OPW Transportation.	✓	S
2.	Ensure that potential flood information is obtained and generated through a Flood Risk Assessment (FRA) that is then used to inform suitable adaptation requirements within planning and development management in line with the guidelines on the planning System and Flood Risk Management. National aquifer and recharge maps will be reviewed as part of this process.	Planning. Environment. OPW	✓	S
3.	Ensure that emergency response plans for flood defence activation and CFRAM maps are reviewed periodically ⁶ to reflect the degree of flood risk.	S.W.A.T/OPW. Fire Services.	✓	S
4.	Identify areas susceptible to isolation as a consequence of flooding. Establish measures to reduce the risk and preparedness for significant events to build awareness and resilience in these areas to minimize impact.	S.W.A.T. Civil Defence. Community Section.	X	S
5.	Review & update current operations around (natural) drainage channels to take into account increased siltation and continued plant growth.	Environment. Water Services.	X	S

Objective 2: To provide and plan for effective drainage systems.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
6.	Reference CFRAM and develop a surface water management plan for the management of flood risks with the aim of: <ul style="list-style-type: none"> ➤ Development of projects to reduce surface water flood risk. ➤ Provide for detailed mapping of areas prone to surface water and groundwater flood risk. 	Environment Section. Transportation Section. OPW	X	S
7.	Specify/limit the design requirements of urban storm water drainage systems for new development to take account the potential future impact of climate change and the requirement for Sustainable Urban Drainage Systems.	Planning. Water Services. Housing.	X	S

Objective 3: To provide for adequate and high quality water supply in times of extreme drought conditions.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
8.	Ensure Emergency Services have access to water during times of drought while also considering identification of access points.	Fire Services.	✓	S
9.	Protection of water sources servicing treatment plants and protection of ground water supply through the implementation of Integrated Catchment Management	Irish Water. Water Services LAWCO	✓	L
10.	Implement Irish Water adaptation actions where applicable and agreed upon with WCCC	Irish Water.	✓	M

⁶ annually

Goal 5 Natural Resources and Cultural Infrastructure

Goal: Fostering and implementing meaningful approaches to protecting natural and key cultural assets through an appreciation for the adaptive capacity of the natural environment to absorb the impacts of climate change.

Objective 1: To protect heritage and cultural infrastructure which may be affected by extreme weather events.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
1.	Undertake a risk assessment of the heritage and cultural assets in the county to assess the vulnerability and the risk to the historical environment from the impacts of severe weather events and to help build resilience of these assets.	Heritage Officer. Arts Officer.	X	M
2.	Explore ways to capitalize on new archaeological finds which have resulted from extended periods of drought and other climate change impacts.	Heritage/Conservation Officer. OPW.	X	L
3.	Integrate climate change considerations and future risks into the maintenance of heritage structures/sites in the county.	Heritage Officer. Facilities Manager.	X	M

Goal 6 Community Health and Wellbeing

Goal: Empowered and cohesive communities with strong understanding of climate risks & increased resilience to impacts of climate change with capacity to champion climate action at local level.

Objective 1: To build capacity and resilience within communities to help minimise the effects of extreme weather events.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
1.	Raise awareness of the impacts of climate change and ways for communities and the elderly/vulnerable/isolated to increase resilience to these impacts. This should include: <ul style="list-style-type: none"> ➤ Information on Severe Weather Event preparation. ➤ Property security and safety. ➤ Health related illnesses ➤ Public safety awareness. ➤ Water safety awareness for unsupervised watercourses in local areas. ➤ Air pollution in residential areas from increased frequency of fires ➤ Housing maintenance awareness to combat deterioration of property from changing conditions. ➤ Road safety awareness when driving during extreme conditions. ➤ Water conservation best practice during extreme heat events. ➤ Dangers of swimming in quarries, canals and rivers unsupervised. ➤ Elderly vulnerable and isolated people/communities 	Community Section. Civil Defence. Environment. Gardaí. HSE/RSA. Irish Water Safety. Irish Water. PPN. OPW/HSE. MET Eireann. Age Action. Local Community Groups.	✓	S
2.	Identify and assess vulnerable communities across the county in the context of their vulnerability and associated risks to the impacts of climate change.	HSE.	X	M
3.	Develop a programme for vulnerable communities to enhance their capacity to respond to and recover from extreme weather events with aims such as: <ul style="list-style-type: none"> ➤ Providing advice on the risk of extreme events affecting their locality. ➤ Providing support to develop appropriate resilience arrangements to enable response and recovery. ➤ identify and provide emergency homeless shelters and provisions for mass evacuation potentialities. 	C.A.S.G. Community Section. Civil Defence. Gardaí/HSE. Transportation. Housing	X	M

