



**CLIMATE  
RESILIENT  
GALWAY CITY**  
ENGAGE | PLAN | ADAPT



# ACKNOWLEDGEMENTS

Grateful acknowledgement is made to the Climate Action Regional Office - Atlantic Seaboard North Region with regard to the development of the Draft Galway City Council Climate Adaptation Strategy. In addition, Galway City Council would also like to express gratitude to the following sources for their assistance and contributions to the draft strategy:

- The Galway City Council Climate Adaptation Team.
- Climate Ireland, Dr Barry Dwyer and the Team at the Centre for Marine and Renewable Energy Ireland, Cork.
- The Department of Communications, Climate Action and Environment.
- The Regional Climate Action Steering Group and the Climate Adaptation Team Leaders from Mayo County Council, Donegal County Council, Sligo County Council, Galway County Council.



# FOREWORD



**Mike Cubbard**  
**MAYOR**  
Galway City Council

We are delighted to welcome and lead Galway City Council's first Draft Climate Adaptation Strategy.

Climate change is already happening and presents many challenges for society. Tackling climate breakdown is an urgent priority and the critical nature of the challenge must be understood by all with a concentrated programme of action. In particular, we must adapt the way that we interact with our environment and improve the resilience of our City while developing sustainably and take advantage of any opportunities that Climate Change may present.

Galway City Council is committed to taking proactive action to engage, plan and adapt to increase the resilience of Galway City Council and the services it provides to the people of Galway City, its economy, environment and communities.

The Strategy creates a framework for measures, priorities and policies that Galway City Council will undertake in terms of climate adaptation and represents the start of our climate adaptation journey towards a "Climate Resilient Galway City".



**Brendan McGrath**  
**CHIEF EXECUTIVE**  
Galway City Council

## Climate Adaptation

Action on climate change requires two simultaneous approaches: mitigation and adaptation. Mitigation prevents future climate change from happening through actions that reduce greenhouse gas (GHG) emissions (for example improving the energy efficiency of your home). Mitigation is necessary to ensure that impacts do not become too severe, but adaptation is also necessary.

Adaptation manages the consequences of climate change through actions that prepare for and respond to climate-related challenges (for example new flood defence infrastructure) but importantly it also takes advantage of potential benefits of climate change. No matter how focused we are on mitigation, greenhouse gases already in the atmosphere will result in climate change so adaptation is necessary to deal with the inevitable impacts.

We need to plan to adapt to that we cannot mitigate and take action to prevent climate change leading to impacts that we cannot adapt to either directly at the local and regional level, or indirectly at the global level.

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# INTRODUCTION



**Ireland has directly experienced the extreme weather events of flooding, drought, and lock down by extreme snow fall. But many countries have experienced much worse. The shift in climate is bringing profound shifts of desertification, rising sea levels, displaced population, profound challenges to the natural world, and economic and social disruption. We are close to a tipping point where these impacts will sharply worsen.**

Agenda 2030 and the Paris Agreement on climate change require a transformational shift of our economies and societies towards climate resilient and sustainable development. Ireland and the international community is responding to this requirement, setting out a profound change in the systems and practices which support our lifestyle. Every home, every community, every workplace and every farm, must be mobilised to get involved. Every network which supports our lives – energy, transport, telecommunication, public service, waste management – must adapt rapidly. If we delay the transition we, as a country, shall most certainly face greater costs and fewer opportunities. The reality is that, only by adapting now, can our enterprises remain competitive and our society resilient.”  
Extracts - Climate Action Plan 2019 – to tackle climate breakdown.

It is in this context that climate change is recognised as a critical challenge by Galway City Council. Taking proactive action to adjust and prepare for anticipated changes will reduce losses, improve our environment and provide a host of community benefits. Developing a robust approach to adaptation is the first step on this journey.



**Galway City Council's Climate Change Adaptation Strategy 2019-2024** (the Adaptation Strategy) sets out our strategic priorities, measures and responses for adaptation for Galway City Council over the next five years; as required by the Climate Action and Low Carbon Development Act 2015.

The Adaptation Strategy lays the groundwork for a new, integrated approach to adaptation under the National Adaptation Framework while building on adaptation action already underway.

The Climate Action and Low Carbon Development Act 2015 also requires climate change principles and objectives to be considered in all our policies and programs. In doing so, the Strategy will provide an opportunity to not only enhance our adaptive capacity and resiliency but also an opportunity to reduce the long-term costs and impacts associated with climate change.

The aim of this first strategy is to identify the risks, challenges and opportunities that need to be considered and to take coherent coordinated action. The Strategy is based on four main themes: **Critical Infrastructure and Buildings, Natural and Cultural Capital, Water Resource & Flood Risk Management and Community Services** and provides for many actions that will be developed and implemented over the next five years. Priority is awarded to actions where severe weather has impacted the safety of citizens and critical infrastructure, however assets which are currently or may in the future be susceptible to severe weather impacts are also considered.

These actions will be driven by Senior Management, Climate Adaptation Implementation Group and Elected Members via Strategic Policy Committees (SPCs) and Climate Adaptation Monitoring Group.

#### **Climate Action Regional Office – Atlantic Seaboard North**

The newly established Climate Action Regional Office – Atlantic Seaboard North is one of four regional climate change offices that have been set up in response to Action 8 of the 2018 National Adaptation Framework – Planning for a Climate Resilient Ireland.

Mayo County Council is the lead authority for the Atlantic Seaboard North Region, which consists of Donegal County Council, Sligo County Council, Mayo County Council, Galway County Council and Galway City Council.

# OUR APPROACH



## ENGAGE

The first key step in our approach is improving our understanding and communication of the risks from a changing climate across the Local Authority departments, businesses, communities and individuals. The Strategy aims to engage with communities and place them at the centre of this adaptation process, and to encourage broad participation and collective decision making on how our citizens want to adapt to the challenges and opportunities, and how we as a Local Authority can support this change. Tailored training and development programs will be essential components to aid the delivery of the plan.



## PLAN

The planning process will include details on how our climate is changing, potential impacts and opportunities, as well as the identification of areas at risk to inform planning and decision-making. The compilation of inventories and baselines with the assistance of relevant state agencies and third level academic institutions will assist operations as the adaptation journey of Galway City Council progresses. The integration of climate change principles throughout future plans and procedures will be fundamental in strengthening our resilience.



## ADAPT

The success of this plan will be measured by our ability to develop and implement co-ordinated responses to climate risk where needed. Many adaptation actions are already underway at Galway City Council and mainstreaming adaptation measures into all levels of operations and policies within Galway City Council will be an important aspect of implementing climate action at local level. The team will develop a progress report to document observed climatic changes or impacts in the City; successfully implemented actions; barriers to the implementation of actions; new sources of funding; and windows of opportunity for climate action.



# ADAPTION & MITIGATION

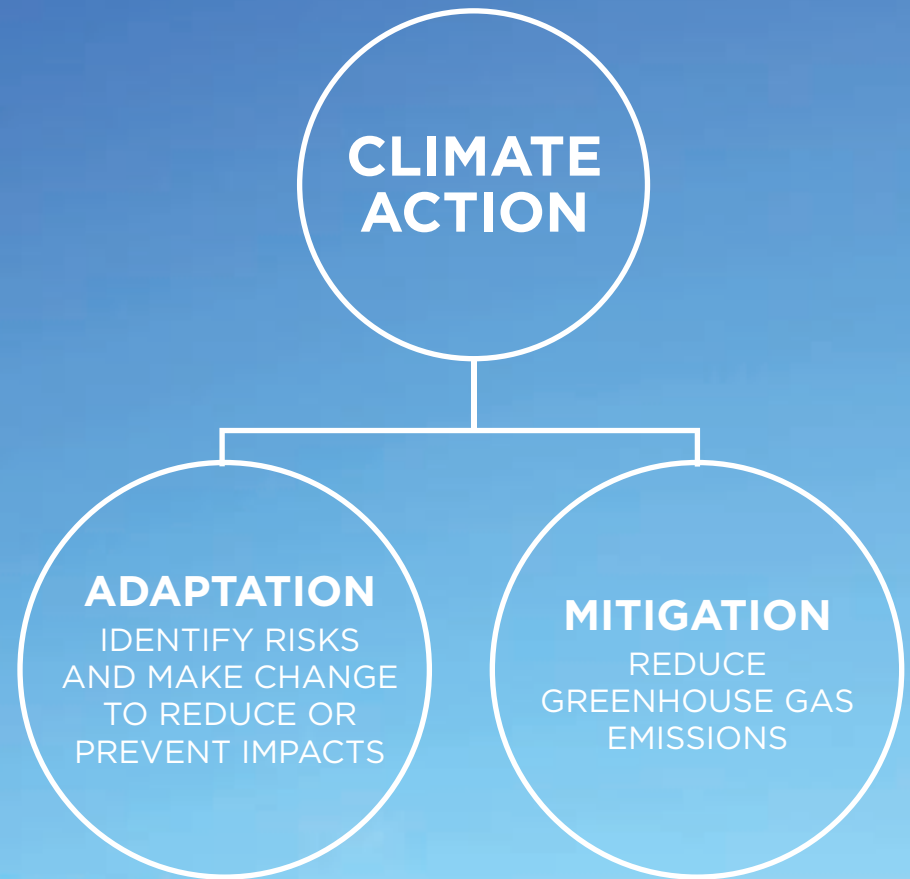
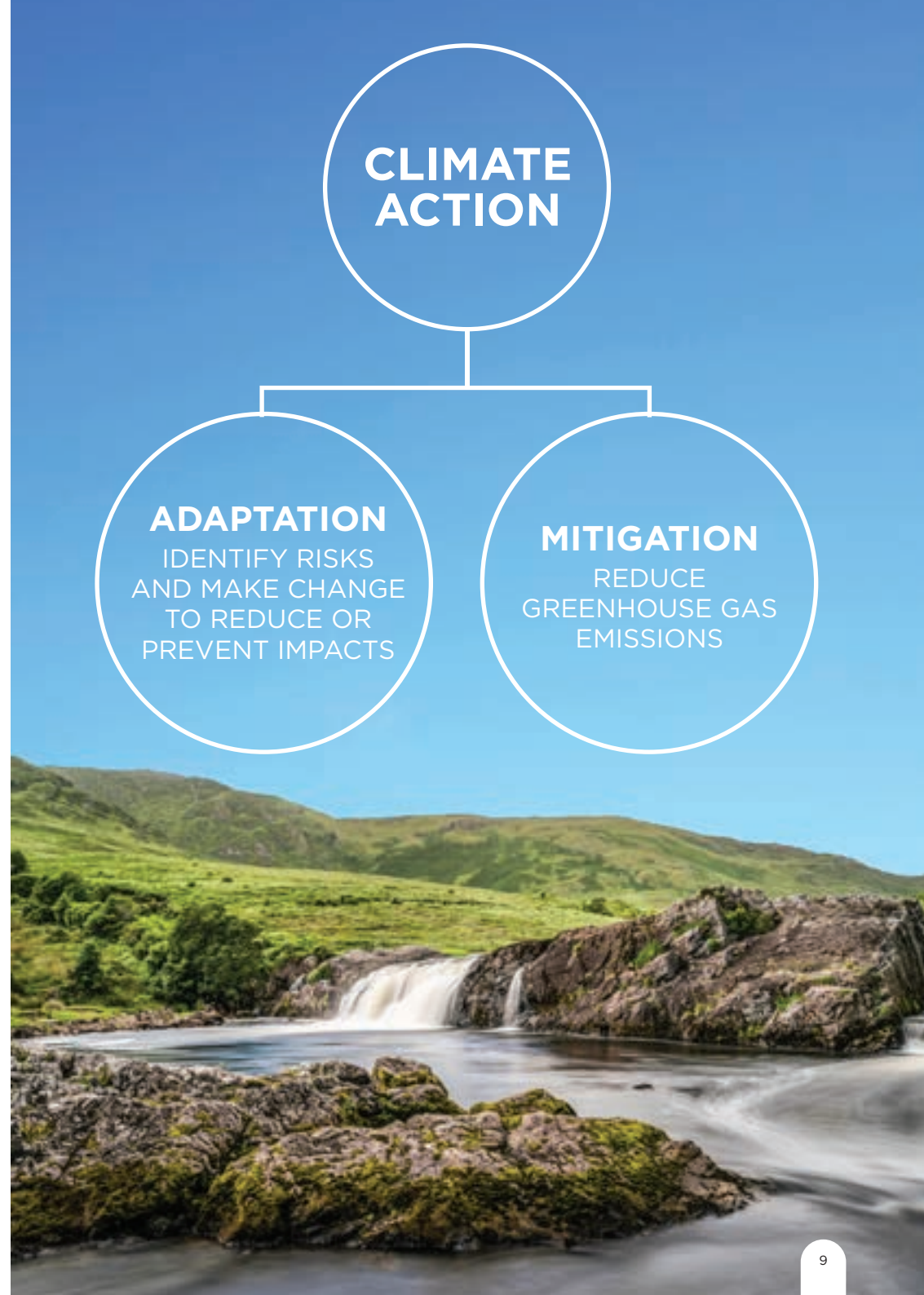
Climate change **Adaptation and Mitigation** are distinct but complementary activities.

**Adaptation** means anticipating the adverse effects of climate change and taking appropriate action to prevent or minimise the damage that it causes additionally it means taking advantage of opportunities that may arise. This includes green growth, innovation, jobs and ecosystem enhancement as well as improvements in areas such as water and air quality, the natural and built environment.

**Mitigation** is the process of reducing carbon pollution and greenhouse gas emissions to limit the extent to which our climate changes in the future. It involves improving energy efficiency, switching to more sustainable energy sources and trapping and storing carbon in vegetation and soils.

Substantial and sustained reductions in GHG emissions are required to limit the extent of climate change and reduce the likelihood of encountering severe, irreversible changes (IPPC, 2013). This needs to be accompanied with action to prepare for the effects of climate change, as the world will continue to warm for several decades.

This Strategy is concerned with preparing for the changes that a changing climate will bring through climate adaptation. The process involves developing a comprehensive understanding of how changes will affect Galway City Council and the communities within its functional areas as well as actively working to reduce our exposure to new and increased risks.



# STATUTORY CONTEXT



# STATUTORY CONTEXT

Key drivers for the development of Galway City Council Climate Adaptation Strategy include International, European and National Climate Change Agreements, Directives, Legislation and Regulations. This includes the Irish Government’s Climate Action and Low Carbon Development Act 2015, National Mitigation Plan, National Adaptation Framework and National Planning Framework.

## International and European Policies & Agreements

### United Nations Framework Convention on Climate Change - 1992

The UNFCCC is an international environmental treaty adopted on 9 May 1992. It entered into force on 21 March 1994 with the objective of “stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”

### Kyoto Protocol - 1997

The Protocol is based on the principle of common but differentiated responsibilities: it acknowledges that individual countries have different capabilities in combating climate change, owing to economic development, and ergo puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere by Ireland.

### EU Adaptation Strategy -2013

A White Paper an EU framework for adaptation to climate change was produced in 2009 which led to a comprehensive EU adaptation strategy in April 2013. The EU Adaptation Strategy has an overall aim of contributing to a more climate resilient Europe.

### Paris Agreement - 2015

The Paris Agreement was adopted in 2015. The aims of the Agreement are to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels. There are 195 Parties to the UNFCCC.

## National Policies & Agreements

### Climate Action and Low Carbon Development Act 2015

#### National Mitigation Plan (2017)

Initial step to set us on a pathway to achieve the level of decarbonisation required.

#### National Adaptation Framework (2018)

Sets out the potential implications of climate change for Ireland and specifies the national strategy for the development of adaptation measures by key sectors and by local authorities.

#### Climate Change Advisory Council

Has several reporting obligations, including Annual and Periodic Reviews of progress towards meeting the national transition objective.

## National Planning Framework - Ireland 2040

The transition to a Low Carbon and Climate Resilient Society is one of ten key national strategic outcomes which will guide the implementation of the new National Planning Framework. The National Development Plan 2018-2027 brings almost €22 billion between Exchequer and non-Exchequer resources to addressing the transition to a low-carbon and climate resilient society.

# SECTORAL ADAPTATION PLANNING

Under the National Adaptation Framework – Planning for a Climate Resilient Ireland, seven Government Departments (or Agencies, where appropriate) with responsibility for twelve priority sectors are required to prepare sectoral adaptation plans.

The broad objective of the sectoral plans will be for government departments and relevant agencies to consider their own vision for a climate resilient future which will have a sector specific focus. This is essential in terms of understanding the key risks that face each sector. The National Adaptation Framework aims to present an overarching view of how each sector can contribute to a climate resilient Ireland in line with National, European and International policy.

The National Adaptation Framework has grouped the sectors into four key thematic areas:

## 1. Critical Infrastructure and Buildings

## 2. Natural & Cultural Capital

## 3. Water Resources & Flood Risk Management

## 4. Public Health

This approach reflects trends at EU level which incorporate a thematic focus on climate adaptation which may be expanded upon in future National Adaptation Frameworks. Our Strategy has adopted these thematic areas to facilitate potential synergies and efficiencies that can be achieved in bringing forward coherence between sectoral adaptation policies and measures.

The Galway City Council Adaptation Strategy will facilitate partnerships via the Climate Action Regional Office with key stakeholders in the twelve priority areas to ensure that our adaptive actions are complementary, mutually reinforcing and avoid conflicting outcomes.

Theme	Sector Level	Lead Department for Sectoral Adaptation Plans
<b>Natural and Cultural Capital</b>	Seafood	Department of Agriculture, Food and the Marine
	Agriculture	
	Forestry	
	Biodiversity	Department of Culture, Heritage and the Gaeltacht
	Built & Archaeological Heritage	
<b>Critical Infrastructure</b>	Transport infrastructure	Department of Transport, Tourism and Sport
	Electricity and Gas Networks	
	Communications networks	Department of Communications, Climate Action and Environment
<b>Water Resources and Flood Risk management</b>	Flood Risk Management	Office of Public Works
	Water Quality	
	Water Services Infrastructure	Department of Housing, Planning and Local Government
<b>Public Health</b>	Health	Department of Health

# SUSTAINABLE DEVELOPMENT GOALS

In September 2015, Transforming Our World, the 2030 Agenda for Sustainable Development (the 2030 Agenda) was adopted by all 193 Members 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.

## 17 Goals to Transform Our World

The Agenda is made up of 17 Sustainable Development Goals (SDGs) which cover the social, economic and environmental requirements for a sustainable future. Ireland is fully committed to achieving the SDGs and the National Implementation Plan 2018-2020 represents Ireland's initial framework for doing so. It is the first in what will be a series of SDG Implementation Plans in the period to 2030.

The SDGs address the global challenges we face, including those related to poverty, inequality, climate, environmental degradation, prosperity, peace and justice.

Climate change presents the single biggest threat to sustainable development everywhere and its widespread, unprecedented impacts disproportionately burden the poorest and most vulnerable. Urgent action to halt climate change and deal with its impacts is integral to the successful implementation of the SDGs.

**Goal 13. Climate Action: Take urgent action to combat climate change and its impacts, focuses on the integration of climate change measures into national policies, the improvement of education, awareness-raising and institutional capacity on climate change mitigation, adaptation, impact reduction and early warnings.**



# ROLES & RESPONSIBILITIES



# SHARED RESPONSIBILITY

The impacts and opportunities of climate change are complex and cover many cross sectoral issues. It is important to recognise that the response to climate change requires a whole of society approach and that the implementation and monitoring of this Strategy will involve working collaboratively with several agents. Partnership is key, as this Strategy taken in isolation is not going to provide solutions for all of society's adaptation needs.

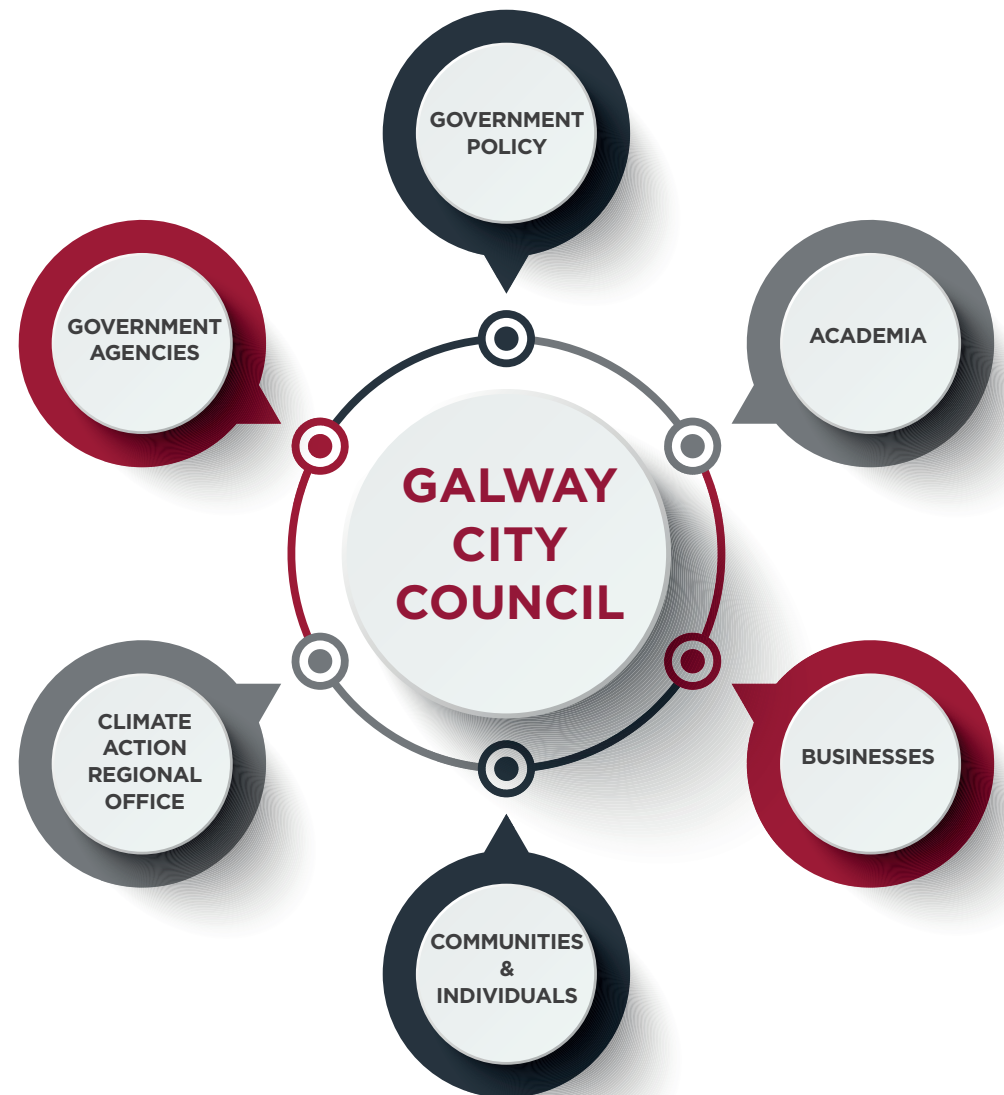
Climate change will impact both the services and assets that Galway City Council manage and the local communities within our functional area. Local Authorities play an influential role in preparing communities for climate change through the services they deliver, such as planning and development, critical infrastructure, environmental facilities and socio-economic programmes. However working together with government departments and agencies, local businesses, communities and individuals will be essential in achieving the ambitions of this Climate Adaptation Strategy, with each sector having different but complementary and important roles to play in managing climate risks.

Crucially however one of Galway City's great strengths is its communities (third level, business, voluntary, other government agencies) and their support is vital to the success of this Strategy. Action at a local level will have a significant impact on our overall ability to meet our climate targets and will extend and complement action being undertaken at national and international levels.

The local communities that will be most impacted by climate change are also best placed to identify the opportunities they have in the future. It is in our best interest to ensure that these communities are empowered and enabled to play an effective role and that policies where possible, encourage 'place-based' initiatives.

Community groups are often led by volunteers who tap into the resources of their local community to achieve effective on-the-ground results. Galway City Council recognises the importance of this type of community action and proposes to support these initiatives.

## CLIMATE RESILIENT GALWAY CITY



# ROLES & RESPONSIBILITIES

Governments at all levels, businesses, households and the community each have important, complementary and differentiated roles in adapting to the impacts of climate change.



## Government Departments & Agencies

Some climate change risks have the long-term potential to undermine the national economy or affect critical infrastructure and natural systems of national significance. Addressing risks, as well as managing and adapting to climate change impacts will be a long-term obligation for all levels of government.