Objective 2: To collaborate with external agencies and work with communities to enhance the effectiveness of community programmes related to climate change.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
4.	Work with Waterford LEADER to: <ul style="list-style-type: none"> ➤ Identify funding streams available to communities to enable local climate adaptation action projects ➤ Support and develop adaptation actions and climate resilience activities in local areas. 	Community Section. Tidy Towns. PPN.	✓	S
5.	Scope the potential of working with external agencies to provide	Community Section.	X	M

	training/awareness programmes for smaller/isolated communities around climate change adaptation efforts.	Local Enterprise Board.		
6.	Explore the potential of incorporating climate change adaptation into local area plans which will enhance the opportunity for structured community coordination and drive climate change adaptation actions at local levels.	Community Section. C.A.S.G. PPN.	X	M
7.	Encourage Tidy Towns Programs to integrate and take into consideration of the impacts of climate change and proactively plan to reduce risks and vulnerabilities in the local areas.	Environment. Parks.	X	S

Objective 3: To protect and encourage climate change resilient community infrastructure within Waterford County.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
8.	Integrate climate change considerations in the planning and development stage for festivals and community events.	Community Section. Planning/Finance. Emergency services.	✓	S
9.	Explore the need for funding for heating/cooling systems for community facilities with aim of ensuring any funding is put towards more energy efficient/environmentally systems.	Community Section. WEB. Facilities Manager.	X	M - L

Objective 4: To support climate change adaptation in schools & community groups.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
10.	To implement and support climate change adaptation measures as covered by the WCCC environment education officer under the Green Schools program	Biodiversity Officer. Environment Education Officer	✓	

Objective 5: To cater for an increase in immigrants displaced as a result of a changing climate.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
11.	To cater for climate change immigrants/refugees that have been displaced due to severe climatic weather events as decided by the relevant govt dept.	HSE/ Gardaí/WCCC depts./Intreo. Civil Defence.	X	L

Goal 7 Biodiversity

Goal: To protect biodiversity from the impacts of climate change and to conserve and manage ecosystems so that they deliver services that increase the adaptive capacity of people and biodiversity.

Objective 1: To support biodiversity with the implementation of the All-Ireland Pollinator Plan.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
1.	Implementation, monitoring and evaluation of the "All-Ireland Pollinator Plan"	NBDC. Biodiversity Officer. Heritage Officer.	✓	S
2.	Review the Waterford Biodiversity Action Plan and provide for actions that ensure: <ul style="list-style-type: none"> ➤ Risks from adverse climate change have been identified. ➤ Carbon capture within habitats is considered. ➤ Invasive species are examined. ➤ Identify areas considered beneficial for use as local carbon offset through carbon sequestration^{xi}. ➤ Development of Tree Management Strategy 	Heritage Officer. NBDC. OPW. Environment. Planning. Biodiversity officer. Horticulturist.	✓	S
3.	Maintain existing, and identify new ecological networks to increase habitats through sympathetic management of terrestrial, freshwater ecosystems while implementing appropriate spatial and land use planning.	Planning. C.A.S.G. Environment.	X	M
4.	Review and assess the choice of planting in parks with aim of limiting vulnerability to harsher conditions and maintaining and increasing biodiversity.	Environment. Horticulturist.	X	M
5.	Co-design green spaces and wildlife refuges in urban environments and peri-urban ^{xixiii} areas with local communities to provide habitats for connecting people to biodiversity.	Planning. Biodiversity officer. Horticulturist.	X	M
6.	To promote the Junior Pollinator Plan and Tidy Towns Pollinator Plan	Biodiversity Officer. Local Schools.	✓	S
7.	To reduce the use of pesticides.	Horticulturist.	✓	M