Government departments and agencies will work collaboratively with all stakeholders to evaluate adaptation tasks to effectively manage climate change risks to public infrastructure and the environment, deliver government services and create the regulatory environment that supports and promotes resilience and action among individuals and groups. One of the most important roles of government is to ensure that society has the information required to make informed decisions and to adjust its behaviour for positive climate action.



## Galway City Council

Galway City Council is responsible for a broad range of services, the administration of a range of EU and National legislation as well as the management of a substantial number of assets and infrastructure of local, regional, state and national significance. We are on the frontline in dealing with the impacts of climate change and have a critical role to play in ensuring that local circumstances are adequately considered in the overall adaptation process and in involving the local community directly in efforts to facilitate effective change. We are strongly positioned to inform government departments and agencies about the needs of local communities, to communicate directly with communities and to respond appropriately to local climate events

## Climate Action Regional Office



The CARO will coordinate a consistent approach in terms of adaptation strategies at local authority level in the Atlantic Seaboard North Region, assisting the local authorities to prepare and implement Climate Adaptation Strategies. In addition they will collaborate with government agencies and third level institutes on research, information and resources on climate change adaptation.



## Businesses

To enable businesses to manage the risks to their assets and activities from climate change, they will need to be aware of the risks, their responsibility and supports available. In addition it is necessary for this sector to take steps to understand the magnitude and nature of the specific risks to their assets and activities and to develop strategies and actions to manage the risks. Businesses will need to consider climate risk in plans and investments but simultaneously they can identify and invest in emerging opportunities that our changing climate will bring.



## Academia

Academia have a critical role to play in preparing society to adapt to the impacts of climate disruption by providing research and education around adaptation strategies. Communicating and translating science and big data into information that policymakers, businesses and communities can apply to their work.

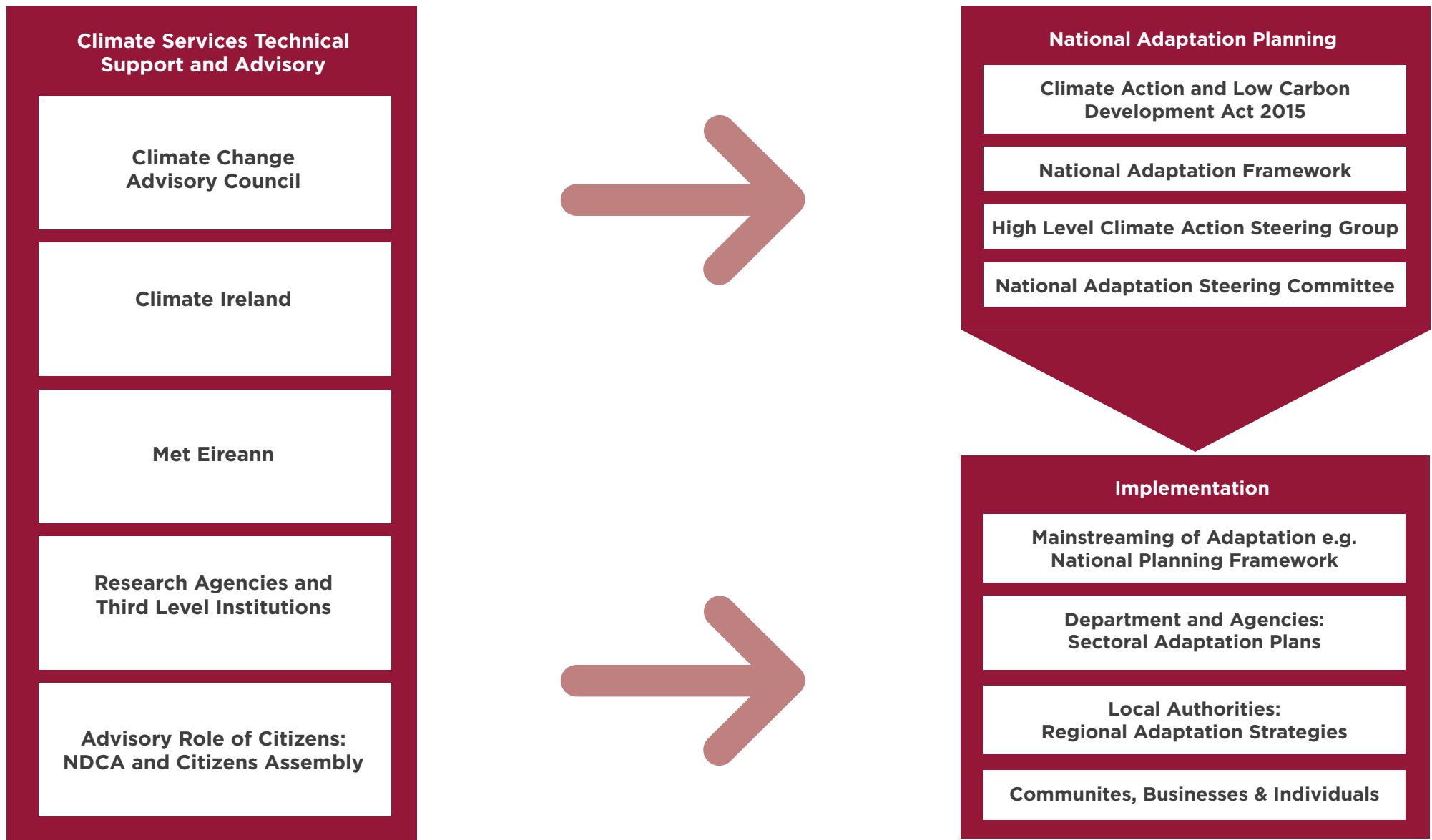


## Communities & Individuals

Community based adaptation to climate change focuses on empowering communities and individuals to use their knowledge and decision-making processes for action on climate change. To achieve this communities need to engage with the other stakeholders to build awareness and understanding of climate change, to consider the risks and opportunities, to develop local resilience and response plans to emerging risks.



# NATIONAL ADAPTATION GOVERNANCE STRUCTURE



# REGIONAL PROFILE & CITY PROFILE



# ATLANTIC SEABOARD NORTH REGION

The Atlantic Seaboard North Region (ASBN), consists of the counties of Donegal, Sligo, Mayo and Galway. Its geographic area covers 18,354 km<sup>2</sup> and a population of 613,292 persons based on the Central Statistics Office data from Census 2016. The counties of Mayo and Donegal have the second and third highest dependency ratios respectively in the country; with 17.6% of the population over 65 and 20.3% under 15 in Mayo. While 15.7% of Donegal's population is over 65 and 22% is under 15 years of age.

## Natural & Cultural Capital

The ASBN region is home to half of the State's National Parks, with many other outstanding assets, including blue flag beaches, forest parks, trails, and a growing number of established Greenways and Blueways, with additional projects in development. A significant area of the Region is subject to conservation including SACs, SPAs, NHAs or proposed NHAs and hosts extensive areas of peatlands which are of high biodiversity value as well as important carbon sinks. There is also rich built and cultural heritage throughout this region that creates a link to our past and fosters our sense of place and wellbeing. The protection of our built and natural environment against the impacts of climate change will contribute to the retention of a sense of continuity with our history and the attractiveness of our region as a place to live, work and enjoy.

## Transport Infrastructure

Travel in the region is primarily by private vehicle with the quality of the national road network substantially improved over the last two decades. Intercity rail offers sustainable travel alternatives for longer distance trips to the region, except for county Donegal, which does not have a rail service. International air connectivity is provided at Ireland West Airport Knock (IWAK) and Donegal Airport. The region does not have a port of "National Significance", at Tier 1 or Tier 2 levels however the Port of Galway is categorised as a Port of Regional Significance, (Tier 3) while ports such as Killybegs, Sligo, Greencastle and Ros an Mhíl perform specific roles.

# Atlantic Seaboard North Region

## Local Authorities in the Region

Donegal Co Co, Sligo Co Co, Mayo Co Co, Galway Co Co and Galway City Council.

## Regional Profile

**Area:** 18,354 km<sup>2</sup>

**Coastline Length:** 2,702km, which is 48% of the country's coastline

**Length of Coastline** which is deemed at risk of erosion – 1,011km (Ecopro, 1996)

**Total Population:** 613,292, of which 305,151 live within 5km of the coast

**Major Towns and Cities:** Galway City, Sligo City, Ballina, Castlebar, Tuam, Ballinasloe, Letterkenny, Buncrana.

**18 inhabited offshore islands** that contain some of our most vibrant and culturally distinctive communities, with many areas forming part of the Gaeltacht

## Natural & Cultural Capital

Significant number of **Natura 2000 sites**

**National Parks** - Ballycroy National Park (Co. Mayo); Connemara National Park (Co. Galway); Glenveagh National Park (Co. Donegal)

**33 Blue Flag Beaches**

**2.1 million overseas tourists** in 2015

## Transport Infrastructure

**Ports:** Galway Port (Tier 3), Killybegs, Sligo, Greencastle and Ros a Mheal perform specific roles

**International Air Connectivity** – Ireland West Airport Knock (770,000 passengers in 2018) and Donegal Airport

# GALWAY CITY - CITY OF THE TRIBES

Galway City has a population of almost 80,000 with a growing population that stands out from other areas of the North Atlantic Seaboard Region that have experienced declining growth in rural areas. Galway City's population is predominantly a younger population with 39% of the population between the age of 20 and 40, and older people over 65 comprising 11% of the City's population.

## Coastline

Galway City has a coastline along its southern boundary. The coastline forms part of the Wild Atlantic way and includes four beaches; Silverstrand, Salthill, Grattan beach and Ballyloughane. Galway City's coast has very high recreational amenity value and ecological value. Galway City includes a port which has hosted the finish of the Ocean Race on two occasions.

## Waterways

Galway City is bound to the north by Lough Corrib from which the River Corrib flows to Galway Bay through the heart of Galway, with historic canals and mill races.

## Academia

Galway City has two major third level institutions; the National University of Ireland Galway and the Galway Mayo Institute of Technology.

## Archaeology

Galway City is one of Ireland's best examples of a Medieval City.

## Architectural Heritage

The architectural heritage of Galway City comprises its medieval buildings and streets and its waterways.

## Tourism

In 2018 Galway City and County saw over 1.4 million overseas visitors. Galway City is one of the most popular tourist destinations outside of Dublin and is part of the Wild Atlantic Way experience.

## Economy

Galway has a strong local economy with a variety of business sectors, including manufacturing industry, tourism, retail and distribution, education, healthcare, and services that include financial, cultural, construction and professional.

# Galway City City Profile

**Area:** 554.2 km<sup>2</sup>

**Coastline Length:** 50km

**Total Population:** 79,934.

**Galway City boroughs:** Ballybane, Ballybrit, Bushypark, Castlegar, Claddagh, Dangan, Knocknacarra, Menlo, Newcastle, Ragoon, Renmore, Roscam, Salthill, Shantalla, Terryland, Wellpark.

## Natural & Cultural Capital

**Natura 2000 sites:** Lough Corrib SAC and SPA, Galway Bay Complex SAC, and Inner Galway Bay SPA

**Culture:** Galway City has a museum and theatres Galway City is the European City of Culture for 2020. The European Capital of Culture is a city designated by the European Union for a period of one year during which it is given a chance to showcase its cultural life and cultural development.

**Events:** Galway Arts Festival, Galway Oyster Festival, Galway Races, Macnas Halloween Parade.

**Waterways:** River Corrib, Canals, Mill Races, Terryland River and Barna Stream

**European Green Leaf City:** In 2016, Galway City was awarded the designation of European Green Leaf 2017, by the European Commission. Galway was the first Irish city to be awarded the European Green Leaf, and the third city ever to receive the designation.

## Transport Infrastructure

**Road Network:** 20km National Roads

120km Major Non-National Roads

Other Roads including Housing Estates taken in Charge

**Cycling Network:** Galway City has Cycleways for cycling.

**Public Transport:** Galway City has a City-wide Bus Service.

An aerial photograph of a large, powerful ocean wave. The water is a deep, vibrant blue, and the wave's crest is breaking into thick, white foam. The perspective is from above, looking down at the wave's structure as it moves across the sea.

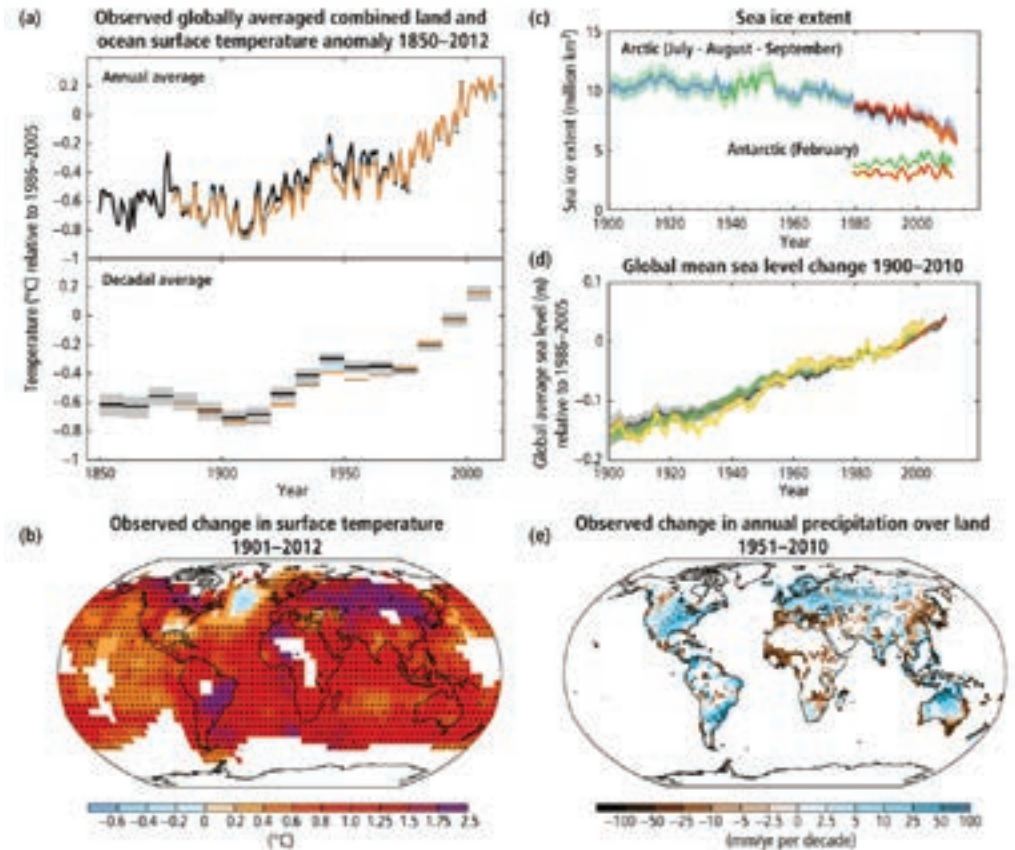
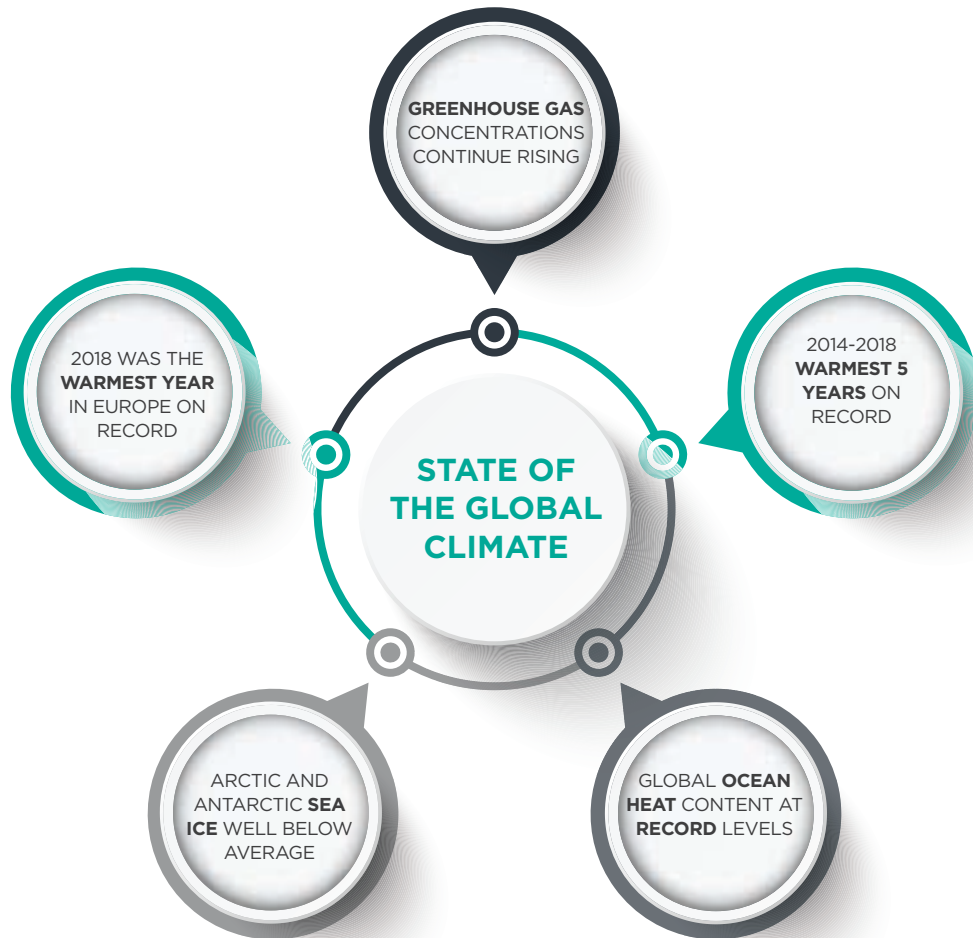
# **OBSERVED & PROJECTED CLIMATE CHANGE**

# OBSERVED CLIMATE CHANGE

## Global Climate Indicators

The Global Climate Indicators are a set of parameters that describe the changing climate. They comprise key information for the most relevant domains of climate change: temperature and energy, atmospheric composition, ocean and water as well as the cryosphere (part of the earth's surface where water exists as ice).

Analysis of these different indicators and independent data sets unequivocally point to one thing: the world has warmed since the late 19th century.



“Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen”. [IPCC AR5]

# OBSERVED CLIMATE CHANGE

## Overview of 2018 Global Temperatures

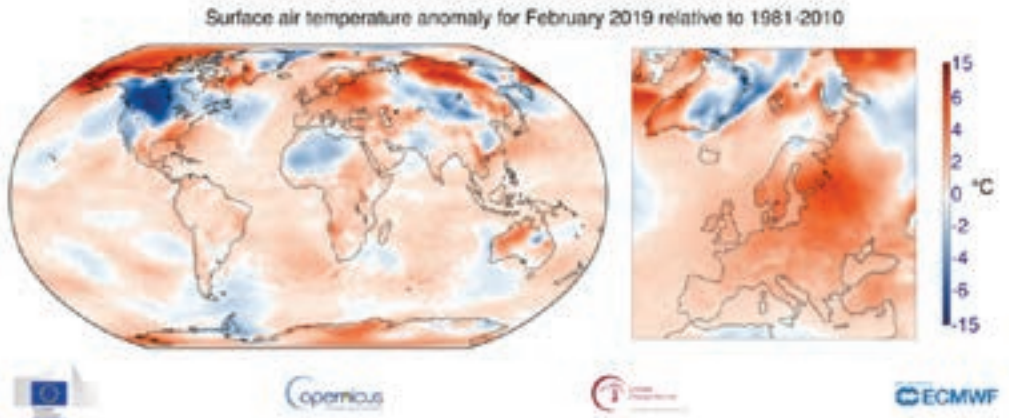
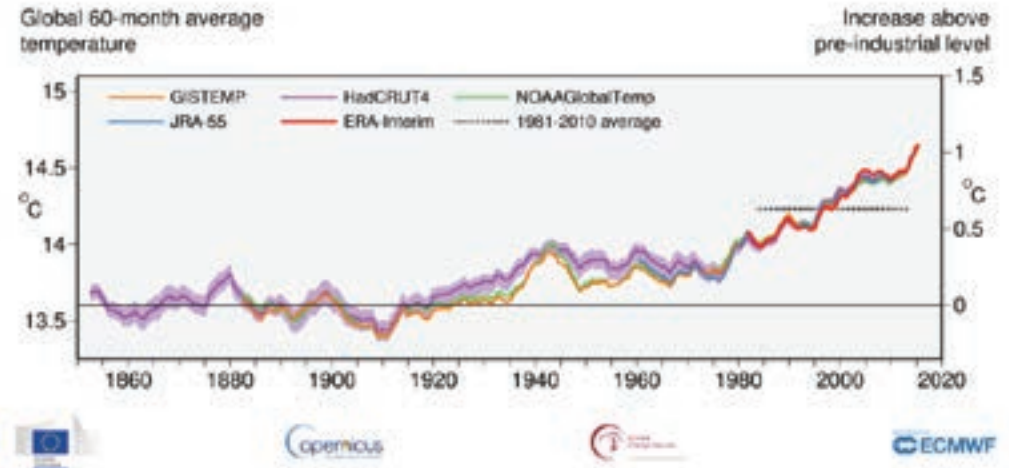
Data released by the Copernicus Climate Change Service (C3S) show that 2018 was the fourth in a series of exceptionally warm years and together with the Copernicus Atmosphere Monitoring Service (CAMS), C3S reports that atmospheric CO<sub>2</sub> concentrations have continued to rise.

The Copernicus C3S data show that 2018 surface temperatures were more than 0.4°C higher than the long-term average recorded over the period 1981-2010. The most pronounced warming compared to the long-term average occurred in the Arctic. Most land areas were warmer than average, especially Europe, the Middle East and the western USA.

Apart from a relatively cold February and March 2018, Europe saw above average temperatures during all months of the year. Starting at the end of spring and continuing well into autumn and even winter, northern and central Europe experienced weather conditions that were persistently warmer and drier than average.

Copernicus is the European Union's Earth Observation programme, looking at our planet and its environment for the ultimate benefit of all European citizens. It offers information services based on satellite **Earth Observation and in situ (non-space) data.**

The C3S mission is to support adaptation and mitigation policies of the European Union by providing consistent and authoritative information about climate change.



# OBSERVED & PROJECTED CLIMATE CHANGE

## Observed Global Climate Change

Warming of the global climate system has been observed via global average air and ocean temperatures, widespread melting of snow and ice, rising sea level and more frequent extreme weather events.

Each of the last three decades have been successively warmer at the Earth's surface than any preceding decade since 1850. The globally averaged combined land and ocean surface temperature data show a warming of 0.85 [0.65 to 1.06] °C over the period 1880 to 2012.

Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010 with only about 1% stored in the atmosphere. Over the period 1901 to 2010, global mean sea level rose by 0.19m. The rate of sea level rise since the mid-19th century has been larger than the mean rate during the previous two millennia.

Oceanic uptake of CO<sub>2</sub> has also resulted in acidification of the ocean. The pH of ocean surface water has decreased by 0.1, corresponding to a 26% increase in acidity, measured as hydrogen ion concentration.

Over the period 1992 to 2011, the Greenland and Antarctic ice sheets have been losing mass, likely at a larger rate over 2002 to 2011. Glaciers have continued to shrink almost worldwide.

The increase in global temperature is closely correlated to the increase in greenhouse gas emissions. Levels of greenhouse gases are now 30% higher than any time during the last 800,000 years, thus enhancing the greenhouse gas effect resulting in global warming.

Source: IPCCAR5 Summary



### Surface Temperature

- Each of the last three decades has been successively warmer at the Earth's surface than any of the preceding decades since 1850.
- In the Northern Hemisphere, 1983-2012 was likely the warmest 30-year period of the last 1400 years (NAO, 2018).
- In 2017, global mean temperatures were 1.1 °C ± 0.1 °C above pre-industrial levels, and it was one of the three warmest years on record (WMO, 2018).



### Sea Level Rise

- 'Thermal Expansion' of the ocean has contributed about half of the 70mm of global mean sea level rise observed over the last 25 years.
- The upper 75m warmed by 0.11°C (0.09 to 0.13°C) per decade over the period 1971 to 2010.
- The rate of SLR is nearly double that of the last century and is accelerating slightly every year.
- Estimates derived from satellite measurements for the period 1993 to 2012 indicate a rise in global average sea level rise of 3.18 mm per year.
- Decades of ocean observations show that the CO<sub>2</sub> absorbed by the ocean is changing the chemistry of the seawater (ocean acidification). The acidity of surface ocean waters has increased by about 30% since the beginning of the Industrial Revolution.



### Shrinking Ice Sheets & Glaciers

- Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide.
- Arctic Sea Ice and Spring snow cover in the Northern Hemisphere has also continued to decrease in extent.
- Data from NASA's Gravity Recovery and Climate Experiment show Greenland lost an average of 281 billion tons of ice per year between 1993 and 2016, while Antarctica lost about 119 billion tons during the same time period.
- Satellite observations also reveal that the amount of spring snow cover in the Northern Hemisphere has decreased over the past five decades and that the snow is melting earlier (National Snow and Ice Data Centre, 2018).



# OBSERVED & PROJECTED CLIMATE CHANGE

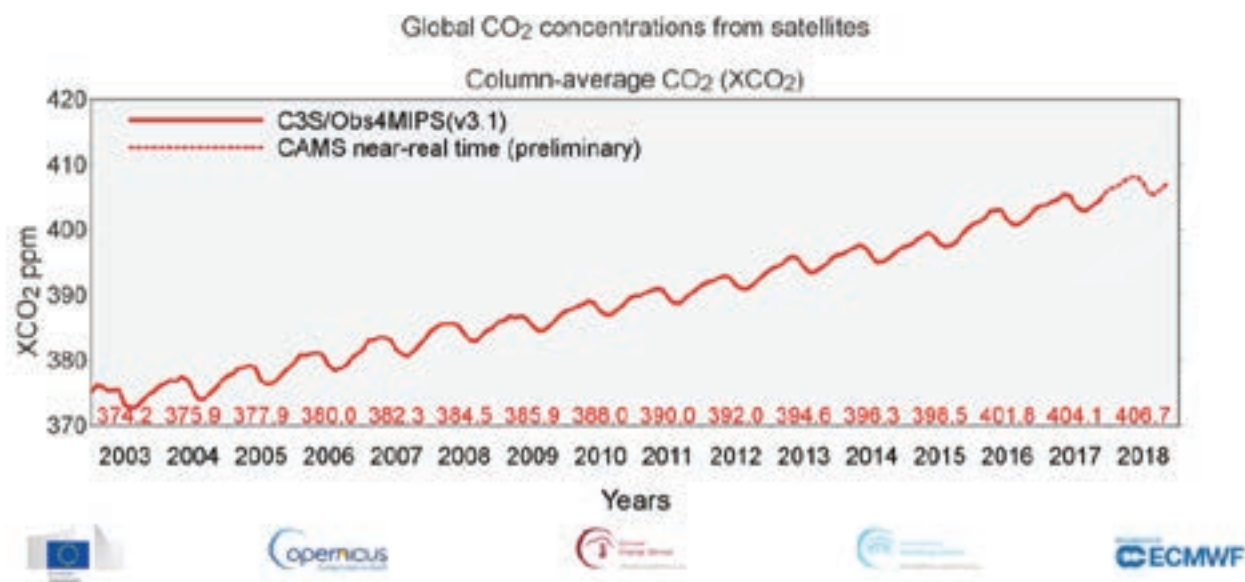
## Projecting Climate Change

In order to predict the potential impacts of climate change in the future, many different variables must be considered. One of the key pieces of data is the emission of greenhouse gases, including carbon dioxide. This in turn must take account of several other factors which affect these emissions such as; population, economic activity, lifestyle, energy use, land use patterns, technology and climate policy.

The analysis of satellite data from the Copernicus Climate Change Service indicates that carbon dioxide concentrations have continued to rise in recent years, including in 2018. The recent special report 'Global warming of 1.5°C' by the Intergovernmental Panel on Climate Change (IPCC) further underlines the urgency of implementing effective measures to mitigate climate change.

The estimated annual mean XCO<sub>2</sub> growth rate for 2018 is 2.5 +/- 0.8 ppm/year. This is larger than the growth rate in 2017, which was 2.1 +/- 0.5 ppm/year

Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks" [IPCC, AR5]



# OBSERVED & PROJECTED CLIMATE CHANGE

## Representative Concentration Pathways (RCPs)

RCPs are scenarios that describe alternative trajectories for carbon dioxide emissions and the resulting atmospheric concentration from 2000 to 2100. They encompass the range of possible climate policy outcomes for the 21st century.

As part of the IPCC's Fifth Assessment Report (AR5), 4 Representative Concentration Pathway scenarios (**RCP2.6**, **RCP4.5**, **RCP6.0** and **RCP8.5**) were selected for climate modeling and research based on different assumptions about population, economic growth, energy consumption and sources and land use over this century.

### RCP 2.6

Global CO<sub>2</sub> emissions peak by 2020 and decline to around zero by 2080. Concentrations in the atmosphere peak at around 440ppm in mid-century and then start slowly declining.

### RCP 4.5

Emissions peak around mid-century at around 50% higher than 2000 levels and then decline rapidly over 30 years and then stabilise at half of 2000 levels. CO<sub>2</sub> concentration continues to trend to about 520ppm in 2070 and continues to increase but more slowly.

### RCP 6

Emissions double by 2060 and then dramatically fall but remain well above current levels. CO<sub>2</sub> concentration continues increasing, though at a slower rate in the latter parts of the century, reaching 620ppm by 2100.

### RCP 8.5

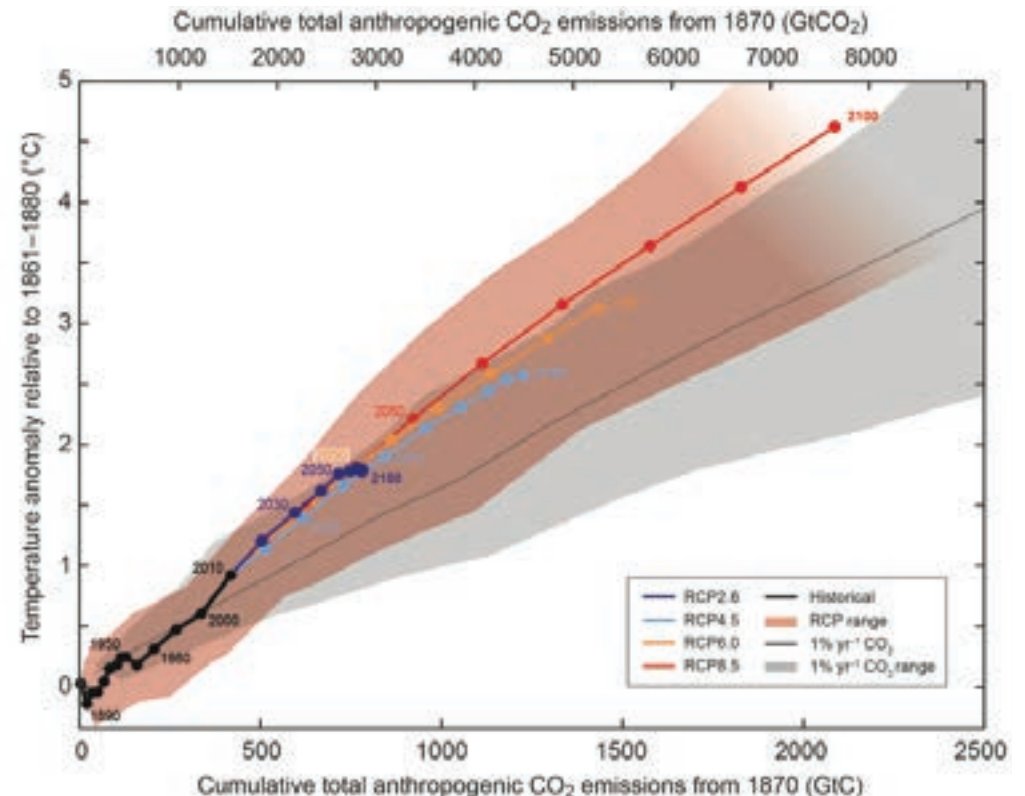
Emissions continue to increase rapidly through the early and mid-parts of the century. By 2100 annual emissions have stabilised at just under 30 giga tonnes of carbon compared to around 8 giga tonnes in 2000. Concentrations of CO<sub>2</sub> in the atmosphere accelerate and reach 950 ppm by 2100 and continue increasing for another 100 years.

### Climate Forecasts

The IPCC's AR5 report forecasts temperature change under these scenarios, from best (RCP2.6) and worst (RCP8.5) scenario.

Scenario	2046-2065	2081-2100
	Mean and Likey Range	Mean and Likey Range
<b>RCP2.6</b>	1.0° (0.4 to 1.6)	1.0° (0.3 to 1.7)
<b>RCP4.5</b>	1.4° (0.9 to 2.0)	1.8° (1.1 to 2.6)
<b>RCP6.0</b>	1.3° (0.8 to 1.8)	2.2° (1.4 to 3.1)
<b>RCP8.5</b>	2.0° (1.4 to 2.6)	3.7° (2.6 to 4.8)

AR5 global warming increase (°C) projections



Source: IPCCAR5

# OBSERVED & PROJECTED CLIMATE CHANGE

## Global Projections (IPCC AR5)

### Surface Temperature (Global)

The global averaged combined land and ocean temperature data indicate a warming of 0.85°C, over the period 1880 – 2012 and surface temperature is expected to rise over the 21st century. Relative to 1850-1900, temperatures at the end of the 21th century (2081-2100) are expected to be 1.5°C - 2.0°C higher, depending on the greenhouse gas concentration scenario used. It is very likely that heatwaves will be more frequent and last longer. It is virtually certain that there will be more hot weather extremes and fewer cold weather extremes over most land areas on daily and seasonal timescales. Occasional cold winter extremes will continue to occur.

### Precipitation (Global)

Changes in precipitation will not be uniform. In many mid-latitude and subtropical dry regions, mean precipitation will likely decrease, while in many mid-latitude wet regions, precipitation will very likely become more intense and more frequent.

### Sea Level Rise (Global)

Ocean thermal expansion and glacier melting have been the dominant contributors to 20th century global mean sea level rise. Observations since 1971 indicate that thermal expansion and glaciers (excluding Antarctic glaciers peripheral to the ice sheet) explain 75% of the observed rise. The global ocean will continue to warm during the 21st century, with the strongest warming projected for the surface in the Tropic and Northern Hemisphere Subtropical region. Global mean sea level rise will continue during the 21st century, very likely at a faster rate than observed from 1971 to 2010. For the period 2081–2100 relative to 1986–2005, the rise will likely be in the ranges of 0.26 to 0.55 m for RCP2.6, and of 0.45 to 0.82 m for RCP8.5 (medium confidence). Earth System Models project a global increase in ocean acidification for all RCP scenarios by the end of the 21st century, with a slow recovery after mid-century under RCP2.



### Rising Sea Level

Sea Level is projected to rise by up to 0.82m relative to 1986-2005.



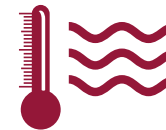
### Higher Temperatures

Maximum and minimum average temperatures are projected to rise



### Hotter & More Frequent Hot Days

Increase in temperatures reached on hottest days, and an increase in frequency of hot days.



### Warmer & More Acidic Ocean

Sea surface temperatures are expected to increase, and the ocean will become more acidic.



### Fewer Frost

A decrease in the frequency of frost risk is projected.



### More Frequent Sea Level Extremes

Higher sea levels will increase the risk of coastal storm surge and storm tide inundation.



### More Intense Rainfall Events

High variability in rainfall, with the intensity of heavy rainfall events likely to increase.

# OBSERVED & PROJECTED CLIMATE CHANGE FOR IRELAND SUMMARY

## For Ireland, the key long term climate change trends are:

- Temperatures are increasing and are expected to continue to increase everywhere and across all seasons.
- When compared with temperature, projections of precipitation are less certain. However, significant reductions in levels of average precipitation are expected in Spring and Summer while projections indicate the increased occurrence of extreme precipitation events, particularly during winter.
- Projections show little change in average wind speed and direction. However the frequency of extreme wind conditions are expected to increase, particularly during winter.
- Sea levels will continue to increase by up to 0.81m by 2100.

## We can also expect to see:

- Increases in the frequency and intensity of summer heat waves, extreme temperatures and drought.
- Reductions in the frequency of frost and snowfall.
- An increase in the duration of the growing season (phenological cycle).
- Increases in the frequency and intensity of coastal inundation and erosion.

## Observed Changes

Ireland's climate is changing in line with global patterns:

- Temperatures are rising across all seasons.
- The timing and spatial distributions of precipitation is changing.
- Sea levels are rising.
- The frequency and intensity of extreme weather events are changing.

These changes are expected to continue and intensify into the future with a wide range of economic, environmental and social impacts



# PROJECTED CLIMATE CHANGE FOR IRELAND

## SEA LEVEL RISE

- Sea levels are expected to increase for all Irish coastal areas. Projected changes in sea level will magnify the impacts of changing storm surge and wave patterns in coastal areas.
- Decrease in mean and extreme wave heights by the end of the century. Increase in magnitude and intensity of storm wave heights

## WIND

- An increase in the intensity of extreme wind storms is expected.
- Decrease in wind speeds for summer and increases for winter rainfall events is likely.

## PHENOLOGY

- An increase in the duration of the growing season is likely with spring occurring earlier.
- Projections indicate that bud burst will continue to advance until at least 2100.

## PRECIPITATION

- An increase in seasonality in precipitation can be expected with significant decreases projected for spring and summer and increases for winter.
- An increase in the occurrence of extreme rainfall events is likely.

## SURFACE AIR TEMP

- Average surface air temperatures are expected to increase everywhere and across all seasons.
- An increase in the intensity and duration of heatwaves is expected.

## HYDROLOGY

- Increasing seasonality in hydrological regimes can be expected with decreased summer and increased winter flows likely.
- Flood risk will increase due to a combination of higher river-flows and increases in extreme precipitation events.



# OBSERVED & PROJECTED CLIMATE CHANGE FOR IRELAND - TEMPERATURE

## Observed Changes



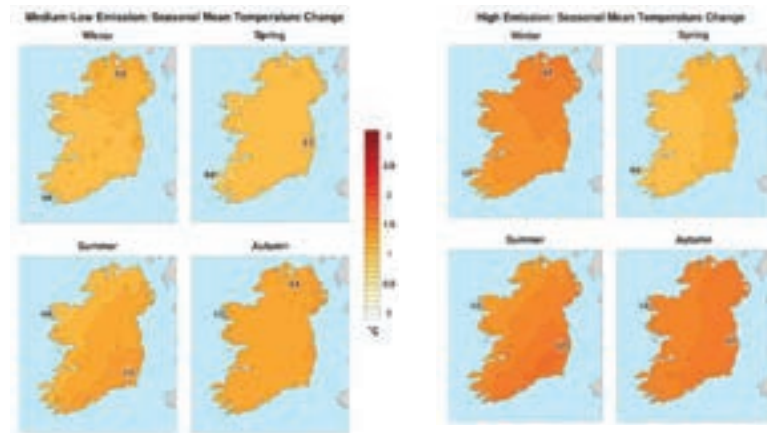
Average annual temperatures have increased by 0.8 °C nationally since 1900.



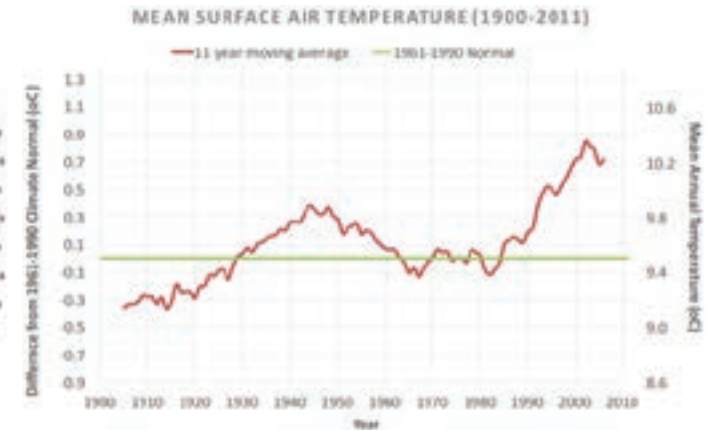
The number of warm days (>20 °C) has increased while the number of frost days (<0°C) has decreased.



There has been an increase in the duration of the growing season.



Projected changes in seasonal mean temperatures for the medium-low (left) and high (right) emission scenarios (Nolan, 2015)



A time series graph of mean annual observed temperature for Ireland (1900-2011). The green bar shows the mean temperature for the period 1961-1990 (Dwyer, 2012)

## Temperature Projections for mid-century (2041-2060) compared with the baseline period (1981-2000)

- Projections suggest average temperatures will continue to increase, with warming across all seasons. Future climate simulations indicate a rise of 1 to 1.6°C in mean annual temperatures.
- Levels of warming are greater for the extremes (i.e. hot and cold days), the number of warm days are expected to continue to increase and heatwaves are expected to occur more often.
- The warmest 5% of daily maximum summer temperatures are projected to increase by 0.7-2.6°C.
- The coldest 5% of winter night time temperatures are projected to increase by 1.1-3.1°C.
- Increases in minimum temperatures will mean that frost days (days when minimum temperature is less than 0°C) and ice days (days when maximum temperatures are less than 0 °C) are expected to occur less often.
- Increasing temperatures will mean that the growing season will occur earlier and extend further. Projections for mid-century indicate an increase of 35-40 days.

# OBSERVED & PROJECTED CLIMATE CHANGE FOR IRELAND - PRECIPITATION

## Observed Changes



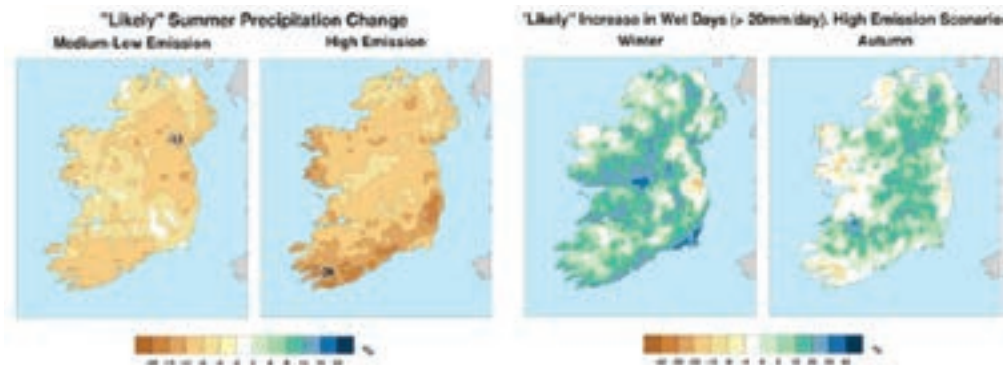
When compared with the period 1961-1990, average annual rainfall has increased by 5% (60mm) for the period 1981-2010.



The largest increases are observed over the western half of the country.



There is no consistent trend in the frequency



The 'likely' projected change (%) in summer precipitation and in number of wet days for winter and Autumn (Nolan, 2015)

*Due to the large spread in the range of projected changes, these projections should be viewed with a low level of confidence. However, and with a higher degree of confidence, projections indicate a substantial increase in the occurrence of Heavy precipitation events, particularly during winter*



Annual average rainfall totals (right axis) and the annual anomalies, or differences from the 1961 to 1990 average (left axis) (Dwyer, 2012).

## Precipitation Projections for mid-century (2041-2060) compared with the baseline period (1981-2000)

- Changes in precipitation over the course of the present century are likely to have a greater impact on Ireland than changes in temperature, due to the potential of increased flooding during the winter months and reductions in river flow during the summer months. Projected changes in precipitation suggest that an increased seasonality with wetter winters and drier summers and a change in the spatial distribution of the rainfall we receive are likely for all future time periods.
- For winter and autumn, projections indicate an increase in average precipitation, particularly for the high scenario.
- Increase in the number of "wet days" (>20mm rainfall) for winter (mean value 24%) and autumn (mean value 18%).
- Increase in the number of "very wet days" (>30mm rainfall) for winter (mean value 24%) and autumn (mean value 49%).
- Significant reductions are expected in average levels of annual, spring and summer precipitation and are largest for summer (0-20%).
- Dry periods are expected to occur more often and particularly in summer (12-40% reduction).
- Increases in dry periods (> 5 consecutive days with less than 1mm rainfall) are largest for summer.
- An increase in the number of dry periods (> 5 consecutive days with less than 1mm rainfall) are projected across all seasons with largest increase projected for summer with likely values ranging from 12% to 40% .

Source: Climate Ireland

# OBSERVED & PROJECTED CLIMATE CHANGE FOR IRELAND

## - WIND

### Observed Changes



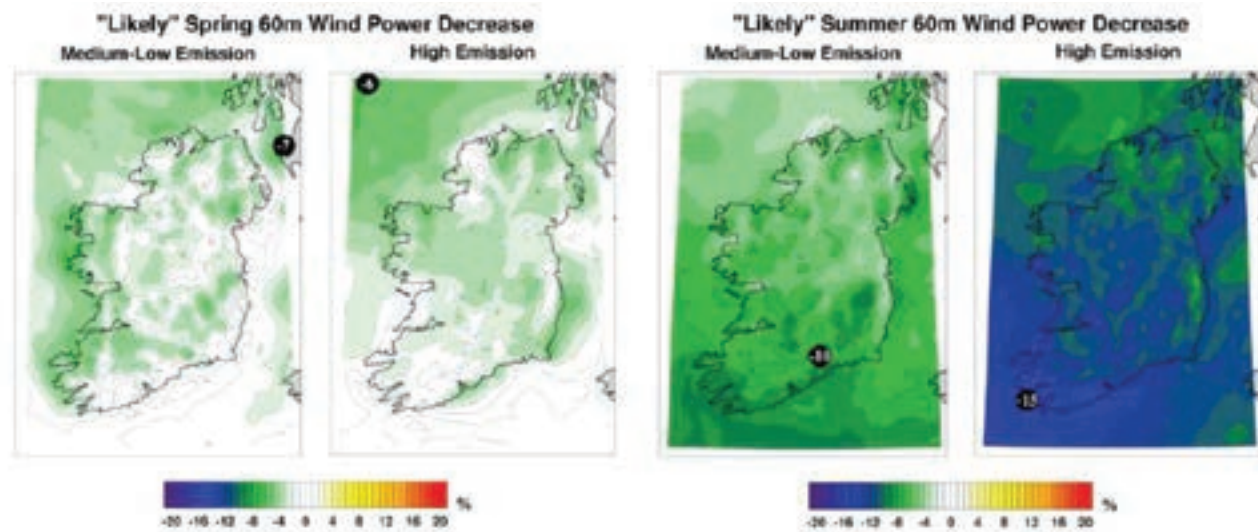
No long-term change in average wind speed can be determined with confidence



Similarly, there is no long-term change evident in number of gale gusts (a wind speed of >17.5m/sec).



Wind direction has remained stable



Projected 'likely' decrease in 60m average wind power for spring and summer (Nolan, 2015)

### Wind Projections for mid-century (2041-2060) compared with the baseline period (1981-2000)

Projected change information relate to levels of wind power at 60m, useful in the context of projecting future energy resources.

- Projections indicate a decrease in wind speeds for spring, summer and autumn months.
- For winter, projections show a large range (increase and decrease) of change and should be viewed with caution.

- Small increases in extreme wind speeds over Ireland projected. A small increase in extreme wind speeds is expected during winter, which may impact on turbines and the continuity of power supply.
- Projections indicate an overall decrease in wind power over the entire year and during the spring, summer and autumn months by mid-century.
- Projections of wind direction show no substantial change.

Source: Climate Ireland



# OBSERVED & PROJECTED CLIMATE CHANGE FOR IRELAND - STORMS

## Observed Changes



The number of storms (“cyclones”) in the North Atlantic has increased by approx. 3 storms per decade (1950-2012)



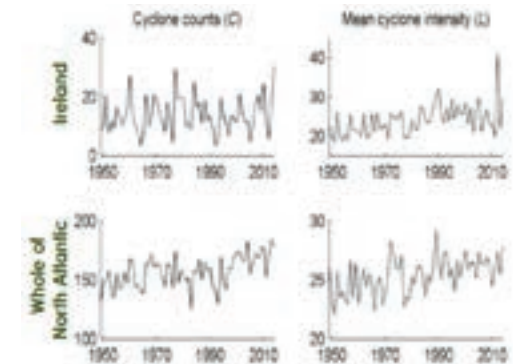
The intensity of North Atlantic Storms has also increased.



The number of these storms tracking over Ireland has remained variable.