		Environment.		
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Objective 2: Protect and enhance biodiversity to increase the resilience of natural systems to climate change.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
8.	Enhance and restore natural systems to help increase resilience – starting with hydrological processes (freshwater and marine), carbon processes (for bogs) and pollination.	DAFM/BIM/OPW. Bord na Mona. Coillte. ENGOS	X	L
9.	Develop a tree planting strategy to undertake and implement an active native tree planting programme in the context of climate change adaptation in conjunction with biodiversity awareness campaigns. Undertake risk assessment of trees located along travel routes and near critical infrastructure.	Parks. Heritage Officer. Area Engineers. Biodiversity Officer. Horticulturist.	✓	M
10.	Protect and enhance green infrastructure and make provision for the integration of appropriate landscapes and planting schemes into all relevant projects undertaken by WCCC.	CASG. Environment. Biodiversity officer.	X	M
11.	Integrate natural borders/buffers as an integral component of the design of greenways/blue ways, tracks, trails and amenity areas.	Parks. Roads. Area Engineers.	✓	M
12.	Encourage the use of information boards at public amenities, tourism sites, wilderness areas, natural landscape's, cultural heritage sites and other appropriate locations to bring awareness of the benefits of the natural environment and its role in climate change.	Environment. Parks. Biodiversity Officer. NBDC.	✓	M
11.	Examine methods or new technologies for use during extreme heat events for the watering of plants/trees.	Parks/ DAFM. Environment. 3 rd Level Institutions Teagasc.	X	L

Objective3: To promote effective biodiversity management and enhance protection of natural habitats and landscapes.

No.	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
12.	Develop an integrated coastal management strategy which includes ecosystem based adaptation actions to manage climate impact risks and build resilience to climate change.	DAFM/EPA. DCHG/DCCAE. Dept of Marine.	✓	M
13.	Promote the "Leave no Trace" scheme for beaches / woodlands / parks etc to increase awareness and promote responsible outdoor recreational activities through education, research and partnerships.	Environment. Biodiversity officer. Tidy Towns.	✓	S

Goal 8 Coastal Flooding & Erosion

Goal 8 Improved understanding of the risks associated with increasing sea levels, coastal erosion and possible loss of coastal/ maritime ecosystems and how best to deal with, prepare for and minimise impacts due to increasing sea levels and sea temperatures.

Objective 1: To adapt to and prepare for rising sea levels and higher tides.

No	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
1.	Review CFRAM maps and plan for affects of increasing tidal levels on flood plains, flood barriers etc.	Planning. Environment. OPW	✓	S
2.	Prepare a map of County Waterford that projects increasing tidal level and sea level heights predictions for the years 2050 and 2100	Planning. Environment. OPW	✓	M
3.	To work with relevant external agencies in order to help affected coastal communities implement relevant works that cater for rising sea levels and increasing tide heights.	Dept of Marine. Planning. Environment. OPW	X	L

4.	To maintain "Blue Flag Beaches" status and high water quality while planning for projected sea levels rises.	Water services. Environment. Dept of Marine. OPW	X	L
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Objective 2: To cater for increase in coastal erosion/deposition and coastal protection due to increasing sea level, maritime storms and higher tides.

No	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
5.	Identify and review areas of Waterford's coastline that are vulnerable to increased levels of coastal erosion due to increasing sea levels.	Roads. Engineering Depts. OPW	X	L
6.	Develop a robust plan to ensure that all flood barriers are in place prior to the onset of maritime storms.	Roads. OPW	✓	S
7.	Update plans and resources of WCCC emergency services and emergency response crews to cater for localized effects of maritime storms.	Emergency Services. OPW	✓	M

Objective 3: To support the protection of coastal infrastructure.

No	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
8.	Review the current sea levels at WCCC's coastal infrastructure and explore measures to raise roads levels and protect coastal assets in order to reduce risk of flooding due higher sea level rises.	Roads. OPW	✓	L
9.	Include consideration for higher sea levels within future development plans for coastal communities.	Planning. OPW	X	M

Objective 4: To replace natural wetlands which have been lost as a result of rising sea levels.