Tracks of storms with a core MSLP of less than 940 hPa and with a lifetime of at least 12 hours. Left: Past RCM 18km simulations (1981-2000); Right: RCP 8.5 18-km simulations (2041-2060) (Nolan, 2015)



Left: Count of storms for Ireland (Top) and the whole North Atlantic (Bottom) during winter Right: Mean intensity of storms for Ireland and whole North Atlantic - modified from Mathews et al. (2014)

## Storm Track Projections for mid-century (2041-2060) compared with the baseline period (1981-2000)

Storms are rare events and projections should be considered with a level of caution.


- The number of very intense storms is expected to increase in the North Atlantic Region.
- Projections indicate that the winter tracks of these very intense storms may extend further south than


the current situation, meaning that more of these storms (e.g. winter 2012/2013) will reach Ireland.


- However, due to our limited understanding, further work is required to increase confidence in these projections.

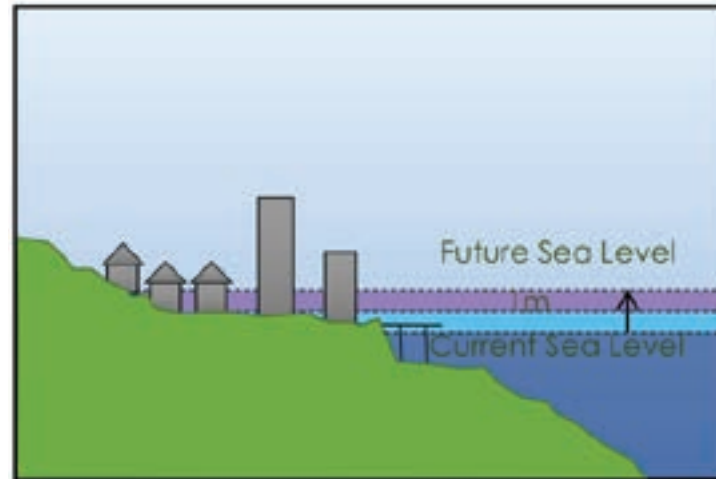
# OBSERVED & PROJECTED CLIMATE CHANGE FOR IRELAND - SEA LEVEL

**Observed Changes**

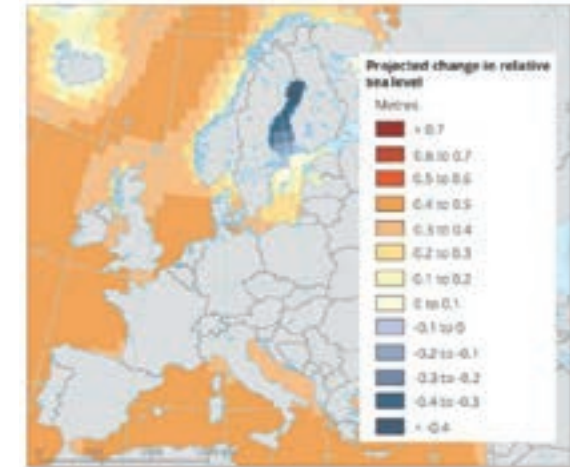
 Sea levels are rising at around 3.5 cm per decade in the marine territories surrounding Ireland.

 Increasing Sea Levels are resulting in record high tides (>2.9m)

 Increases are greatest for the Irish sea. This is due to a more pronounced warming of the Irish sea which contributes to sea level rise due to thermal expansion



Conceptual outline of simple coastal inundation due to relative sea level rise



Projected change in relative sea level for the period 2081-2100 compared to the period 1986-2005 for the medium-low emissions scenario (adapted from EEA, 2014)

## Sea Level Projected Changes for the Period 2081-2100 (relative to 1986-2005)

Sea levels are rising primarily because of thermal expansion due to increasing global temperatures but also due to melting ice sources (e.g. glaciers and ice sheets).

Regional projections of sea level rise are subject to a high degree of uncertainty as warming of the surface layers of the oceans is not likely to be uniformly distributed across the ocean surface. Regional changes in atmospheric pressure and ocean circulation will also affect the distribution of sea level rise (Hulme et al., 2002). Determining future changes in sea level around the Irish coast is further complicated due to isostatic rebound, i.e.

post-glacial changes in the elevation of the land relative to the sea. Combining these sea level projections with isostatic rebound rates for Ireland means that projected rates of relative sea level will vary substantially around the Irish coast.

- Sea levels will continue to rise for all Irish coastal areas i.e. up to 0.81m by the end of the century.
- Increases will be greatest in the south of Ireland. This is because the north of Ireland is still rising after the last ice age.

- Increased sea levels will result in increased levels of high tide and when combined with storm surge, significant increases in levels of coastal inundation and erosion can be expected.
- The projected increase in relative sea level is likely to result in an increase in wave energy being transmitted to the shoreline.

# OBSERVED & PROJECTED CLIMATE CHANGE FOR IRELAND - WAVE HEIGHT

## Observed Changes



Analysis of data from satellite altimetry shows a general increase in wave heights in the Northeast Atlantic for the period 1988-2002.



Data from the Irish buoy network covers a relatively short period and there is no observable change.

## Irish Marine Weather Buoy Network

The Irish Marine Weather Buoy Network is the result of successful collaboration between the Marine Institute, Met Eireann, The UK Met Office and the Irish Department of Transport joint.

The project is designed to improve weather forecasts and safety at sea around Ireland, and provides vital data for weather forecasts, shipping bulletins, gale and swell warnings as well as data for general public information and research.



Irish Marine Data Buoy Observation Network

## Wave Height Projected Changes for the Period 2077-2099 (relative to 1980-2009)

Projections of average significant wave height for Ireland suggest a decrease in annual and seasonal wave heights for both the medium-low and high emission scenarios.

- The largest decreases are expected for summer (up to 15%), particularly off the south coast, and for winter (up to 10%), particularly off the west coast.
- Projected changes for autumn and spring are small and considered less robust than those for winter and summer so should be treated with caution.
- Further work is required to improve the estimates and to further clarify uncertainties in projected changes.

# THE ADAPTATION STRATEGY PROCESS



# OUR APPROACH TO THE STRATEGY

The approach to the development of the Climate Adaptation Strategy for Galway City Council follows a five-step process provided for within the Local Authority Adaptation Strategy Development Guidelines (DCCAE, 2018).

The Climate Action Regional Office supported the process by providing workshop presentations, materials and templates, as well as providing a link to other Sectors involved in preparing Climate Adaptation Strategies.






## Climate Adaptation Team

Local Government has a very broad remit undertaking many actions on behalf of Central Government Departments and Agencies. Given this broad scope of operations it was necessary to form a Climate Adaptation Team with a representative across all departments, in order to assess the current adaptation baseline for climate change.

Activities included some workshops, which allowed for inter-departmental dialogue on both qualitative and quantitative aspects around how climate events of the past had created challenges and opportunities for Galway City Council.

Having now drafted the Strategy we are at 'Step 5' in the Implementation and Monitoring Phase of the Strategy.

### Step 2 Assessing the Current Baseline on Past Events

-  Extreme Cold Weather & Low Temperatures
-  High Temperature & Low Rainfall
-  Sea Level Rise & Coastal Flooding
-  Strong Winds
-  Extreme Rainfall

### Step 1 Preparing the Ground

#### Adaptation Team

-  Critical Buildings & Infrastructure
-  Natural and Cultural Capital
-  Water Resources and Flood Risk Management
-  Community Services

### Step 3 Identifying Future Climate Impacts, Vulnerabilities & Risk

### Step 4 Identifying, Assessing and Prioritising Adaptation Actions

### Step 5 Drafting, Implementing and Monitoring Strategy

STEP 1: PREPARING THE GROUND

STEP 2: BASELINE ASSESSMENT

STEP 3: FUTURE CLIMATE RISKS

STEP 4: GOALS, OBJECTIVES & ACTIONS

STEP 5: IMPLEMENTATION

# STEP 1: PREPARING THE GROUND

STEP 1: PREPARING THE GROUND

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STEP 4: GOALS, OBJECTIVES & ACTIONS

STEP 5: IMPLEMENTATION

# PREPARING THE GROUND

Climate Change has an impact on all functional areas of Galway City Council. A Climate Adaptation Team was convened from a broad cross-section of operations, drawing on various skills and experience from the organisation.

The various departments within Galway City Council were divided into the four Operational Themes, set out in the National Adaptation Framework;

1. Critical Infrastructure & Buildings
2. Natural & Cultural Heritage
3. Water Resources & Flood Risk Management
4. Community, Services, Health and Well being\*.

\* This theme is listed as 'Health' in the National Adaptation Framework, but 'Community, Services and Well being' is more relevant to the Local Government sector.

# ADAPTATION STRATEGY TEAM



# STEP 2: ASSESSING CURRENT BASELINE



STEP 1: PREPARING THE GROUND

STEP 2: BASELINE ASSESSMENT

STEP 3: FUTURE CLIMATE RISKS

STEP 4: GOALS, OBJECTIVES & ACTIONS

STEP 5: IMPLEMENTATION



# GALWAY CITY COUNCIL'S ADAPTATION BASELINE

Understanding how Galway City Council has been impacted by climate hazards in the past is a crucial first step in the development of an Adaptation Strategy for the future.

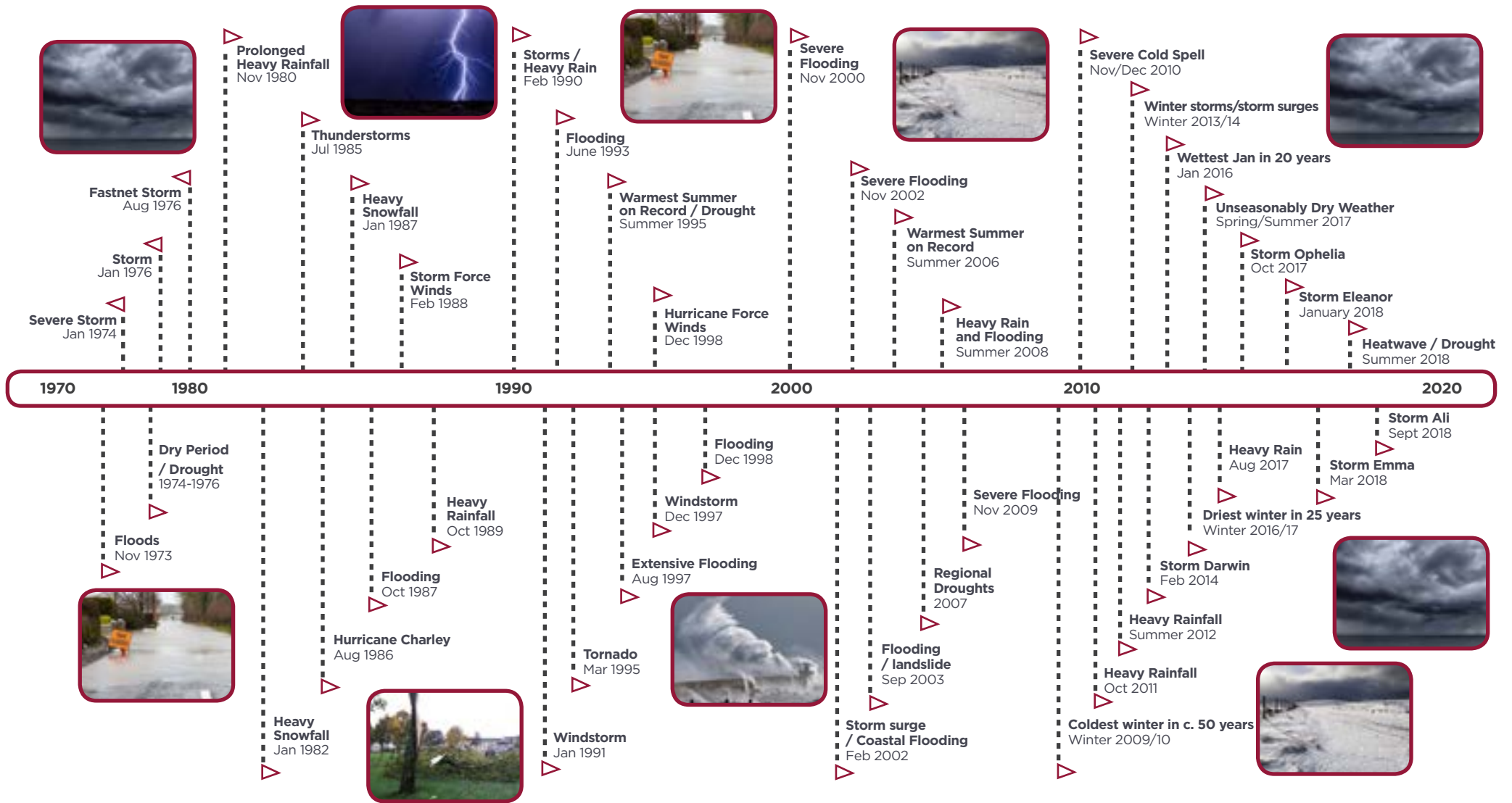
A baseline assessment was carried out taking account of the range of climate hazards that have affected Galway City in the past and assess the consequences of these for services and functions of Galway City Council.

## Past Climate Events & Trends

The first step in the assessment of the adaptation baseline was the identification and compilation of past weather events, as well as periods of climate variability within Galway City Council's functional area. Climate events and associated impacts over the last 30 years were taken as the base period to establish and review the current state of play.

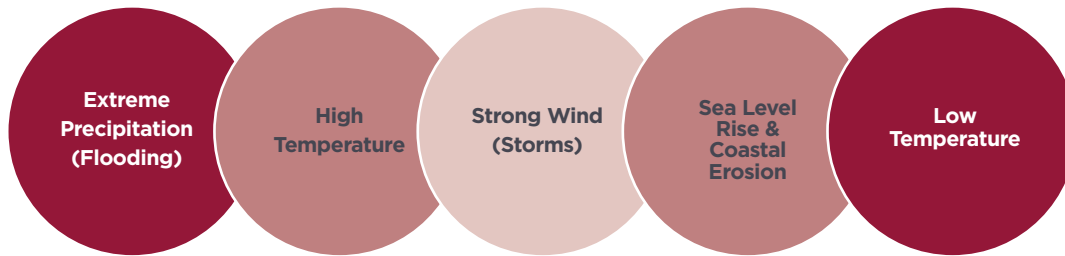
Event Type / Name	Year	Climate Hazards	Outline Description
<b>Storm Ali</b>	2018	Strong Winds	Orange Wind Warning - gale-force winds of up to 120km/h, stormy conditions
<b>High Temperatures, Heatwave &amp; drought</b>	2018	High Temperature	High Temperatures, Heatwave and drought
<b>Storm Hector</b>	2018	Strong Winds	Heavy rain and gales
<b>Storm Emma &amp; Beast from the East</b>	2018	Snowfall	Snowfall Blizzard / Heavy Snowfall
<b>Storm Doris</b>	2018	Strong Winds	Gale force winds, heavy rainfall, sleet and snow
<b>Storm Elanor</b>	2018	Strong Winds	Orange Warning - Westerly gale to storm winds together with high tides and exceptionally high seas - coastal damage and flooding.
<b>Storm Dylan</b>	2017	Strong Winds	Orange warning of "violent gusts" and coastal flooding from high seas. Strong Winds recorded at Mace Head in Co Galway (119 km/h) and Newport, Co Mayo (111 km/h)
<b>Storm Ophelia (Ex-Hurricane Ophelia)</b>	2017	Strong Winds	Red warning - gale force winds, heavy rain and storm surges along Strong Winds some coasts (flooding).
<b>Heavy Rain</b>	2017	Extreme Rainfall	Cloud Burst in Donegal Inishowen Landslide
<b>Storm Jake</b>	2016	Strong Winds	Orange wind warning and yellow snow-ice warning
<b>Storm Frank</b>	2015	Strong Winds	Red warning - gale force winds, heavy rain and storm surges along Strong Winds some coasts (flooding).
<b>Storm Eva</b>	2015	Strong Winds	Orange WW, strong winds
<b>Storm Desmond</b>	2015	Flooding	Extratropical cyclone with heavy rain, flooding, Flooding in Flooding Crossmolina / Teresa Mannion-Salthill
<b>Storm Darwin</b>	2015	High Temperature	Orange Warning for strong winds
<b>Winter Storms</b>	2013/4	Strong Winds	Winter storms - serious coastal damage and widespread, persistent Extreme Rainfall flooding.
<b>Tropical Storm Katia</b>	2011	Strong Winds	Met Eireann issued an extreme weather warning after predicting that storm gusts would reach up to 80mph, attacking mostly the west and northwest coasts. Sea Flooding. Strong Winds Trains and bus routes were cancelled as power lines were damaged and fallen trees blocked roads, which caused car crashes and road build-up
<b>Winter Cold Spell</b>	2010	Cold Snaps / Frost	Severe Cold Spell
<b>Winter Cold Spell</b>	2009 /10	Cold Snaps / Frost	Coldest winter in almost 50 years (Met Eireann)
<b>Severe flooding</b>	2009	Flooding	CS 6: Severe flooding
<b>Heavy Rain &amp; Flooding</b>	2008	Extreme Rainfall	Heavy Rain & Flooding
<b>High Temperature/ Heatwave</b>	2006	High Temperature	Warmest summer since record breaking 1996
<b>Heavy Rainfall / Cloud Burst</b>	2003	Extreme Rainfall	Pollatomish Landslide
<b>Hurricane force winds over north &amp; northeast</b>	1998	Strong Winds	Hurricane force winds over north and northeast
<b>Windstorm</b>	1997	Stong Winds	Windstorm
<b>Hurricane Charley</b>	1986	Strong Winds	Strong Winds and Rain

# HISTORIC CLIMATE EVENTS IN GALWAY



# GALWAY CITY COUNCIL'S ADAPTATION BASELINE

Through the identification and compilation of these events several event categories emerged. Some have occurred in combination.



## Case Studies

To create a better understanding on how the climate trends and events have impacted Galway City, the climate hazards were assessed through a series of case studies and data collated by the Climate Adaptation Team allowing for insight on local level of exposure and vulnerability to the impacts.

### Case Study 1

#### Extreme Precipitation, November 2009

November 2009 is notable for the high rainfall recorded and the consequent severe flooding experienced in many parts of the country

### Case Study 2

#### High Temperature (and low Precipitation), Summer 2018

Heat and drought conditions in the summer of 2018 affected many parts of the country.

### Case Study 3

#### Strong Winds , Storm Desmond December 2015 and Storm Ali September 2018

Storm Desmond, 5th December 2015, was an extra tropical cyclone bringing heavy rains and severe gales with gusts up to 81mph.

### Case Study 4

#### Winter Storms 2013/2014, and Storm Eleanor January 2018

The winter of 2013/14 was severely affected by a run of winter storms, culminating in serious coastal damage and widespread flooding.

### Case Study 5

#### Low Temperature, February/March 2018

Storm Emma and "The Beast from the East" pushed continental polar air across Ireland, bringing freezing temperatures and snow.

STEP 1: PREPARING THE GROUND

STEP 2: BASELINE ASSESSMENT

STEP 3: FUTURE CLIMATE RISKS

STEP 4: GOALS, OBJECTIVES & ACTIONS

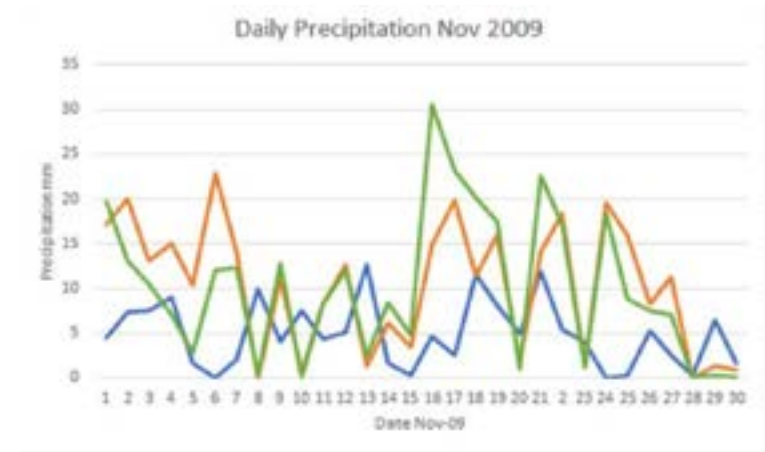
STEP 5: IMPLEMENTATION

# CASE STUDY 1: EXTREME RAINFALL, WINTER 2009 & STORM DESMOND 2015

November 2009 is notable for the high rainfall recorded and the consequent severe flooding experienced in many parts of the country. Very unsettled weather began in the middle of October with rainfall totals for November the highest on record at most stations.

More than twice the average November amounts of rain were measured at almost all stations. The number of very wet days (>10mm rain) numbered 13 for Headford, County Galway in the River Corrib Catchment. The monthly rainfall between November 1st and 30th recorded at OPW's Headford station was recorded at 321 millimetres during the month. The highest daily rainfall total recorded at Headford, Co. Galway during this period was on the 18th of November, with 40.3mm of rainfall.

Storm Desmond, 5th December 2015 was an extra tropical cyclone bringing heavy rains and severe gales to Galway City. The highest daily rainfall total recorded at Athenry Weather Station during this period was on the 5th of December, with 43.3mm of rainfall.



Source Data: Met Eireann

## Impacts:

- Flooding of Roads
- Major Traffic Disruption on Roads to commuters travelling to and from Galway City due flooding of road network in County Galway (November 2009).
- Cancellation of Outdoor Activities and Sporting Events due to prolonged extreme rainfall and saturated playing pitches (November 2009).
- Loss of economic activity during the busy Christmas shopping period as many of the roads accessing the city were affected by flooding (Storm Desmond 2015).
- Flooding of Dressing Rooms owned by Galway City Council at Southpark (Storm Desmond 2015).

## CASE STUDY 2: HIGH TEMPERATURES, SUMMER 2018

During the Summer 2018, Galway City was affected by high temperatures and low rainfall

The weather station at Athenry, Co. Galway recorded the low rainfall with 17 consecutive days of zero rainfall and a total monthly rainfall for June of 25mm in Athenry at 32% of the Long-Term Average (LTA) with drought conditions persisting until mid-July.

Similarly, recorded mean air temperatures were above their LTA. The highest daily temperature was recorded at Athenry at 30.2 degrees in June with the highest night time temperature recorded at 18 degrees on 28 June 2018.

Daily High Temperatures Recorded at Athenry  
(Summer 2018)



Source Data: Met Eireann



### Impacts:

- Low water levels in the River Corrib.
- Water Conservation measures were put in place.
- Change in Water temperature and chemistry in River Corrib had an impact on treatment process for production of Public Water Supply
- Increased visitors to Galway City's beaches.
- Alternative sources of water were required to water vegetation in Parks and Public Spaces to prevent vegetation drought stress.
- Increased usage of public spaces required increased level of service in terms of litter management.

# CASE STUDY 3: STORM DESMOND & STORM ALI, STRONG WIND

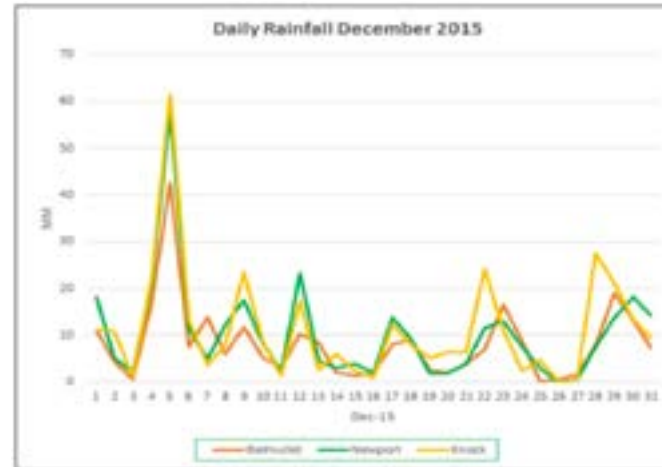
## Storm Desmond

Storm Desmond, 5th December 2015 was an extra tropical cyclone bringing heavy rains and severe gales with gusts up to 81mph.

## Storm Ali

A Code Level Orange Weather warning was issued by Met Eireann on Tuesday 18th September which stated the following:

*“Storm Ali will track close to the west and northwest coast from the early hours of Wednesday morning. South to southwest winds veering westerly will increase to mean speeds between 65 and 80 km/h with gusts between 110 and 120 km/h for a time. The core of strong winds will be along Atlantic Coasts at first and will then move quickly eastwards during the morning.”*



Source Data: Met Eireann

Impact of Event:  
It's unprecedented  
in terms of our  
memory and  
records - which  
in some cases  
go as far back as  
100 years. Gerard  
Fleming, Met  
Éireann, 2015.

## Impacts:

- Flooding of Salthill and closure of the promenade (Storm Desmond).
- Damage to private property and City Council owned buildings including its social housing stock.
- Increased costs of repairs.
- Power outages to Galway City Council's public buildings.
- Emergency response provided by Galway City Council.
- 36 fallen trees in Galway City blocking roads (Storm Ali).
- 7 fallen trees bringing down overhead utility cables (Storm Ali).
- Many roads were closed with traffic diversions in place.
- Additional costs to Galway City Council in the region of €80,000 for Storm Desmond and Storm Ali.

# CASE STUDY 4: SEA LEVEL RISE & STORM SURGE WINTER STORMS 2013/2014 & STORM ELEANOR 2018

## Winter Storms 2013/2014

During the period from 13th December 2013 to 6th January 2014 there were storms in or around Ireland approximately once every three days. In addition to the very strong winds there were periods of extremely heavy rain (most short-lived) and a lot of thunderstorm activity. These storms coincided with high tides and created severe conditions in several coastal areas. After a respite period of around three weeks the country was subjected to a second series of severe storms commencing on 27th January. This second spell of severe weather persisted until 17th February and included the extreme and highly destructive storm event of 12th February 2014. There was a constant threat in several river catchments of severe flooding arising from the rainfall. This series of storms led to an increase in rainfall amounts of between one and a half and two times above normal and led to saturated or waterlogged ground throughout the city. Over 50% of stations across the country reported the wettest winter on record. A combination of strong winds, tidal surges, very high tides and high rainfall conspired to cause widespread damage and flooding along Galway City's coastline causing significant disruption to individuals, business, infrastructure and habitats.



## Storm Eleanor 2018

This flood event occurred during the High Tide on Tuesday January 2nd January 2018 predicted to occur at 5.12pm. At 5.05pm the wind speed was 17 knots from the north; in less than half an hour at 5.32pm, the wind had shifted to the southwest reading 59 knots. The change in direction and 42 knots increase of wind speed combined with the high tide and the storm surge and wave setup contributed to the catastrophic effect.

The sea level rapidly ascended above the dock walls and flowed out onto Dock Road. The flood water gushed across the road and flooded New Dock Street, Merchants Road, Flood Street and into Quay Street and Spanish Parade. This happened in a very short space of time. The levels rose rapidly over approximately 30 minutes and descended again very quickly. The flood had substantially receded by 7.30pm.

Initial observations of water level gauges indicated that the sea level in Galway Bay had risen to a level of 700 to 1,200mm above that forecasted. This was the highest recorded level since 1992 and higher than the 2014 flood event.

## Impacts:

- Road and Carpark Closures.
- 14 Properties flooded in Galway City (Winter Storms 2013/2014).
- 311 Properties flooded in Galway City (Storm Eleanor 2018)
- Structural Damage to Salthill promenade (Winter Storms 2013/2014).
- Leisureland Facility damaged by coastal flooding (Winter Storms 2013/2014).
- Increased costs of repairs.
- Reduced Services due to Office Closures.
- Additional costs to Galway City Council for emergency response in the region of €200,000 for Winter Storms 2013/2014 and Storm Eleanor.

# CASE STUDY 5: LOW TEMPERATURE, FEBRUARY/MARCH 2018

Storm Emma & 'Beast from the East' took place in February/March 2018. During the third and fourth week of February easterly winds pushed continental polar air across Ireland. Snow showers affected the country on the 27th and led to significant accumulations particularly in eastern and southern counties on the last day of the month.

In March, an exceptionally cold polar easterly airstream (continental) covered Ireland. In addition, Storm Emma tracked northwards from the Bay of Biscay during the first week of March. It yielded widespread snow, ice and low temperatures. It was extremely cold with widespread air and ground frosts

Source Data: Met Eireann



“The jet stream is currently disrupted so we are getting storms from different regions. “Precipitation at the north of the storm will be met with the Siberian winds sweeping in from the east - and this will create snow.” forecaster Joanna Donnelly 2018

## Impacts:

- Roads were treated inline with the Winter Maintenance Plan.
- City Council Offices closed for two days.
- High Tides: Tides were monitored and passed without incident, the dock road was closed as a precaution.
- Housing: Some (9) calls in relation to cold weather and the problems were resolved where possible or a short-term solution provided.
- Caring for the Homeless: Sufficient beds were provided for rough sleepers, and harm minimisation packs issued to those who refused beds. Emergency lines were managed by COPE Galway.
- Extra litter picking took place ahead of the severe weather and additional environment staff assisted with gritting footpaths and clearing snow.
- Additional costs to Galway City Council in the region of €20,000 for Storm Emma.

STEP 1: PREPARING THE GROUND

STEP 2: BASELINE ASSESSMENT

STEP 3: FUTURE CLIMATE RISKS

STEP 4: GOALS, OBJECTIVES & ACTIONS

STEP 5: IMPLEMENTATION



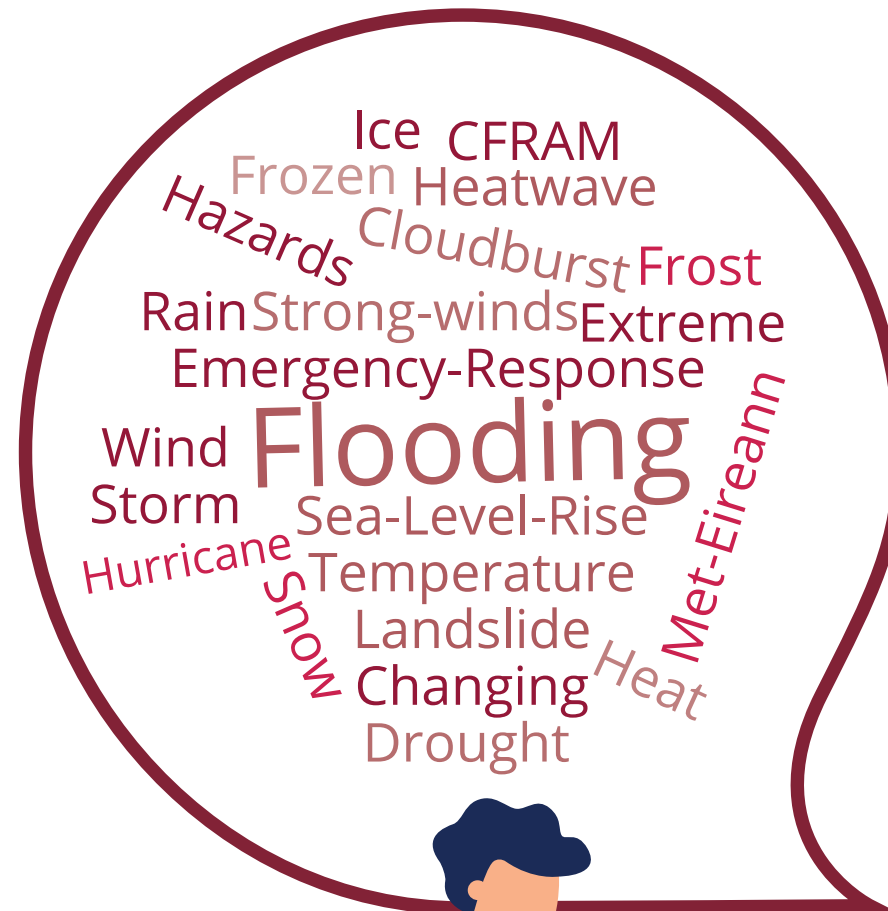
# GALWAY CITY COUNCIL'S ADAPTATION BASELINE

Climate change is a major challenge that poses major risks to our communities, businesses, environment, and way of life. Observations show that temperatures are increasing, precipitation patterns are changing, and sea level is rising. Severe weather events that we have experienced over the past decade clearly illustrate the impacts that Galway City is likely to experience under climate change. These impacts are expected to intensify over the coming decades no matter how much we reduce our greenhouse gas emission.

Looking back at past events, the Adaptation Strategy Team identified 97 impacts on the services provided by Galway City Council. The identified impacts are summarised below for each of the climate events considered in the case studies.

Coastal Flooding has had a major impact on Galway City and Galway City Council in terms of damage to property and providing emergency response during and after events, including services for clean-up and damaged goods removal. The other types of extreme weather events have impacted on the delivery of services. Assessing these events gives a snapshot of Galway City Council ability to cope and following these events Galway City Council strengthened its ability to cope and became more ready and resilient for future extreme events.

Sector	Sea Level Rise & Coastal Flooding	Strong Winds	Low Temperatures	Extreme Rainfall	High Temperatures / Low Rainfall	Total
Critical Infrastructure & Buildings	7	5	7	4	4	27
Natural & Cultural Capital	4	4	3	4	5	20
Water Resource & Flood Management	2	4	3	6	5	20
Community Services	4	4	11	5	6	30
<b>TOTAL</b>	<b>17</b>	<b>17</b>	<b>24</b>	<b>19</b>	<b>20</b>	<b>97</b>



# **STEP 3:** IDENTIFICATION OF CLIMATE RISKS & OPPORTUNITIES



STEP 1: PREPARING THE GROUND

STEP 2: BASELINE ASSESSMENT

STEP 3: FUTURE CLIMATE RISKS

STEP 4: GOALS, OBJECTIVES & ACTIONS

STEP 5: IMPLEMENTATION

# RISKS & OPPORTUNITIES

In preparing for climate change, Galway City Council is faced with the challenge of responding to a broad range of uncertain risks. Although some services and activities may not currently be impacted by climate change, they may be sensitive to projected changes and may experience impacts in the future.

Climate change is creating new risks and exacerbating existing ones. Galway City as a coastal city is vulnerable to coastal flooding and erosion. In the future this risk is expected to increase due to rising sea levels and increased frequency and severity of extreme rainfall and storm events

In developing an understanding of the levels of exposure to climate hazards, the Adaptation Team looked at the climate impacts that are of current significance, climate projections, and the consequences for the delivery of services by Galway City Council.

## Opportunities

Projected changes in climate may also result in additional benefits and opportunities for Galway. Adaptation measures can reduce costs of disruption to business operations and help to realise new business opportunities arising from climate change.

## Climate Risk & Opportunities Register

The Climate Risk and Opportunities Register provides a list of Risk and Opportunity Statements, developed from the baseline and future vulnerability assessments, with associated timeframes and projections of future changes.



# CLIMATE CHANGE IMPACTS



Increased incidence of heavy rainfall events, flooding and more severe cyclones with direct, and indirect, impacts on property, infrastructure, wildlife, community and economic function.



Increased temperatures with impacts on human wellbeing, including heat stress and diseases.



Changes to our natural ecosystems, including the distribution and abundance of pest plants and animals, and loss of climate-sensitive native species.



Ocean warming and acidification, with impacts on the health - of our marine - ecosystems, including our fisheries resources.



Sea-level rise and inundation of low-lying communities and habitats.

# RISKS TO CRITICAL INFRASTRUCTURE & BUILDINGS

The current base assessment for Galway City Council shows that historically the climate events that have had the biggest impacts on Critical Infrastructure and Buildings were in order of decreasing impact,

1. Coastal Flooding
2. Low Temperatures
3. Strong Winds
4. Extreme Rainfall
5. High Temperature and Low Rainfall

Coastal flooding and storms have already accounted for significant losses in infrastructure services and property damage, with damages caused by flooding tending to last longer than other weather-related hazards.

Galway City has significant infrastructure and buildings located near the coast and around the section of River Corrib below the Salmon Weir that can be affected by tidal water levels and storm surge.

**Critical Infrastructure** vulnerable to coastal and fluvial flooding includes:-

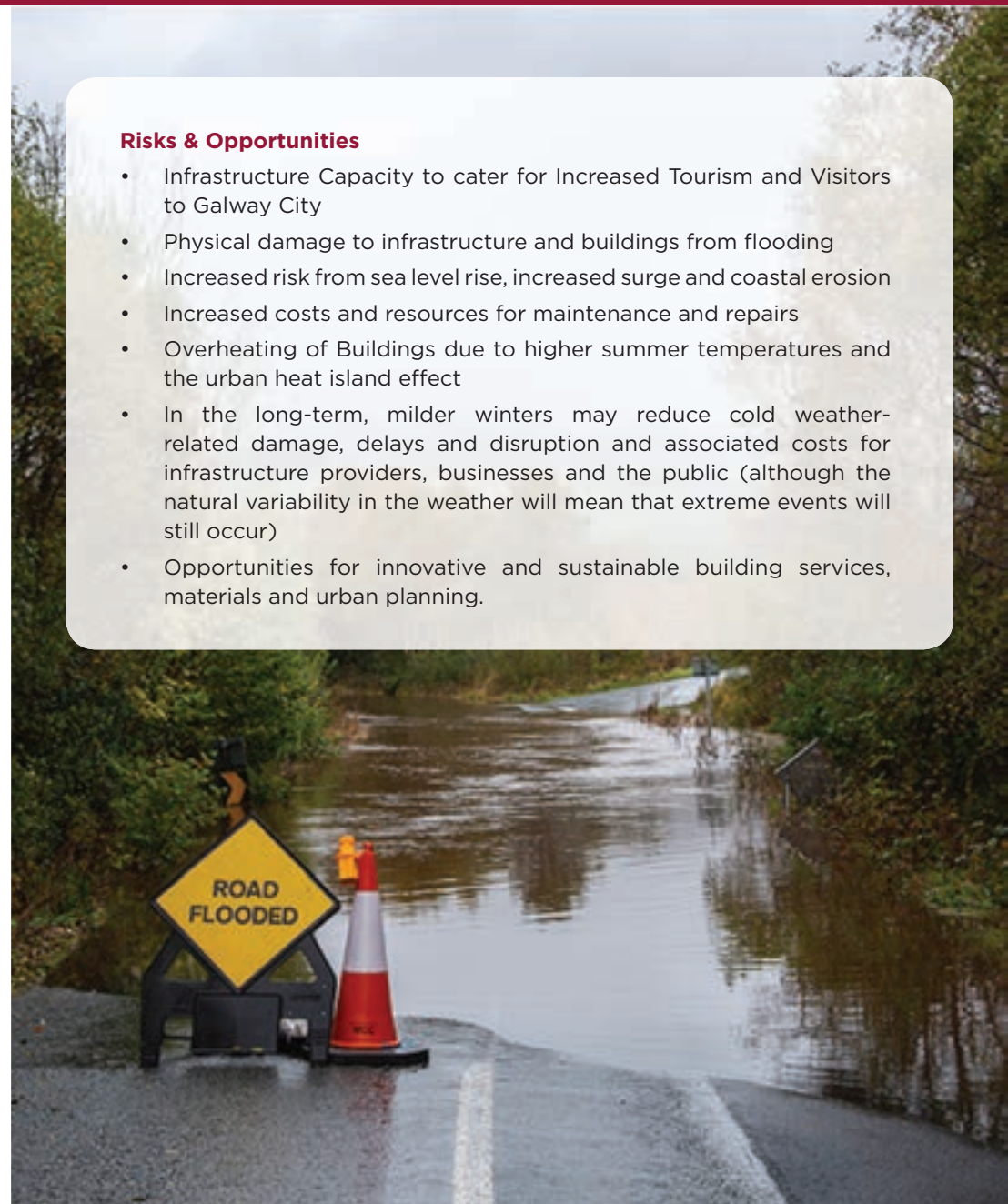
- Regional Road R336
- Roads infrastructure, including public lighting and traffic management
- Wolfe Tone Bridge
- William O'Brien Bridge
- Fire Station at Father Griffin Road
- Surface water disposal and pumping infrastructure

Projected rises in mean sea level is expected to increase the risk and extent of vulnerable areas.

The risk of river and surface water flooding is expected to rise, as patterns of rainfall become more intense. The projected increased rainfall intensity will also lead to overloading of surface water networks, leading to more road and street flooding, overland flows and property flooding. The water network and wastewater treatment facilities will need to adapt to the increased flows.

## Risks & Opportunities

- Infrastructure Capacity to cater for Increased Tourism and Visitors to Galway City
- Physical damage to infrastructure and buildings from flooding
- Increased risk from sea level rise, increased surge and coastal erosion
- Increased costs and resources for maintenance and repairs
- Overheating of Buildings due to higher summer temperatures and the urban heat island effect
- In the long-term, milder winters may reduce cold weather-related damage, delays and disruption and associated costs for infrastructure providers, businesses and the public (although the natural variability in the weather will mean that extreme events will still occur)
- Opportunities for innovative and sustainable building services, materials and urban planning.



# CRITICAL INFRASTRUCTURE AND BUILDINGS(contd.)

High winds also emerged as having an existing impact, with widespread disruption to transportation within the City during storms with strong winds due to fallen and damaged trees and overhead electricity lines.

Tourism and Visitors to Galway City are expected to increase as domestic tourism becomes more attractive to residents in the Summer months than popular destinations abroad. Increased summer mean temperatures may lead to heat related damage and/or disruption to energy and transport networks, in addition to increased journeys and supply demands from more visitors to Galway City. Milder winters may also reduce cold weather-related damage, delays and disruption and associated costs for infrastructure, businesses and the public (although extreme events will still occur).

Increased summer mean temperatures will affect buildings including offices, accommodation including the City Council's own social housing stock, with an increased risks of overheating and increased requirements for cooling in buildings. Conversely Milder winters may reduce demand for heating, reducing costs for businesses and the public, as well as reducing greenhouse gas emissions.

Importantly there may be further opportunities for innovative and sustainable building services, materials and urban planning.





STEP 1: PREPARING THE GROUND

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# BIODIVERSITY

On a global scale, the rate of global change in nature during the past 50 years is unprecedented in human history. The direct drivers of change in nature with the largest global impact have been (starting with those with most impact): changes in land and sea use; direct exploitation of organisms; climate change; pollution; and invasion of alien species. Climate change is a direct driver that is increasingly exacerbating the impact of other drivers on nature and human well-being. (IPBES Report 2019).

Galway City is located at the mouth of the River Corrib and lies at the junction between the blanket bogs of Connemara to the west and the low-lying farmland of east Galway. Galway City has a large and diverse range of habitats and wildlife in relation to its size, due to its varying geology, the extent of urban woodland and its proximity to the river Corrib, Galway Bay and Lough Corrib. These habitats and wildlife are under constant pressure from Human activity and development. They are adapted to the current patterns of temperature and rainfall. As these patterns change, some of these plants and animals may not be able to adapt or move or may become so stressed they become extinct.

These new climatic conditions may be more favourable to species of plants or animals that currently do not live here, but which may in time become invasive at the expense of existing species. This is already occurring e.g. on our inland waterways and the spread of Zebra Mussels. Shifts in spatial range and changes in phenology will have implications for the ecological compositions of communities and habitats, with both winners and losers.

*“Climate change is already having an impact on nature, from genes to ecosystems. It poses a growing risk owing to the accelerated pace of change and interactions with other direct drivers” [IPBES 2019]*

The residual impact of climate change on habitats and biodiversity is a very complex one, as climate change affects organisms along many ecological axes simultaneously and includes secondary effects that result from altered species interactions.

Action is needed to firstly better understand the impacts of climate change on our biodiversity and then to bring climate and environmental change into conservation planning at site level and on a wider scale.

## Risks & Opportunities

- Changes in the timings of seasonal events (phenological mismatch) may lead to disruption of food species and put species, as well as ecosystem services, at risk.
- New conditions may favour generalist species, pests, diseases and invasive non-native species, leading to a reduction in biodiversity and disrupting ecosystem services.
- Better conditions occurring for some flora and fauna.
- Increased productivity in forests and woodlands due to increased temperatures where drought, pests, pathogens and other pressures are not limiting factors.
- Changes in species range may present threats, but also some opportunities, for wider biodiversity and ecosystem services.





# BIODIVERSITY

Coastal habitats and peatlands around Galway City may shrink significantly as a result of climate change

## Coastal Habitats

The coastal zone in Galway City contains a wide range of coastal habitats including saltmarsh, shingle and sand banks, sandy and muddy shores. Galway Bay is thought to be one of the best ornithological areas in the western region. It supports a huge diversity of wintering wetland birds with divers, grebes, cormorants, ducks, swans, geese and waders all represented. Coastal areas are of concern through the combined effect of sea level rise and increase in storm surges; eroding coastal habitats. In addition increasing sea temperatures and chemistry can lead to issues such as algal blooms. Additional pressure on the freshwater wetlands in coastal areas is also expected due to predicted seawater inundation as a result of elevated sea water levels and increased storm surge. This could result in their conversion into salt marshes in affected areas.

## Peatlands

Extensive peatland areas (lowland blanket bog and wet heath) occur on the western edge of Galway City. These internationally rare habitats occur together in mosaics in the townlands of Cappagh and Ballagh. The peaty landscape is part of the cultural heritage of the west of Ireland, particularly Galway. An area of peatland just within the City boundary is part of the Moycullen Bogs Natural Heritage Area (NHA). Peatland may be significantly impacted by a rise in temperatures and altered precipitation patterns, including more frequent droughts. Careful management of peatland systems is required in order to prevent such natural intact ecosystems becoming carbon sources as opposed to carbon sinks. Climate change will make meeting existing conservation objectives increasingly challenging and potentially have implications for the provision of ecosystem services in the long-term, such as carbon storage, clean water provision and pollination.

### Non-Native Species

- Changed conditions, especially rapid warming, have facilitated the establishment and spread of alien amphipods and non-native crayfish. These are already reported as 'nuisance' in the UK and Europe because of how they alter food web interactions.
- From a human perspective, alien species often cause management problems, an example of which is the fouling of underwater structures by zebra mussel (*Dreissena Polymorpha*) or blocking navigation channels as a result of thick growth of various macrophytes.
- Non-indigenous species have been shown to do better under warmer conditions experienced in recent years and their spread is expected to accelerate as a result of climate change.

Ecosystems and biodiversity can also play a significant role in influencing climate change. Trees and plants remove carbon dioxide from the atmosphere, regulate air temperatures and catch rainfall. Wetlands act as significant carbon sinks, store large volumes of water and slow down its flow.

# CULTURE & HERITAGE

It is the wealth and diversity of our natural, built and cultural heritage that gives Galway City its unique identity and character and contributes to the economic and cultural well-being of the city.

Galway City's most prominent cultural & Heritage assets are its coastline, its heritage as a medieval city, its streetscapes and architecture, its waterways and cultural buildings including theatres and museum.

Major impacts on coastal cultural heritage are likely to occur from projected sea level rise, increased coastal erosion and coastal flooding, more frequent storm events and greater wave energy. Coastal flooding and erosion will be one of the most widespread and demanding impacts of climate change, posing challenges across all sectors, including cultural and heritage.

It is anticipated that there will be a direct impact on cultural heritage, from changes to our current climate, and indirect impacts, including ones arising from cultural reactions and changes to natural habitats and landscapes. Indirect effects may arise from mitigation and adaptive responses e.g. the construction of flood protection schemes.

As a first step to improving our capacity for the management of our cultural heritage (in light of climate change) we need to gather baseline data on our cultural heritage resources, develop vulnerability maps and a hierarchy of priorities for allocating resources.



## Risks & Opportunities

- Increased costs of maintaining built heritage and archaeological sites.
- Impacts from adaptation measures, e.g. flood protection.
- Impacts from coastal flooding and sea level rise on cultural buildings in areas vulnerable to flooding.
- Cultural Events may be adversely affected by extreme climate events or coastal flooding.
- Loss of beaches and landscape from coastal erosion.

# TOURISM

In 2018 Galway City and County saw over 1.4 million overseas visitors . This was the most visited place in Ireland outside of Dublin. Visitors to Galway City choose to visit for many reasons, among them the vibrant city atmosphere set in a medieval City, all year round events and festivals including the Galway Arts Festival, the Galway Races and Macnas Parade, and also Galway City and County's cultural and natural heritage. As changes to the climate affect our cultural buildings, natural and cultural heritage assets, this will have implications for Galway's tourism industry. We need to build an understanding of the likely effects on tourism and what, if anything, we can do about it.

*“As changes to the climate affect our heritage, then they will also have implications for Ireland’s tourism industry”. [ Fáilte Ireland]*

While there are many issues relating to tourism and climate change that are difficult to predict in an Irish context, we can be certain that we will not be as adversely affected as other destinations around the world. Ireland's temperate climate should be capable of absorbing the predicted changes in climate over the next one hundred years without resulting in unacceptable comfort levels for visitors or taking away from the reasons that people choose to come to Galway City. It is also likely that some of the predicted outcomes of climate change will have positive impacts on tourism in Galway. For example, warmer drier summers e.g. 2018, will increase the appeal of many of Galway's Blue Flag Beaches, as well as the appeal of the Wild Atlantic Way, our water-based and other outdoor activities. This will bring its own pressures on amenities, services and resources and it will be necessary to prepare for this. Overall, while there may be gains to tourism from climate change, there are also several significant risks, and it is important to build an understanding and adapt to climate change risks and opportunities to ensure that Galway City's tourism offerings are of a consistently high quality, and that sustainable management policies and practices are put in place.