No	Action	Lead & Partner(s)	Budgeted	Timeframe S/M/L
10.	Identify regions of wetlands and implement protection measures with the aid of CFRAM maps taking into account that current protection measures may be insufficient.	Planning. Environment. NBDC/OPW.	X	L

6 Implement, Monitor & Evaluate

6.0 Implementation

This strategy represents all functions and operations of WCCC, it is important that the CASG bring together representatives from all key functional areas with various technical, operational and management expertise that can successfully carry out the necessary tasks and implement the actions contained within the strategy. The Management Team will nominate a representative to the CASG and assign its Chair. The CASG will meet quarterly. The tasks of the group are as follows:

- Prioritize actions within the short, medium & long-term timeframe.
- Develop an approach and initiate implementation of the actions.
- Liaise with other stakeholders and relevant sectors locally and regionally for the implementations of relevant actions.
- Monitor and evaluate the implementation of any actions.
- Report any progress or setbacks to the CASG, the Environment SPC and finally to the full council.

The Eastern and Midlands CARO will continue to assist and provide guidance where possible in the practical implementation of the actions of this strategy. WCCC will continue the positive relationship, collaboration and engagement with the Eastern and Midlands CARO as is necessary throughout the life time of this strategy which includes submitting an annual progress report to CARO if required.

1. Prioritize Actions

The purpose of this task is to prioritize adaptation actions for delivery within the short, medium and long term timelines as defined in the strategy document. Actions are to be assigned timeframes for implementation and furthermore assigned owners for delivery. Progress reporting will be aligned to this prioritization.

2. Implementation

WCCC will endeavor to implement climate change adaptation actions using national policies and practices subject to support and available funding from the relevant government departments and with the resources that are made available.

3. Develop an approach and initiate the implementation

The purpose of this task is to break down the adaptation framework into what actions will be taken, when and who will carry out the actions by way of the Implementation Plan. The CASG will devise a methodology for implementation that will include:

- Who is responsible for implementing the adaptation actions.
- Identify funding required for the adaptation measures.
- Identify/establish key indicators or targets as mechanisms for measuring outcomes.
- Collaboration with other stakeholders.
- Identification of where adaptation measures could be incorporated into existing plans, policies and budgets.
- Timeframe over which the measures will be implemented.
- Identify risks to the implementation of actions.

It is recommended to expand out the actions into the implementation plan, and once complete, key personnel can assume responsibility and begin implementing the adaptation actions.

4. Liaise with other stakeholders & sectors

The LA will be required, as considered necessary, to liaise with key stakeholders to provide for the delivery of actions. Conversely, the sectors, as identified in the NAF, will engage and liaise with LA's in the delivery of sectoral adaptation actions stemming from their respective adaptation plans.

5. Monitor & evaluate the implementation

Monitoring and evaluating the implementation of actions is critical to ensure the long-term success of climate change adaptation. It is essential in tracking the performance of activities within the lifetime of this strategy, in determining whether planned outcomes from adaptation actions have been achieved and in determining whether new adaptation actions should be undertaken.

The CASG is encouraged to use results from the monitoring and evaluating program to:

- Revisit vulnerability and risk assessments conducted as part of adaptation actions.
- Make changes where appropriate based on monitoring results.
- Update observed changes.
- Include new climate data and recent extreme climatic hazards/events.
- Factor in changes to exposure and/or adaptive capacity.
- Evaluate the success or outcome of completed actions.

This ensures an iterative process and allows actions to be determined by latest climate change data and projections. In this way monitoring and evaluating can help improve the efficiency and effectiveness of adaptation efforts within WCCC.

6. Report on the progress

The CASG should develop and agree appropriate and continuous timeframes and mechanisms to report on the progress of the practical implementation of the actions of this strategy to the management team, Environmental SPC and the elected members of WCCC as considered appropriate.

Reporting on progress, i.e. a Climate Change Adaptation Progress Report should be prepared annually, (based on the initial date of the adoption of the strategy), for input by the Management Team and SPC and reviewed by the Elected Members.