## Risks & Opportunities

- Development and use of natural amenities will increase e.g. Greenways and beaches but changes in water availability, biodiversity loss, increased natural hazards, coastal erosion and inundation, damage to infrastructure will all impact tourism.
- The possibility of extending the tourist season into the shoulder periods of April/May and October.
- Events may be adversely affected by extreme climate events or coastal flooding.
- Opportunity to green festivals and market Galway City as a Sustainable Destination.

# WATER & WASTEWATER SERVICES

Substantial reductions in summer and autumn flows in the River Corrib could have potentially serious implications for water supply and water resource management in Galway City.

The Terryland Water Treatment Plant, is one of Galway City’s main source of treated water, the capacity of the treatment plant is vulnerable to climate change, particularly the risk of higher temperatures and low rainfall, leading to reduced water levels, low flows in the River Corrib with a consequence of reduced intake capacity.

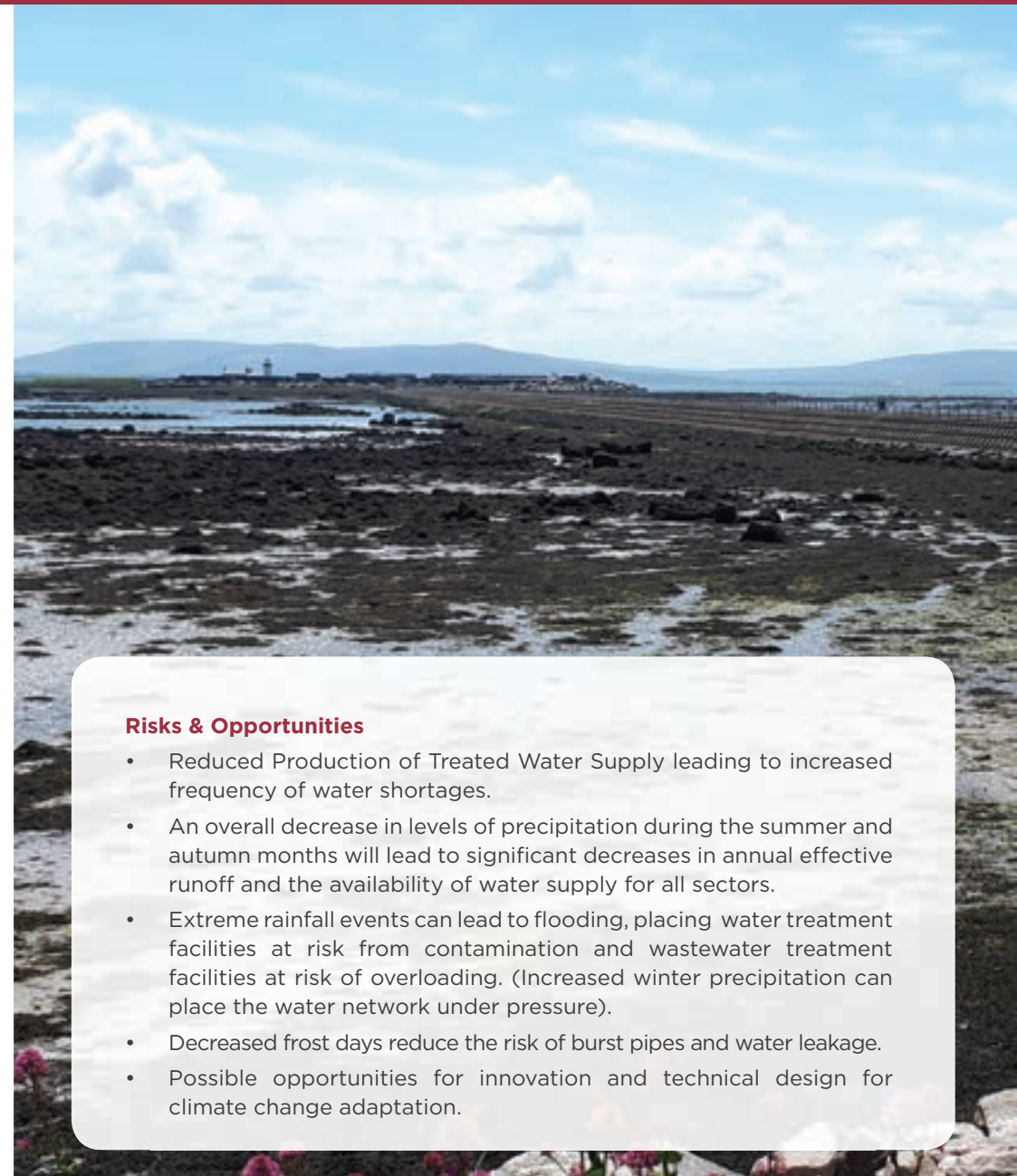
Rising average temperatures are also expected to increase the temperature of River Corrib which can change the water characteristics. More frequent changes to the water characteristics, may impact on the ability of the current water treatment infrastructure to treat raw water to mitigated by upgrading of treatment process.

Galway City Council and Irish Water are working together to adapt and future-proof the Terryland Water Treatment Plant to climate change.

Conservation of water i.e. water usage and water delivery will become increasingly important.

Water supply interruptions can also be caused by flooding and cold weather, although the probability of cold events that cause problems with water supply is likely to decline in the long-term, as winters become warmer.

More regular flood events will put increasing pressure on sewage treatment and collection systems that integrate rainwater runoff. Water supply and wastewater treatment calculations will also need to be reviewed, especially in urban areas dependent on surface water collection.



### Risks & Opportunities

- Reduced Production of Treated Water Supply leading to increased frequency of water shortages.
- An overall decrease in levels of precipitation during the summer and autumn months will lead to significant decreases in annual effective runoff and the availability of water supply for all sectors.
- Extreme rainfall events can lead to flooding, placing water treatment facilities at risk from contamination and wastewater treatment facilities at risk of overloading. (Increased winter precipitation can place the water network under pressure).
- Decreased frost days reduce the risk of burst pipes and water leakage.
- Possible opportunities for innovation and technical design for climate change adaptation.

# WATER QUALITY

The effects of extreme events, such as storms and flooding and slow onset changes such as temperature rise, changes in precipitation regimes and sea level rise, will have a transformative effect on water. This has potentially serious implications for water resource management, bathing waters, blue flag designations and the successful implementation of the Water Framework Directive.

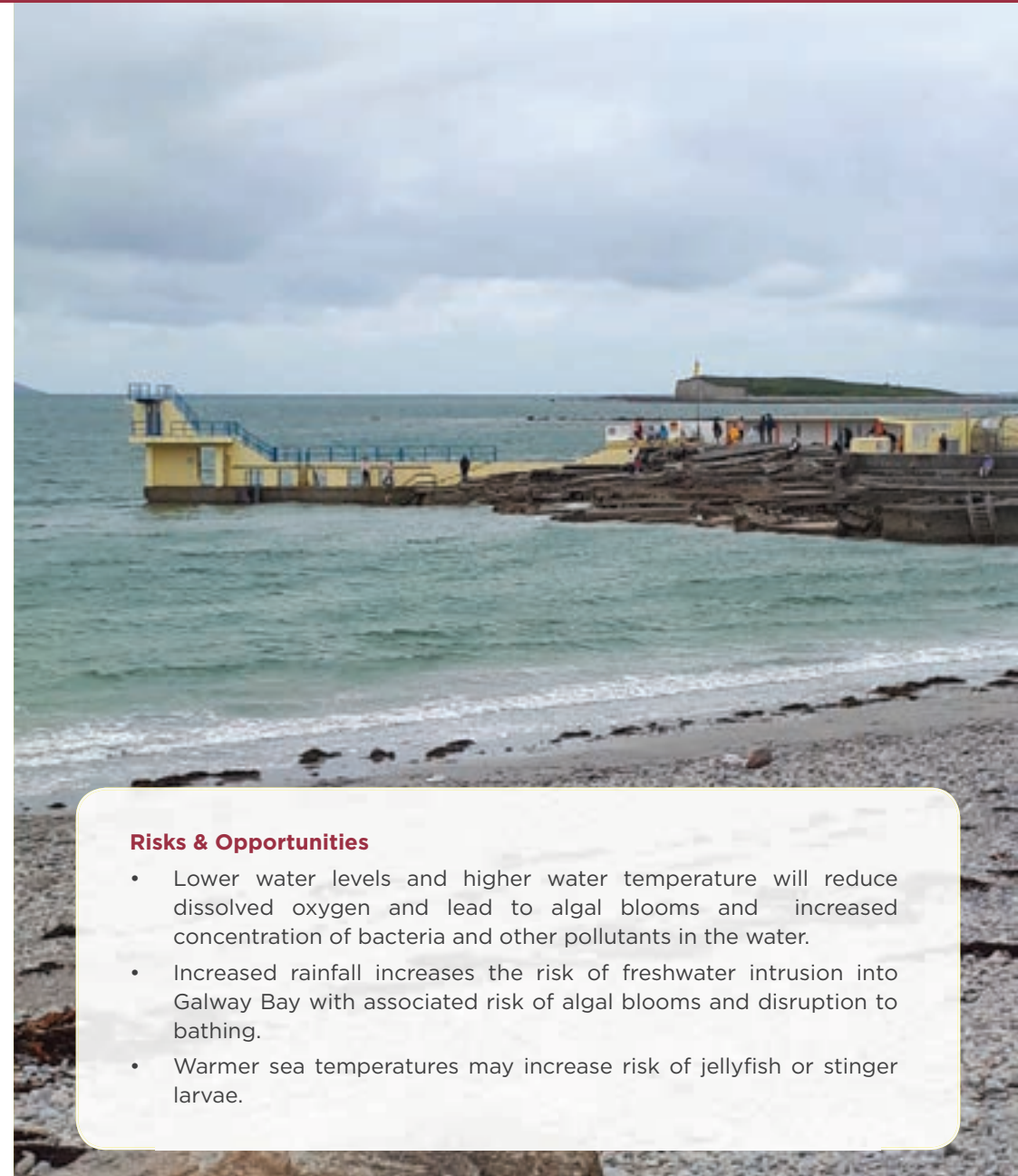
While increasing temperatures in Ireland are projected to occur in all seasons and time periods, it is likely that projected changes in the seasonal and spatial distribution of rain will present a much greater challenge for water quality.

An increase in the occurrence of river flooding is expected during winter months. In turn, the summer is likely to see more droughts resulting in low water flow.

Changes in seasonal water levels and the occurrence of extreme high and low flow events will have direct impacts on rivers, lake and coastal water quality. More regular flood events and intense rainfall patterns are expected to result in increased runoff and an increase in discharge of untreated material directly into waterways.

Flooding from rivers and runoff into Galway Bay has the potential for plumes of freshwater intrusion into coastal saltwater with an associated risks of migration of shellfish and microcystis bloom in Galway Bay impacting on beaches and swimming. Warmer coastal waters may impact on the abundance of species presenting nuisances to swimmers, including little jellyfish or stinger larvae .

It will be important to assess and manage these risks and ensure emergency and resilience plans minimise the risks.



## Risks & Opportunities

- Lower water levels and higher water temperature will reduce dissolved oxygen and lead to algal blooms and increased concentration of bacteria and other pollutants in the water.
- Increased rainfall increases the risk of freshwater intrusion into Galway Bay with associated risk of algal blooms and disruption to bathing.
- Warmer sea temperatures may increase risk of jellyfish or stinger larvae.

# FLOOD MANAGEMENT

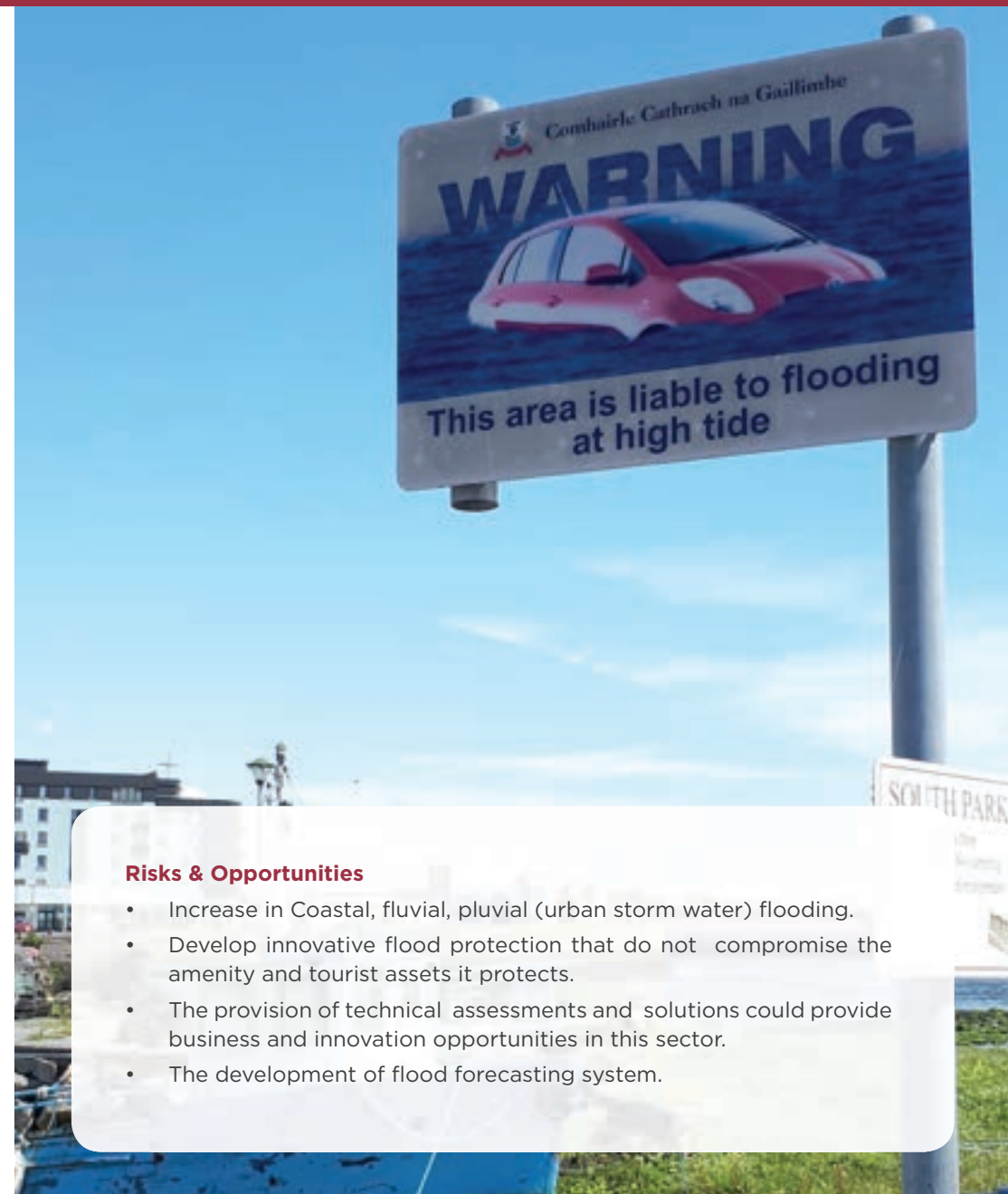
Due to rising sea levels and more intense rainfall projections, Galway City will face a greater risk of flooding, particularly from extreme and currently rare events.

**Galway City Council is working with the Office of Public Works to find adaptation solutions for protection of Galway City from Flooding.**

Communities and business operating in flood risk areas, are exposed to direct damage to buildings and assets, and indirect impacts on wellbeing, sales, supply chains and reputations. A better understanding of future flood risk and local impacts is needed for Galway City Council to develop appropriate adaptation measures. Galway City Council during recent flood events provided assistance to communities affected by flooding by collecting damaged goods and providing pumps and dehumidifiers.

## New Approach

The Water Framework Directive has resulted in a shift in our approach; away from site specific hard engineering solutions, towards an integrated assessment of water resources and flood management at the catchment scale. The capacity to adapt to greater extremes in hydrological conditions will depend on our ability to apply integrated decision making, together with technology and systems that are appropriate and sustainable.



### Risks & Opportunities

- Increase in Coastal, fluvial, pluvial (urban storm water) flooding.
- Develop innovative flood protection that do not compromise the amenity and tourist assets it protects.
- The provision of technical assessments and solutions could provide business and innovation opportunities in this sector.
- The development of flood forecasting system.

# COMMUNITY & BUSINESS SUPPORT SERVICES

## Community Engagement & Sports Partnership

Many of Galway City communities and sporting organisation vulnerable to climate change impacts are already dealing with climate change and have experience of adapting.

Galway City Council supports communities with grants and advice. There is an opportunity for engaging with communities on adaptation initiatives and supports through grant funding and awareness initiatives, through the established Public Participation Network and the Local Community Development Committee.

Galway City Council has a key role to play in developing and supporting community and sport initiatives. Raising awareness of the risks and opportunities likely with climate change will help increase community resilience to the risks and inform our approach to how communities and sport should adapt in the future.

## Local Enterprise Office

The Local Enterprise Office Galway is a service provided through a Service Level Agreement SLA between Enterprise Ireland and by Galway County Council and acts as “First Stop Shop” for anyone seeking information and support on starting or growing a business in Galway City.



### Risks & Opportunities

- Loss to productivity, economic confidence and wellbeing due to extreme events.
- Increased insurance premiums and inability to obtain insurance cover.
- Opportunity for growth of new economic programmes in tourism.
- Diversification of food production and growth in green economy/eco system services.
- Retailers that understand how weather affects sales and plan supply accordingly may benefit from climate-related impacts.
- Future increased volatility of commodity prices is expected in response to climate change impacts globally with opportunity to develop more local food production markets with changing climate conditions.
- Increased temperatures combined with increased periods of time spent outdoors could lead to increased vitamin D levels and improved individual physical and mental health.

# EMERGENCY MANAGEMENT

Galway City Council as the local authority for Galway City plays a pivotal role in planning for, and responding to, emergency situations. In managing climate risks and vulnerabilities, Galway City Council possess up-to-date knowledge of the local natural and man-made environment.

The role of emergency management in reducing current and future losses from floods is widely recognised however current resources and procedures may not be enough to address the climate events projected for the city.

Galway City Council's communication sections plays an important role, informing the public of warnings, advice during and after climate events. There is a risk that the out of hours call centre may be disrupted by national storm events.

The provision of Emergency Services for Galway City is provided by Galway County Council.

The projected increases in frequency and severity of extreme weather events will increase the likelihood of Emergency Response personnel being exposed to these greater risks. The severity of these risks needs to be part of the assessment of the appropriate response and the implementation of suitable controls and procedures to prevent risk of injury/death. Flooding, for example, can cause site contamination and increase the risk of illness from poisoning or infection.

A review of plans and resources is required to plan and prepare for localised incidents and catastrophic emergencies, to identify potential risks and produce emergency plans to either prevent or mitigate the impact of any incident on their local communities.



## Risks & Opportunities

- Increased risk to emergency staff in relation to climate related incidences e.g. high winds, flooding, forest and peatland/gorse fires.
- Increasing temperature places pressure on water supply and increases the risk of wild fires.
- Increased demand on staff and equipment due to weather related events.
- Opportunities to incorporate climate change resilience into emergency management plans.
- Increased risk to buildings, staff welfare and property damage associated with Fire Service Headquarters due to flooding
- Out of hours call centre may be vulnerable to national storm events.



# CORPORATE GOVERNANCE

## Facilities Management

Corporate Services manage City Council's offices and the Sandy Road Depot. Increased summer mean temperatures will affect the offices with an increased risks of overheating and increased requirements for cooling. It is expected that extreme weather events will be more frequent with associated office closures and disruption to services.

## Health and Safety

Workers in specific areas are more vulnerable to the health impacts of climate change because they may experience longer and more intense exposures to climate change related hazards. These changes have the potential to both directly and indirectly affect the health and well-being of workers.

## Increased Temperatures

Higher temperatures combined with longer and more frequent exposure to heat, will increase the risk of heat stress, air pollution, contraction of diseases such as Lyme's Disease and UV exposure, particularly among outdoor staff. This may lead to more cases of heat-related illnesses such as dehydration but can also have indirect impacts on injury caused by fatigue or negligence e.g. changes in the worker's emotional state, such as irritability. Overheating in buildings has also been identified as an issue during sunny and warm weather, as experienced in 2018. Thermal comfort for occupants of buildings during periods of warm weather may affect working efficiencies and the closure of workplaces in the future.

## Extreme Weather Events

Extreme weather events including flooding and storms, such as Storm Ophelia, which are projected to become more frequent and intense, can have multiple effects on occupational health and safety. These extreme events affect staff involved in emergency, rescue and clean-up efforts delivered in high risk situations due to more frequent floods, landslides, storms, droughts, and wildfires. These issues are likely to increasingly affect outdoor staff whose welfare will need to be considered through regular review of their activities. Policies to promote awareness of the health and safety effects of climate change will be developed with existing and future Safety and Health Plans taking account of climate change risks in their risk assessments.



### Risks & Opportunities

- Increased risks of overheating and increased requirements for cooling of offices.
- Increased frequency of offices closures leading to disruption of services.
- Opportunities for innovative and sustainable building services.
- Opportunity for engaging with communities on adaptation initiatives and supports through grant funding and awareness initiatives
- Failure to implement appropriate adaptation plans will lead to increased demand on resources e.g. staff and finance.
- Increased risk of health and safety issues for staff dealing with emergency situations.
- Greater adaptive capacity within the local governance sector will enhance operations and communities in Galway City

# AIR QUALITY - HEALTH & WELLBEING

Galway City Council plays a role in monitoring ambient air quality in Galway City and is working with the Environmental Protection Agency (EPA) on the National Ambient Air Monitoring Programme to monitor compliance with the requirements of the Clean Air For Europe (CAFE) Directive. Air Quality is affected by the emissions of air pollutants and weather conditions that can assist or hinder the dispersion of air pollutants. Strong westerly winds favours the effective dispersion of pollutants, are usually associated with strong Polar jet and cold Arctic region. The climate change projection from climate models cannot resolve the weather patterns that affect the dispersal of air pollutants. Blocking high pressure systems due to weakening polar jet may increase the likelihood of stagnation events.

## Winter

In the winter, blocking high pressure systems like the beast from the East in 2018, can lead to cold conditions with more air pollution from the burning of fossil fuels coupled with inversion conditions that result in increased concentrations of air pollution and poorer air quality.

## Summer

In the summer, more daylight, higher temperatures and drought conditions favour the photochemical production of Ozone (O<sub>3</sub>) at ground level in the presence of the air pollutant Nitric Oxide (NO) released from the combustion of fossil fuels. Increased mean temperatures can affect the ability of trees to mitigate air pollution by reducing the tree's capacity to absorb pollutants and increase biogenic emission of volatile organic compounds from vegetation and peatlands that interact to increase ozone production.

## Ground Level Ozone

- Exposure to high concentrations of ground level ozone causes chest pains, nausea and coughing in humans. Long term exposure to moderate concentrations causes a reduction in lung capacity and can worsen heart disease, bronchitis, emphysema and asthma.
- Ground Level ozone induces stress on trees thereby increasing the emissions
- Ozone contributes to the greenhouse effect and subsequent global climate change.

### Risks & Opportunities

- Win-Win Opportunities to reduce air pollution and mitigate climate change by reducing air pollution from transport and heating.
- Risk of Increase Ground Level Ozone in Summertime.
- Opportunities to collaborate with partners on EU funded research on air pollution and climate change.
- Opportunities to mitigate and adapt through Green Infrastructure.



# STEP 4: GOALS, OBJECTIVES & ACTIONS



STEP 1: PREPARING THE GROUND

STEP 2: BASELINE ASSESSMENT

STEP 3: FUTURE CLIMATE RISKS

STEP 4: GOALS, OBJECTIVES & ACTIONS

STEP 5: IMPLEMENTATION

# OUR VISION FOR A CLIMATE RESILIENT GALWAY CITY

Galway City Council is already taking steps to improve energy efficiency and to reduce our carbon emissions, as part of the global fight against climate change.

While working to reduce our greenhouse gas emissions, our city must also prepare for the unavoidable impacts of climate change. The decisions and actions we take over the coming years to adapt will determine how we live with climate change in years to come.

## Our Vision for A Climate Resilient Galway City

**A Regional City that understands how climate change will affect the region, our businesses and communities, and actively works together to reduce our exposure to climate risks and to capture new opportunities**

A climate awareness programme and communication strategy has helped the public understand the reasons and benefits of adaptation improvements.

Galway City is building a reputation as a champion in climate adaptation (and mitigation), drawing international attention, and availing of funding and investment opportunities.

Empowered communities, responsible businesses and public sector organisations work together in trust and partnership to shape how the city develops.

As Galway City faces new challenges and opportunities, all parties collaborate to make sure climate resilience is taken into account in plans, policies and investment decisions.

STEP 1: PREPARING THE GROUND

STEP 2: BASELINE ASSESSMENT

STEP 3: FUTURE CLIMATE RISKS

STEP 4: GOALS, OBJECTIVES & ACTIONS

STEP 5: IMPLEMENTATION



## OUR VISION FOR A CLIMATE RESILIENT GALWAY CITY

### CRITICAL INFRASTRUCTURE & BUILDINGS

Disruption to critical infrastructure is kept to a minimum despite an increase in extreme rainfall, storm events and sea level rise.

Smarter and sustainable transport continues to grow in Galway City, reducing pressure on the road network infrastructure, improving health and allowing for essential travel and haulage has become more efficient. Proactive road maintenance ensures road surfaces and foundations are resilient to new climate pressures.

New developments combine cutting edge technologies to create demonstration sites and new buildings that are climate resilient and deliver co-benefits for carbon reduction efforts, linking climate adaptation and mitigation.

## Goal 1

Increase the resilience of Critical Infrastructure & Buildings to climate change by planning and implementing appropriate adaptation measure.

### OBJECTIVES

- Integrate climate change and climate adaptation into the City and Local Area Development Plans.
- Ensure Future infrastructure and buildings are planned and built in consideration of future flood risk projections.
- Develop an Integrated Coastal Zone Management Plan.
- Capture Data on Impacts of Extreme Climate Events and Map Climate Impacts and Risks.
- Carry out a risk assessment of the likely impacts of climate change and their effect on key infrastructure, use it to inform adaptation policy.
- Increase Resilience of Buildings
- Mitigate Overheating of City Council Buildings (High Internal Temperatures due to Solar and Internal Gains)



## OUR VISION FOR A CLIMATE RESILIENT GALWAY CITY

### NATURAL & CULTURAL HERITAGE

Wildlife corridors are maintained and protected to help animals move safely around the city and increase ecosystem resilience.

Important historical buildings and heritage sites are maintained and protected to take account of the changing climate, safeguarding the Galway City's heritage without altering its character and significance.

A vibrant city that welcomes visitors and has seized the opportunities afforded by changing tourism patterns and made sure its many festivals and celebrations are climate resilient. Key events in Galway City's cultural and festival calendar are prepared for more frequent extreme weather, safeguarding the city's status as a destination.

## Goal 2

Increase the resilience of Natural & Cultural Heritage to climate change by planning and implementing appropriate adaptation measure.

### OBJECTIVES

- Build Awareness of Nature Based Adaptation Solutions.
- Support and Conserve Biodiversity for its intrinsic value within the Natural Environment and its interaction with the Climate.
- Integrate Climate Change into the Invasive Species Management Plan.
- Promote Green Infrastructure.
- To Protect and Exploit Benefits in relation to Tourism and Natural and Cultural Capital.



## OUR VISION FOR A CLIMATE RESILIENT GALWAY CITY

### WATER RESOURCES & FLOOD RISK MANAGEMENT

A City with waterways, coastal waters and beaches with Excellent water quality, achieved through regular monitoring of water quality and the implementation of adaptation measures.

A City with resilient water and wastewater networks, achieved by working with Irish Water.

A City that is resilient to flooding and sea level rise, achieved by working with the Office of Public Works and through informed decision making, investing in targeted flood protection measures, early warning systems reducing the potential of flooding and damage.

A City that through land use planning, green infrastructure and catchment management of the River Corrib with Galway County Council enables water to flow through the city in a controlled manner during extreme rainfall events.

Adaptation of Recreational Amenities in the Coastal Area, Beach management and Water Safety to ensure the continued enjoyment of Galway City's coast.

## Goal 3

Increase the resilience of Water Resources and Flood Risk Management to climate change by planning and implementing appropriate adaptation measure.

### OBJECTIVES

- Mitigate the Risk and Impact of Flooding.
- Manage Surface Water Drainage Risk for Extreme Rainfall Events.
- Capture Data on Impacts of Extreme Rainfall Events on Water Resources.
- Mitigate Surcharging of Combined Sewers.
- Protect Water Supplies.
- Adapt the Recreational Use of Beaches and Coastal Amenities



## OUR VISION FOR A CLIMATE RESILIENT GALWAY CITY

### COMMUNITY SERVICES

Climate opportunities and risks are well communicated within the organisation and the communities it serves.

Businesses are benefiting from early identification of vulnerabilities, and investment in adaptation measures. Galway City is building a reputation for resilience, increasing confidence among citizens and investors, and encouraging new businesses to make Galway City their home.

The City continues to be Healthy Place for people with reduced air pollution from transport and heating from combustion of fossil fuels and solid fuels, while mitigating climate change through the reduction of greenhouse gases.

## Goal 4

Increase the resilience of Community Services to climate change by planning and implementing appropriate adaptation measure.

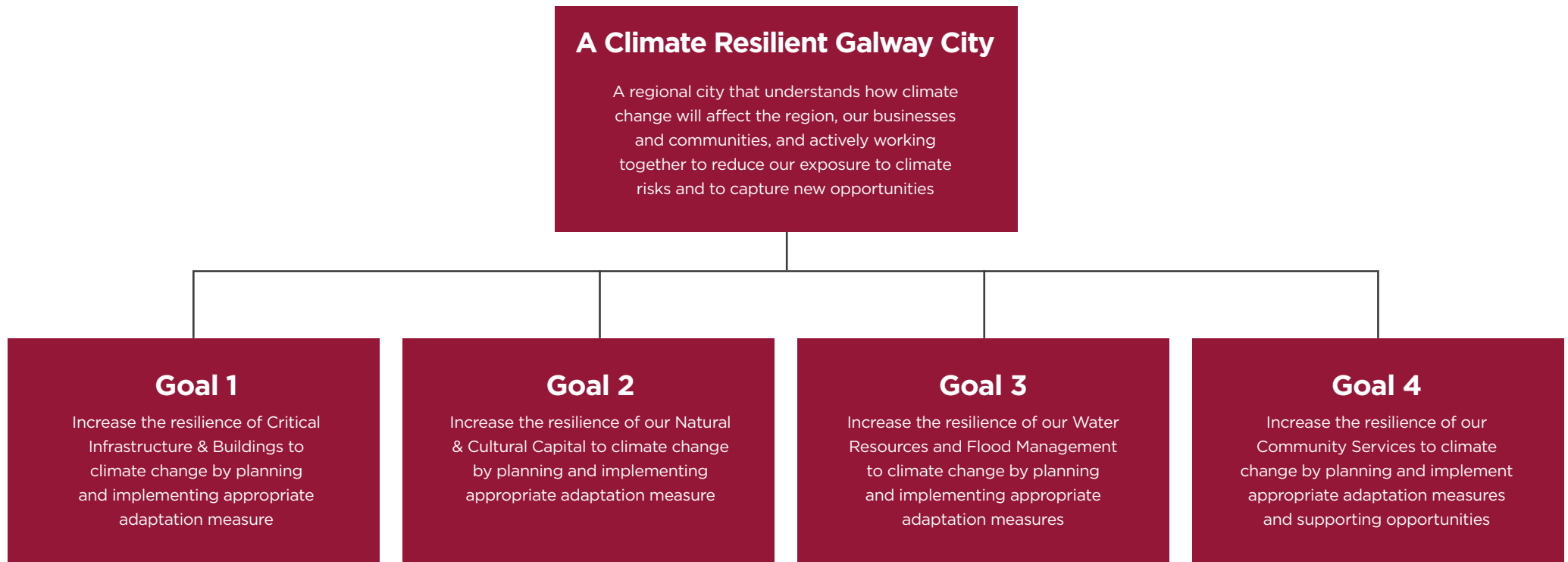
### OBJECTIVES

- Prepare Business Continuity Plan for Galway City Council.
- Increase Awareness of Climate Change.
- Increase Resilience in Emergency Response Plans.
- Support Community and Voluntary Sector Climate Action Projects.
- Integrate Climate Change into Festivals and Events.
- Promote Opportunities & Support Business.
- Increase Awareness of the Health Issue of Lyme Disease.
- Ensure that Galway City continues to be a Healthy Place with Excellent Air Quality



# GOALS FOR A CLIMATE RESILIENT GALWAY CITY

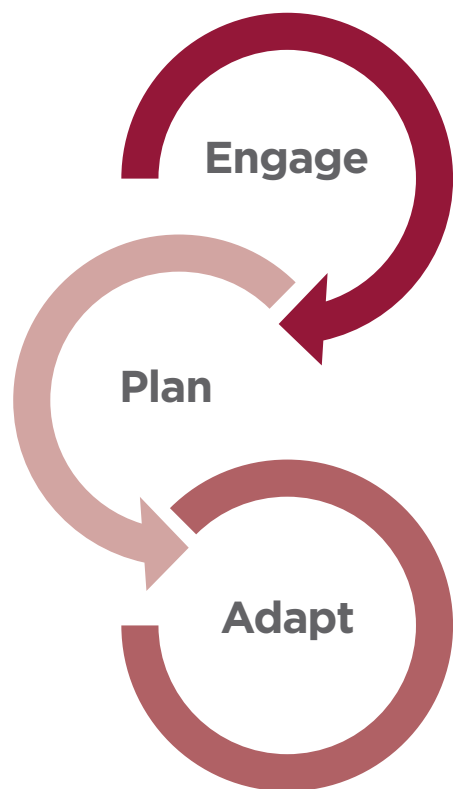
This first Climate Adaptation Strategy for the City is a starting point on our adaption journey towards a Climate Resilient Galway City. To achieve a Climate Resilient Galway City, four Goals have been identified under this first Strategy, which are high level long-term statements



# OBJECTIVES TO MEETING THE ADAPTATION GOALS

The four Goals are high level long term statements, while the Objectives define strategies or implementation steps to attain the identified Goals. The Objectives are common across all four Goals and set out the steps to implementing the Strategy.

## Objectives



### Engage

Improve education, awareness-raising and capacity on climate change, adaptation (and mitigation), impact reduction and early warning across the Local Authority departments, businesses, communities and individuals

### Plan

Integrate climate action measures into policies, strategies and planning, as well as the identification of areas at risk to inform planning and decision-making

### Adapt

Strengthen resilience and adaptive capacity, and develop and implement co-ordinated responses to climate risk where needed

# ADAPTATION ACTIONS

The Goals and Objectives of the Adaptation Strategy provide an overarching framework for climate adaptation planning in Galway City.

The development of specific Actions under each of the Goals and Objectives of this current 5-year Strategy is the next step in this process, which will enable the Climate Ready journey at Galway City Council.

The Actions have been divided across the 4 Goals, with an additional category added for governance of the Adaptation Strategy.

## Action Timeframes

The Adaptation Actions will be implemented in the Short (5 years or less), Medium (greater than 5 and less than 10 year) and Long term (greater than 10 years).

Many of the early Actions are centred around awareness, training, and updating policies, procedures and plans to take account of climate projections and impacts. In Preparing the initial Implementation Plans for Adaptation Actions, the Climate Adaptation Implementation Group can accelerate the delivery of Prioritised short timeframe Adaptation Actions within a timeframe of 3years or less. For those measures for implementation in the medium and long terms some Actions have been identified to gather data and build a better understanding of impacts in the short term.



# ACTION PLAN:



# ACTION PLAN: GOVERNANCE & SUPPORT

## Governance & Support

**Objective: To Put in Place Governance and Support Structures for Monitoring and Implementation of the Adaptation Strategy.**

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
1	Engage / Plan / Adapt	<p><b>Climate Adaptation Implementation Group</b> To ensure that the Goal, Objectives and Actions are achieved, establish a dedicated Adaptation Implementation Group to ensure the successful implementation of the Galway City Climate Adaptation Strategy. Climate Adaptation Implementation Group will manage and oversee the delivery of the Adaptation Actions and the mainstreaming of Climate Adaptation into all plans, programmes, strategies and policies of Galway City Council.</p> <p>In addition, a Climate Adaptation Monitoring Group will be established as a sub-committee of the Climate Change, Environment and Recreation Strategic Policy Committee to include both elected and sectoral representatives from the SPC. Terms of reference for the Monitoring Group will be agreed</p>	Short	✘	Senior Management Team	CARO, Sectors named in the National Adaptation Framework
2	Engage / Plan / Adapt	<p><b>Corporate Plan</b> Include the objective of Climate Adaptation as a Strategic Goal of the Corporate Plan.</p>	Short	✓	Corporate Services	CARO, Senior Management Team
3	Engage / Plan / Adapt	<p><b>Annual Reporting</b> Monitor and report on progress. Prepare an annual progress report on the Strategy which will be submitted to the Council with the Annual Report</p>	Short	✘	Senior Management Team	CARO
4	Engage / Plan	<p><b>Capturing Costs of Climate Events</b> Develop procedures and templates to ensure that the financial aspects of extreme weather are collated, recorded and reported to operational and senior management team</p>	Short	✓	Finance	All Departments, CARO
5	Engage	<p><b>Communication and Stakeholder Engagement on the Climate Adaptation Strategy</b> Communication and Stakeholder Engagement on Climate Adaptation Strategy Public Information Events and Public Consultation to be held as required</p>	Short	✘	Environment and Climate Change	CARO

\* Included in Existing Service Delivery Plans

# ACTION PLAN: INFRASTRUCTURE

## Critical Infrastructure and Buildings

### Objective 1: To integrate climate change and climate adaptation into the City and Local Area Development Plans

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
1	Engage/ Plan	Integrate climate change and the Climate Adaptation Strategy (and mitigation) into the City Development Plan, and apply planning policies to reduce the vulnerability of Galway City Council to the impacts of climate change. (Review of Existing City Development Plan due to commence 2021)	Short	✓	Planning Department	Dept. of Housing, Planning & Local Government, Northern & Western Regional Assembly
1-2	Engage/ Plan	Integrate climate change and the Climate Adaptation Strategy (and mitigation) into Local Area Plans, and apply planning policies to reduce the vulnerability of Galway City Council to the impacts of climate change.	Medium	✓	Planning Department	

### Objective 2: To Ensure Future infrastructure and buildings are planned and built in consideration of future flood risk projections

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
2-1	Engage	Review and update periodically the flood risk zones for coastal, fluvial, pluvial and groundwater flood to ensure that they take account of projected climate change, OPW flood maps, local knowledge and events, research and other sources of data to inform planning decisions	Short	✗	Eniornment & Climate Change	OPW, CARO, Marine Institute, Met Eireann, Communities, Elected Members
2-2	Plan	Ensure site specific Flood Risk Assessments are prepared for new infrastructure and buildings that inform planning decisions and suitable adaptation requirements in line with the guidelines on the planning System and Flood Risk Management in accordance with the recommendations of Galway City Development Plan's Strategic Flood Risk Assessment.	Short	✓	Planning Department	
2-3	Adapt	Ensure urban storm water drainage systems for new development take into account the potential future impacts of climate change in their designs, particularly the projected increase in intense rainfall events, and include the use of sustainable drainage systems.	Short	✓	Planning Department	

\* Included in Existing Service Delivery Plans

# ACTION PLAN: INFRASTRUCTURE

## Critical Infrastructure and Buildings

### Objective 3: To develop an Intergrated Coastal Zone Management Plan

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
3-1	Engage	Engage stakeholders to identify how Galway City can adapt to increased coastal flood and erosion risk.	Short	✓	Environment & Climate Change	DHPLG, DAFM, DCHG, DCCAIE, Academia, Marine Institute, DTTAS, EPA, OPW, GSI, NPWS
3-2	Engage	Assess the potential impacts of climate change in term of sea level rise (OPW High-End Future Scenario), wave heights and storm surge, on Galway City's coastal zone. Coastal Zone includes critical infrastructure, beaches, natural features, habitats of coastal ecosystems (Galway Bay SAC/ SPA), existing coastal protection structures, tourism, private property, legacy landfill sites.	Short	✗	Environment & Climate Change	
3-3	Plan	Develop Guidance and Policies for the coastal protection of Galway City's high value amenity and tourist assets, its critical infrastructure and the preservation, enhancement and development of protected habitats of coastal ecosystems.	Medium	✗	Environment & Climate Change	
3-4	Plan/ Adapt	Develop an Integrated Coastal Zone Management Plan for Galway City to ensure new developments take account of future risk from coastal erosion/storm surges and sea level rise, including the identification and restriction of development in coastal erosion zones where appropriate, and ecosystem based adaptation actions to manage climate risk and build resilience to climate change.	Medium	✗	Planning Department	

### Objective 4: To Capture Data on Impacts of Extreme Climate Events and Map Climate Impacts and Risks

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
4-1	Engage	Record the full impacts of extreme climate events on Galway City, including areas and infrastructure impacted, people/ communities affected, resources deployed during and after the event.	Short	✗	Environment & Climate Change	All Departments, ICT, CARO, Academia
4-2	Plan	Work with CARO to setup and maintain a GIS database for the capture and mapping of data of Climate Impacts and map- ping and identification of Climate Risks.	Short	✗	Environment & Climate Change	
4-3	Plan/ Adapt	Develop a reporting and information sharing system that allows for the assessment of the full impacts of climate change and supports a true economic evaluation of adaptation projects in the future.	Short	✗	Environment & Climate Change	

\* Included in Existing Service Delivery Plans

# ACTION PLAN: INFRASTRUCTURE

## Critical Infrastructure and Buildings

**Objective 5: To Carry out a risk assessment of the likely impacts of climate change and their effect on key infrastructure, use it to inform adaptation policy**

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
5-1	Engage	Develop a register of road infrastructure at risk from existing and projected climate events.	Short	X	Transport Department	TII, Galway County Council
5-2	Engage	Develop a register of Galway City Council's Information and Communication Systems (including Galway Traffic Management System) at risk from existing and projected climate events.	Short	X	ICT	Transport Department, Corporate Services, Water Services
5-3	Plan	Put in place a monitoring plan to inspect the integrity of Galway City Council's existing road infrastructure, particularly elements at risk from extreme events, to determine their physical condition, and ability to deal with projected climate change.	Short	X	Transport Department	TII
5-4	Adapt	Identify backup and contingency plans for climate events that have the potential to impact Information and Communication Systems, the failure of which would have major consequences and/or a cascading effect on other services.	Short	X	ICT	Transport Department, Corporate Services, Water Services
5-5	Adapt	Identify and implement any operational measures to protect critical road infrastructure/equipment to reduce the risk/ impact from climate events, and develop necessary maintenance/upgrade programme to prolong the lifespan and address climate risk.	Short	X	Transport Department	TII

\* Included in Existing Service Delivery Plans



# ACTION PLAN: INFRASTRUCTURE

## Critical Infrastructure and Buildings

### Objective 6: To Increase Resilience of Buildings

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
6-1	Engage	Increase awareness of homeowners to potential impacts from climate change events and how best to look after their home to avoid or reduce impacts. This is to include updating the tenant's handbook and the online communication and social media plan to provide the necessary climate change adaptation and mitigation information.	Short	✓	Housing	Dept. of Housing, Planning & Local Government, SEAI
6-2	Engage	Assess the vulnerability of the City Council's Social housing stock to climate events, such as flooding or storms.	Short	✓	Housing	
6-3	Engage	Assess the vulnerability of Council buildings to climate events, such as flooding or storms. Carry out a risk assessment of the likely impacts of climate change and their effect on Council owned and leased Buildings, use it to inform adaptation policy.	Short	✗	Corporate Services	Recreation and Amenity, Economic Development and Culture.
6-4	Engage/ Plan /Adapt	Review maintenance and repair standards, frequency and procedures for City Council housing stock and City Council owned/leased buildings to address the expected increase in risk of structural deterioration during extreme events.	Short	✓	Housing & Corporate Services	

### Objective 7: To Mitigate Overheating of City Council Buildings (High Temperatures due to Solar and Internal Gains)

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
7-1	Engage	Desktop assessment of overheating risk of City Council buildings to increased summer temperatures and risks of Overheating and increased Cooling Energy Requirements. The assessment to include a Cost Benefit Analysis of options for mitigating overheating of the City Council's Buildings	Medium	✗	Housing & Corporate Services	Recreation and Amenity, Economic Development and Culture.
7-2	Adapt	Optimise ICT Systems in City Council Buildings to minimise cooling energy consumption balanced against Business Requirements.	Medium	✗	Corporate Services	ICT
7-3	Plan/ Adapt	Prepare an Action Plan for the adaptation of City Council buildings vulnerable to overheating.	Medium	✗	Housing & Corporate Services	
7-4	Adapt	Develop a policy and pilot project on mitigation of overheating of City Council Buildings; including green infrastructure (e.g. shading with trees, green roofs etc.)	Medium	✗	Corporate Services	

\* Included in Existing Service Delivery Plans



# ACTION PLAN: NATURAL & CULTURAL

## Natural and Cultural Capital

### Objective 1: To Build Awareness of Nature Based Adaptation Solutions

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
1-1	Engage	Develop and implement an awareness campaign around the role of the natural environment and its positive contribution to Climate Action (adaptation & mitigation) * including updating the Website <a href="http://www.galwaybiodiversity.com">www.galwaybiodiversity.com</a> to provide information on Climate Change, mapping of habitats and carbon sinks	Short	X	Recreation and Amenity	Recreation and Amenity Department, EPA, NPWS, National Biodiversity Data Centre, Academia, Department of Culture, Heritage and the Gaeltacht, Arts Office, Community Office, PPN, ICT Department
1-2	Engage	Encourage the use of information boards at amenity, tourism, wilderness, natural landscape, cultural heritage and other appropriate locations across Galway city to bring awareness and encourage respect of the benefits of natural environment and its role in Climate Action.	Short	X	Recreation and Amenity	

\* Identify and promote nature based solutions as potential low cost win-win climate change adaptation and mitigation solutions to;

- Mitigate the effect of extreme weather events - reduce the impact of heavy rain and floods, improve the effectiveness of SUDs, improve air quality, and help reduce the urban heat effect through tree planting
- Help nature to adapt to climate change by strengthening habitat networks,
- Reduce habitat fragmentation and provide opportunities for species to migrate
- Promote the restoration of natural processes as a means of increasing resilience
- Research and map areas considered beneficial for use as local carbon offset through carbon sequestration.