The progress report should provide for, inter alia:

- Progress achieved on actions to that point (including key indicators as established).
- Extent to which actions have been achieved and new relationships built with key stakeholders, agencies & communities and identify new and/or emerging opportunities.
- Identification of funding streams used.
- Report on the outcomes of efforts to change behavior.

The requirement to report on progress on an annual basis is also informed by the following:

“Under section 15 of the Climate Action and Low Carbon Development Act 2015, local authorities may be required to report on progress in meeting the terms of the National Adaptation Framework and Sectoral Adaptation Plans.

Local Authorities have been identified by many national sectors under the National Adaptation Framework as a key stakeholder responsible for implementing adaptation actions in their local area and ensuring coordination and coherence with the sectors identified in the NAF. Cooperation and collaboration between Local Authorities and the sectors is encouraged strongly. Under Section 14 of the Climate Action and Low Carbon Development Act 2015, Sectors may be required to report on progress made with the adaptation actions and present annual sectoral adaptation statements to each House of the Oireachtas by the relevant Minister or by the Minister for DCCAE.

The National Adaptation Steering Committee, chaired by the DCCAE maintains a role to ensure a coordinated and coherent approach to implementing actions under the NAF. This steering committee with representation from Local Authorities and the CAROs has a role in promoting cross sectoral coordination.

The High Level Climate Action Steering Committee, chaired by the Minister for Communications, Climate Action and Environment has a role in monitoring progress by sectors and local authorities in delivering on climate change adaptation actions. Under Section 13 of the Climate Action and Low Carbon Development Act 2015, the Advisory Council has a role, at the request of the Minister, in conducting periodic reviews of the implementation of the National Adaptation Framework and sectoral adaptation plans and to report on its findings and recommendations.”

6.1 Opportunities

It is widely acknowledged that Climate Change Adaptation should not just be focused on impacts and consequences. Opportunities that can arise from a changing climate need to also be considered and where possible capitalized upon. These can include:

- The implementation of more cost effective and more efficient operating processes and materials more suitable to a warmer climate.
- The implementation of more energy efficient and cost sensitive solutions for living in a warmer climate
- Improving the living environment in the County through quality of life, public realm improvements and enhancing the natural environment.
- Improving economic opportunities in local communities.
- Ensuring infrastructure and facilities are in place to take advantage of an expected increase in tourism
- Ensuring land use development within the County can take advantage of a potential increase in foreign direct investment increasing local economy growth.
- Improvement in agricultural land that would otherwise be to damp for crops.
- Warmer and longer summers will likely see Irish people remain in Ireland during summer holiday periods thus increasing expenditure within the economy.
- Warmer summers will likely also see an increase of tourists from colder more northern latitudes during summer months.
- Warmer seasons would likely see an increase in growing seasons for farmers resulting in better yields and lower prices for the consumer.
- Warmer climate would see fewer deaths due to intensely cold winters.
- There would be significant reduction of natural fuels usage as temperatures would likely remain higher throughout the year.

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Don Tuohy, Senior Executive Officer, Community.
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^v <https://www.flickr.com/photos/civildefence/albums/72157688375000990/with/26701383418/>

^{vi} Met Eireann defines a heat wave as when there are five consecutive days of temperatures in excess of 25 degrees

^{vii} <https://www.irishmirror.ie/news/irish-news/ireland-weather-heatwave-meteireann-dublin-12802834>

^{viii} <https://www.rte.ie/news/analysis-and-comment/2018/0630/974393-weather-heatwave-ireland/>

^{ix} Fig 10 - [https://en.wikipedia.org/wiki/Hurricane_Ophelia_\(2017\)#/media/File:Ophelia_2017_track.png](https://en.wikipedia.org/wiki/Hurricane_Ophelia_(2017)#/media/File:Ophelia_2017_track.png)

^x <https://archive.irishnewsarchive.com>

^{xi} a natural or artificial process by which carbon dioxide is removed from the atmosphere and held in solid or liquid form

^{xii} denoting or located in an area immediately adjacent to a city or urban area

^{xiii} https://www.google.com/search?q=peri-urban+meaning&rlz=1C1GGGE__IE842IE842&oq=peri-ur&aqs=chrome.2.69i57j0l5.8279j0j7&sourceid=chrome&ie=UTF-8