\* Included in Existing Service Delivery Plans

# ACTION PLAN: NATURAL & CULTURAL

## Natural and Cultural Capital

### Objective 2: To Support and Conserve Biodiversity for its intrinsic value within the Natural Environment and its interaction with Climate

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
2-1	Engage/ Plan	Review and update the Galway City Biodiversity Action Plan 2014 - 2024 to ensure that: a) The risks from current and projected climate change have been identified. b) These risks are addressed, and wherever possible incorporate adaptation measure c) The carbon capture within habitats is considered d) An examination of the changes of seasonality are considered	Short	✓	Recreation and Amenity	EPA, NPWS, National Biodiversity Data Centre, Academia, Department of Culture, Heritage and the Gaeltacht, ICT
2-2	Engage/ Plan	Support Biodiversity through Natural Pollination a) Review the National Pollinator Plan to explore how Galway City Council can support a diversity of plant species to increase food sources and habitats for pollinators with the outcome of a policy and procedure for supporting pollination. b) Explore ways to reduce the impact of a longer growing season on lifecycles of bees and other pollinators in terms of food availability and lifecycles mismatch in select areas in consultation	Short	✗	Recreation and Amenity	
2-3	Adapt	Work with the Department of Culture, Heritage and the Gaeltacht to enhance and restore natural systems through management to increase resilience - starting with pollination and Open Spaces owned by Galway City Council	Short	✗	Recreation and Amenity	
3-4	Engage	Database of Impacts on the Natural Environment  Establish and develop an evidence database of ecosystem health measures and indicators of the effects of climate change, and their impact on the natural environment, that will inform adaptation policy and management.	Medium	✗	Recreation and Amenity	

\* Included in Existing Service Delivery Plans

# ACTION PLAN: NATURAL & CULTURAL

## Natural and Cultural Capital

### Objective 3: To Integrate Climate Change into the Invasive Species Management Plan

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
3-1	Engage/ Plan	Update the Invasive Species Management Plan to ensure that; the relevant risks from current and projected climate change have been identified; invasive species whose spread is linked with climate change are identified; and appropriate management techniques for their control are developed.	Short	✓	Recreation and Amenity	All Departments, EPA, NPWS, Invasive Species Ireland, private landowners, OPW, TII, Lough Corrib Navigation
3-2	Engage/ Plan	Establish a programme to monitor the spread of terrestrial, aquatic and marine invasive species in a changing climate and control, invasive species where their spread is considered problematic	Medium	✗	Recreation and Amenity	

### Objective 4: To Promote Green Infrastructure

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
4-1	Plan	City Development Plan. Include planning policies, objectives and guidelines in the City Development Plan to promote green infrastructure to:- a) Reduce Urban Flooding and River (Fluvial Flooding) b) Strengthen habitat networks and prevent habitat fragmentation.	Short	✗	Planning Department	Environment and Climate Change Department, EPA, NPWS, CARO, private landowners, Department of Culture, Heritage and the Gaeltacht
4-2	Plan/ Adapt	Develop a Policy on Green Infrastructure to improve Air Quality and Climate Change Mitigation. a) Planting of species of trees suitable for improving air quality in the urban environment with warmer mean temperatures, i.e. lower emissions of volatile organic compounds to reduce ground level ozone. b) Planting trees as Carbon Sinks.	Short	✗	Recreation and Amenity	

\* Included in Existing Service Delivery Plans

# ACTION PLAN: NATURAL & CULTURAL

## Natural and Cultural Capital

### Objective 5: To Protect and Exploit Benefits in relation to Tourism and Natural and Cultural Capital

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
5-1	Engage	Ensure that the Galway City Tourism Strategy includes adaptation measures for risks of extreme climate events and projected climate change.	Short	✓	Economic Development and Culture	
5-2	Engage	Carry out an analysis of potential impacts of climate change and adaptation/mitigation measures on natural, heritage, cultural and amenity sites relevant to tourism, including key tourist areas of interest in the City, festivals, beaches, accommodation, museums and theatres.	Short	✗	Economic Development and Culture	Environment and Climate Change, Transport Department, Recreation and Amenity
5-3	Engage	Work with Fáilte Ireland to develop projections for future growth of visitors due to warmer average temperatures and extended tourist season into the shoulder periods of April/ May and October.	Medium	✗	Economic Development and Culture	Fáilte Ireland, CARO

\* Included in Existing Service Delivery Plans

# ACTION PLAN: WATER & FLOODING

## Water Resources and Flood Risk Management

### Objective 1: To mitigate the risk and impact of flooding

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
1-1	Engage/ Plan /Adapt	Roll out Major and Minor Flood Protection and Flood Proofing Measures for Galway City over the short, medium and long term in conjunction with the OPW.	Short	✓	Environment & Climate Change	OPW, CARO, Academia, Marine Institute, Met Eireann, EPA, Climate Ireland
1-2	Engage/ Plan /Adapt	Identify, assess and develop multi-annual maintenance programmes, in conjunction with the OPW, for watercourses and coastlines where such works would substantially reduce flood risk.	Short	✓	Environment & Climate Change	OPW, Lough Corrib Navigation, private landowners

### Objective 2: To manage Surface Water Drainage Risk for Extreme Rainfall Events

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
2-1	Engage	Identify and map areas prone to surface water and groundwater flood risk.	Short	✗	Transport Department	Water Services, Irish Water
2-2	Engage	Assess impact of climate change on surface water pumping.	Medium	✗	Transport Department	
2-3	Plan	Develop Surface Water Management Plans to manage surface water flood risks in the areas identified.	Medium	✗	Transport Department	
2-4	Adapt	Prioritise and implement Surface Water Management Plans/ Projects on a risk basis.	Medium	✗	Transport Department	

### Objective 3: To Capture Data on Impacts of Extreme Rainfall Events on Water Resources

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
3-1	Engage	Monitor water quality before and after climate events to build an understanding of how extreme rainfall events impact on water quality (including freshwater intrusion into Galway Bay, Lough Atalia and other waters, direct runoff of pollutants including plastics, overflows from CSOs and EOs, leachate lagoons)	Short	✓	Environment & Climate Change	LAWCO, EPA, Irish Water, Inland Fisheries, Sea Fisheries Protection Ireland, Lough Corrib Navigation

\* Included in Existing Service Delivery Plans

# ACTION PLAN: WATER & FLOODING

## Water Resources and Flood Risk Management

### Objective 4: To mitigate Surcharging of Combined Sewers

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
4-1	Engage/ Plan /Adapt	Work with Irish Water to identify combined sewers that are at risk of surcharging during extreme rainfall events, and develop suitable solutions.	Medium	✓	Water Services	Irish Water

### Objective 5: To Protect Water Supplies

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
5-1	Engage	Work with and support Irish Water in order to maintain water quantity and quality levels.	Short	✓	Water Services	Irish Water, Galway County Council
5-2	Engage	Work with Irish Water to identify impacts of power outages of varying durations on specific Water and Wastewater Scheme operations, and identify critical and vulnerable receptors.	Short	✓	Water Services	
5-3	Plan/ Adapt	Liaise, support and work with Irish Water in the development, conservation and upgrade of the water supply systems so as to ensure that Galway City has an adequate supply of water to address climate change demands.	Medium	✓	Water Services	

### Objective 6: To Adapt the Recreational Use of Beaches and Coastal Amenities

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
6-1	Engage/ Plan /Adapt	Prepare an adaptation plan for management of beaches, lifeguards and amenities to plan for the opportunities of longer bathing season, higher average summer temperatures, increased visitors, change in water temperatures and the climate change risks of increased algal blooms, storm debris, jellyfish, poor water quality.	Medium	✗	Recreation and Amenity	GCC Environment and Climate Change, Water Safety Ireland, EPA, Marine Institute, Irish Water, HSE

\* Included in Existing Service Delivery Plans





# ACTION PLAN: COMMUNITY SERVICES

## Community Services

### Objective 1: To Prepare Business Continuity Plan for Galway City Council

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
1-1	Plan	<p><b>Business Continuity Plan</b></p> <p>Develop Business Continuity Plan to identify and address the impacts associated with extreme weather events on all functions/services of Galway City Council and put in place measures to maintain an acceptable level of service.</p>	Short	✓	Corporate Services	All Departments

### Objective 2: To Increase Awareness of Climate Change

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
2-1	Engage	<p><b>Internal Awareness Training</b></p> <p>Develop a Climate Change and Adaptation Training Program to educate staff and provide a basic understanding of the projected range of changes in temperature and precipitation, the increase in the frequency and magnitude of extreme weather events for their region and how these changes may affect the LA's assets and operations.</p>	Short	✗	Environment & Climate Change	CARO, DCCAE, EPA, Climate Ireland, Academia
2-2	Engage	<p><b>Community Awareness Campaign</b></p> <p>Through Public Participation Network (PPN) and working with relevant agencies and schools, develop a Climate Change awareness campaign to inform the public of the projected range of changes and their impacts, and identify mitigation and adaptation priorities through an inclusive stakeholder consultation process.</p>	Short	✗	Environment & Climate Change	LCDC, CARO, DCCAE, EPA, Climate Ireland, Academia, Galway City Community Network - the Public Participation Network in Galway City

### Objective 3: To Increase Resilience in Emergency Response Plans

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
3-1	Plan	Review and update the Emergency Response Plans to take account of the changing climate, frequency and severity of climatic events.	Short	✓	Transport Department	Housing, Civil Defence, HSE, Gardai, Met Eireann
3-2	Plan	Ensure that Flood Emergency Response Plans are reviewed annually to reflect the increasing flood risk, flood alert systems, communications strategy and the resource capacity required to provide an effective response	Short	✓	Transport Department	

\* Included in Existing Service Delivery Plans

# ACTION PLAN: COMMUNITY SERVICES

## Community Services

### Objective 4: To Support Community and Voluntary Sector Climate Action Projects

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
4-1	Engage	Identify funding streams for local climate action projects and support communities and voluntary sector in developing and implementing climate adaptation projects at local level.	Short	✗	Environment & Climate Change	CARO, SEAI

### Objective 5: To Integrate Climate Change into Festivals and Events

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
5-1	Plan	Integrate climate change considerations in the planning and development stage for festivals/ events, and consider contingency planning for extreme weather events.	Short	✓	Economic Development and Culture	Met Eireann, CARO, Planning Dept.

### Objective 6: To Promote Opportunities & Support Business

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
6-1	Engage	Identify funding streams for the active implementation of adaption actions that will contribute both environmentally and economically to Galway City and support the appropriate sections of the Council to access these resources.	Short	✓	Economic Development and Culture	CARO, SEAI, DCCA, EPA, Climate Ireland, NWRA, European Commission, IDA, Enterprise Ireland, IBEC, Chamber of Commerce, Science Foundation
6-2	Engage	Galway Local Enterprise Office to support business by signposting clients to the funding streams for climate action measures, supporting the awareness programmes by communicating and promoting them to clients, and supporting relevant projects for funding as part of the LEO financial instruments.	Short	✗	Galway Local Enterprise Office (LEO)	

### Objective 7: To Increase Awareness of the Health Issue of Lyme Disease

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
7-1	Engage	Raise awareness of Lyme Disease and the potential impact of climate change and biodiversity on its prevalence. Information to be provided to the public through the Website <a href="http://www.galwaybiodiversity.com">www.galwaybiodiversity.com</a> , Galway City Council's notice boards at forests/parks and participation in the Lyme Disease Awareness Day.	Medium	✗	Recreation and Amenity	CARO, HSE, HSE health protection surveillance Centre (HPSC), Department of Agriculture, Food and the Marine, Department of Health

\* Included in Existing Service Delivery Plans

# ACTION PLAN: COMMUNITY SERVICES

## Community Services

### Objective 8: To Ensure that Galway City continues to be a Healthy Place with Excellent Air Quality

No	Objective Steps	Actions	Action Timeframe	Budgeted	Lead	Relevant Partners
8-1	Engage	Increase awareness of the impacts of burning fossil fuels on Air Quality, Climate Change and Human Health.	Short	X	Environment & Climate Change	Climate Ireland, CARO, EPA, NUIG
8-2	Plan/ Adapt	Develop policies to reduce air pollution from road vehicles, which promote a modal shift to cycling, public transport and support the decarbonisation of road vehicles.	Medium	X	Environment & Climate Change	
8-3	Plan/ Adapt	Develop policies to reduce air pollution from burning fossil fuels for home heating and illegal burning of waste, which support the decarbonisation of heating while providing a Just Transition in terms of dealing with Fuel Poverty.	Medium	X	Environment & Climate Change	

\* Included in Existing Service Delivery Plans

# STEP 5: IMPLEMENTATION



STEP 1: PREPARING THE GROUND

STEP 2: BASELINE ASSESSMENT

STEP 3: FUTURE CLIMATE RISKS

STEP 4: GOALS, OBJECTIVES & ACTIONS

STEP 5: IMPLEMENTATION

# IMPLEMENTATION, MONITORING & REPORTING

The preparation of this Climate Adaptation Strategy is the start of an iterative process that will deliver a wide range of actions and measures to adapt Galway City to the impacts of climate change. The Strategy is the start of an in-depth, long-term process to ensure Galway City evolves to be a Climate Resilient City.

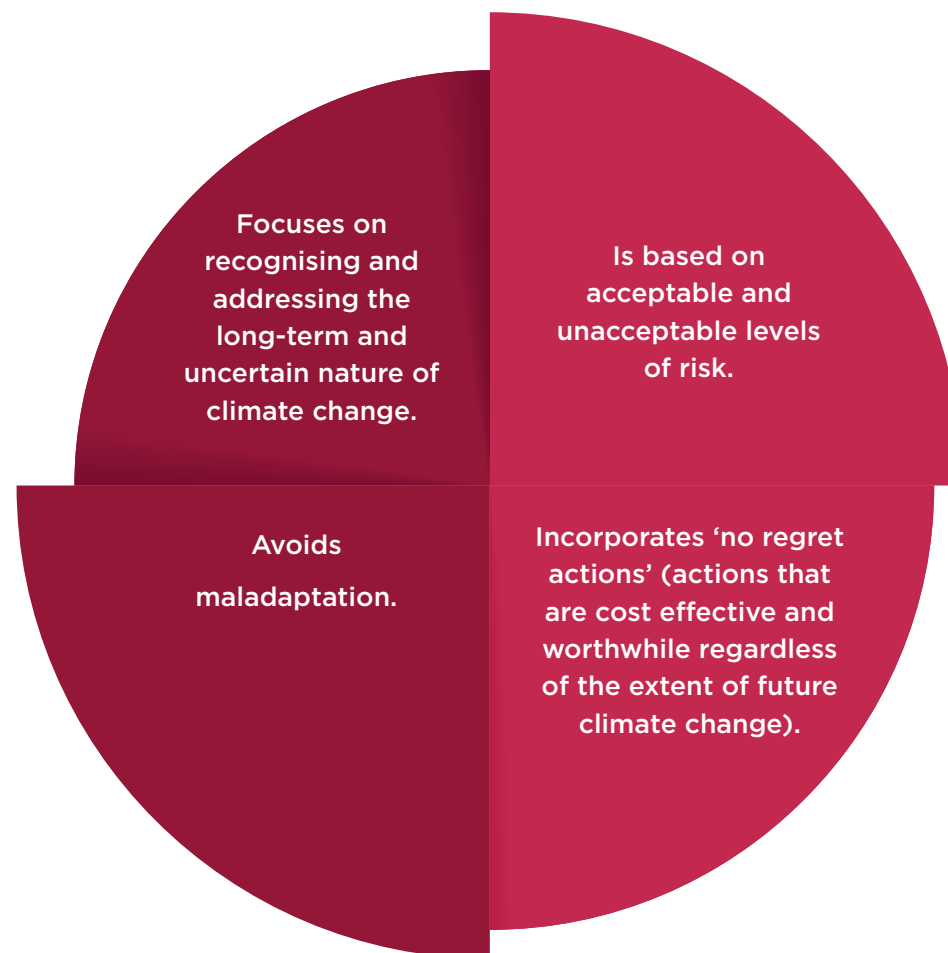
Our adaption journey is a flexible process and subject to regular reviews in terms of the appropriateness of projects, policies and programmes, as well as climate projections.

To ensure the integration of climate adaptation actions listed in this strategy, it is imperative that all strategic documents including the City Development Plan, Corporate Plan, Annual Service Delivery Plans, Operational Policies and Procedures be reviewed.

## CORPORATE PLAN

Galway City Council is central to making Galway City, Sustainable, Inclusive, Prosperous and Proud, and the Corporate Plan is a key part of our delivering on this commitment. The Plan sets out a strategic approach encompassing the various activities of Galway City Council i.e. what we want to deliver for the people of Galway City and how we are going to meet our commitments to our communities. This Plan also sets out how we will work to achieve this and how we will measure our efforts so that the people of Galway City will see that we deliver effectively on our commitments to them.

The Corporate Plan will be reviewed considering the Goals, Objectives and Actions of the Climate Adaptation Strategy and progress on implementation of the Strategy will form part of the Chief Executive's annual progress report to the Council.



# CLIMATE ADAPTATION IMPLEMENTATION & MONITORING GROUPS

To ensure that the Actions in the Strategy are delivered, dedicated Climate Adaptation Implementation and Monitoring Groups will be established to take forward the governance of adaptation in the city.

The Implementation Group will be chaired by a Director of Services and be made up of the Head of each Department assigned with Adaptation Actions. The Climate Action Regional Office (CARO) will also be represented in the Group.

The Implementation Group's role is to oversee the development and implementation of the Adaptation Actions. It will work with the CARO and encourage and facilitate partnership with other stakeholders to ensure efficient and effective delivery of the adaptation actions.

As well as providing a governance structure for adaptation in the city, the Implementation Group will also ensure evidence is built up and kept updated on how the climate in Galway City is changing, and what the potential impacts of this will be. This will serve to aid mapping and identification of areas at risk, and to inform risk assessments, contingency planning and decision making.

It is also crucial that the Implementation Group communicate and raise awareness of climate change and the effects this will have on the city. This will enable the

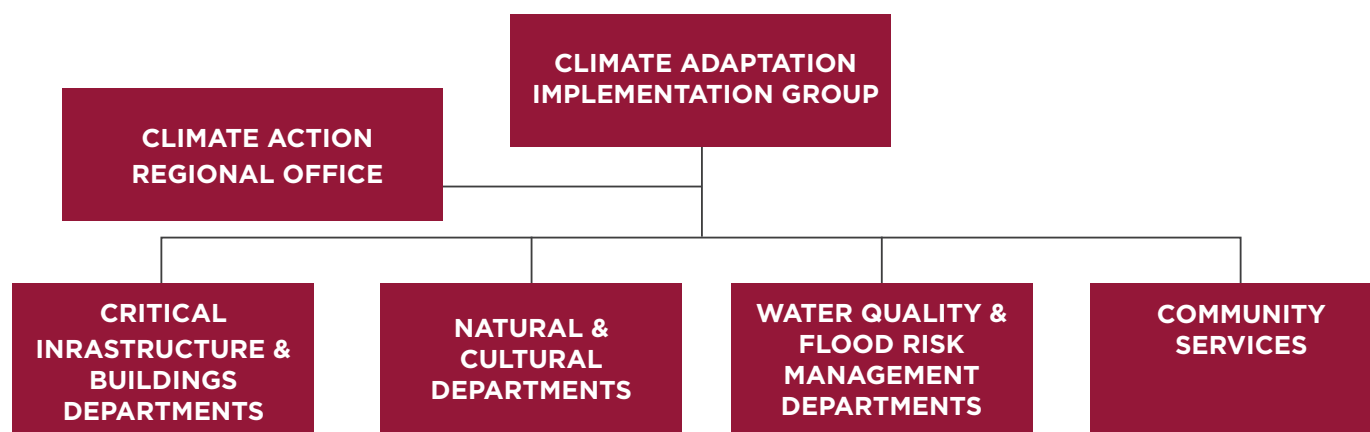
sharing of best practice, help build partnerships and inform, engage and empower all sectors of the city.

The Implementation Group will meet quarterly and report on progress annually. In addition, a Climate Adaptation Monitoring Group will be established as a sub-committee of the Climate Change, Environment and Recreation Strategic Policy Committee to include both elected and sectoral representatives from the SPC. Terms of reference for the Monitoring Group will be agreed.

## Action Implementation Plans

To assist in the delivery and progress around each of the Adaptation Actions listed in the Strategy, each action will require an 'Action Implementation Plan' to be prepared by the lead Department and submitted to the Climate Adaptation Implementation Group for review.

The first Implementation Plan will be prepared within 3 months of adoption of the Strategy. Subsequent Plans will be prepared in July of each year to allow for associated budget submissions.



# MONITORING

The Adaptation Strategy will be monitored to keep a record of progress made in implementing specific adaptation actions in relation to their objectives and inputs, including financial resources.

Monitoring will be undertaken with the help of indicators which may evolve over time as the adaptation process matures and is mainstreamed. Indicators will provide a basis for 'before' and 'after' analysis and describe the positive and negative, anticipated and unanticipated, intended and unintended effects of adaptation actions.

Adaptation indicators will

- Monitor the implementation of adaptation policies, measures and actions.
- Target, justify and monitor funding for adaptation programmes.
- Mainstream adaptation through links between sectors(e.g. infrastructure and the built environment) and related indicators (e.g. climate change impact indicators).
- Communicate adaptation to policy and decision-makers, and other stakeholders.
- Compare adaptation achievements across sectors, regions and countries.
- Inform and report climate change adaptation progress to central government.

Evaluation of the Adaptation Strategy will be a systematic and objective process to determine the effectiveness of adaptation actions. Given the complexity and long-term nature of climate change it is essential that adaptation is designed as a continuous and flexible process and subjected to periodic review, both in terms of the validity of the underlying scientific assumptions and the appropriateness of projects, policies and programmes. Lessons learned and good practices identified during the monitoring and evaluation of ongoing and completed projects, policies and programmes should inform future actions, creating an iterative and evolutionary adaptation process.





# REPORTING

As part of the Implementation Plans each lead Department will prepare an annual Progress Report for their assigned Actions. These will inform an Annual Progress Report on the Climate Adaptation Strategy itself, with reviews on good practices identified during the implementation of actions plans, policies and programmes.

The review of the Adaptation Strategy will be a systematic and objective process to determine the effectiveness of the adaptation actions with items such as appropriateness of allocated timeframes, financial, social and environmental effects of actions.

In general, the following measures will provide insight into the progress of the Climate Adaptation Strategy:

The development of Action Implementation Plans and indicators for the Climate Adaptation Strategy to show active progress.

- The extent to which climate change considerations are increasingly incorporated into high level policies, plans and practical programmes in priority impact areas.
- Growing evidence that implemented adaptation strategies are increasing resilience to extreme weather events.
- Growing evidence of engagement between the Council and its partners, communities, non-governmental organisations and other levels of government on addressing climate change issues.
- Level of technical capacity increases to assess and respond to the risks of climate change.
- Level of public, staff and stakeholder awareness about climate change and its impacts increases as well as support for actions to protect against climate change



The annual reports will be submitted to the Climate Action Regional Office to support the integration of actions and increase resilience to climate change across local governance, economic and community sectors.

# COMMUNICATING

Stakeholder participation is stipulated under the National Adaptation Framework, principally to;

- Promote the integration of a range of knowledge and values in adaptation.
- Build support for the adaptation process through embedding it in local interests and concerns.
- Ensure that adaptation processes at the local scale are aligned with similar processes that are under way in neighbouring authorities and relevant sectors.

The Action Implementation Plans will therefore include a structured and substantive programme for the engagement of stakeholders from the elected members, within the local authority, the local community, relevant non-governmental organisations and state sector bodies, and particularly those who will be expected to play a role in the implementation of Actions of the Adaptation Strategy.

It will also be important that completed local adaptation strategies align with sectoral plans being completed under the NAF. For the purposes of the NAF, 12 key 'sectors' under the remit of seven Government Ministers have been identified which must prepare adaptation plans of their own. These adaptation processes will carry several critical implications for adaptation planning at local authority level (and vice versa). To ensure that any necessary sectoral input is obtained as efficiently as possible coordination between sectoral and local scale adaptation efforts will be facilitated via each CARO.



# MITIGATION

Adaptation will be required to reduce the effects of a changing climate already 'locked in' by past and current emissions and this strategy focuses on the adaptation actions which will be implemented by Galway City Council. We recognise that to build climate resilience and reduce global warming both Adaptation and Mitigation measures are required.

Climate change mitigation and adaptation are not mutually exclusive but are key partners in any strategy to respond to climate change. Mitigation is required to reduce climate risks in the 21st century and beyond, increase prospects for effective adaptation, reduce the costs and challenges of mitigation in the longer term and contribute to climate-resilient pathways for sustainable development.

Sir David Attenborough speaking from the "People's Chair at COP24 said:

*"Right now, we are facing a man-made disaster of global scale. Our greatest threat in thousands of years. Climate change. If we don't take action, the collapse of our civilizations and the extinction of much of the natural world is on the horizon."*

The UN Intergovernmental Panel on Climate Change (IPCC) '1.5-degree report' shows it's not too late to reduce the worst effects of global warming – and confirms prompt actions now will minimise the economic costs.



Mitigation actions also bring a host of co-benefits that are desirable, even without the decarbonisation imperative. Broadly speaking, mitigation should improve energy efficiency and security, stimulate innovation and the creation of new industries and markets. Other positive impacts include improvement in human health because of less air pollution and increased activity. Whilst climate change is the biggest global health threat of the 21st Century, action to combat it is likely to be the greatest global health opportunity of the 21st Century.

# MITIGATION

## National Targets for Reduction in GHG Emissions

The EU's Effort Sharing Decision (Decision No 406/2009/EC) sets targets for the non-Emissions Trading Scheme sector for EU Members States including Ireland for 2020.

Ireland is required to deliver a 20% reduction in non-ETS greenhouse gas emissions by 2020 (relative to 2005 levels). The non-ETS sectors cover those that are outside the EU Emissions Trading Scheme and includes the Agriculture, Transport, Residential, Commercial, Waste and non-Energy Intensive Industry.

Ireland's National Policy position is to reduce CO2 emissions in 2050 by 80% on 1990 levels across the Energy generation, Built environment and Transport sectors, with a climate neutrality goal in the agriculture and land-use sector.

*Ireland's greenhouse gas emissions increased by 3.6% or 2.1 million tonnes of carbon dioxide equivalent, from 59.4 million tonnes of carbon dioxide equivalent in 2015 to 61.5 million tonnes of carbon dioxide equivalent in 2016.*

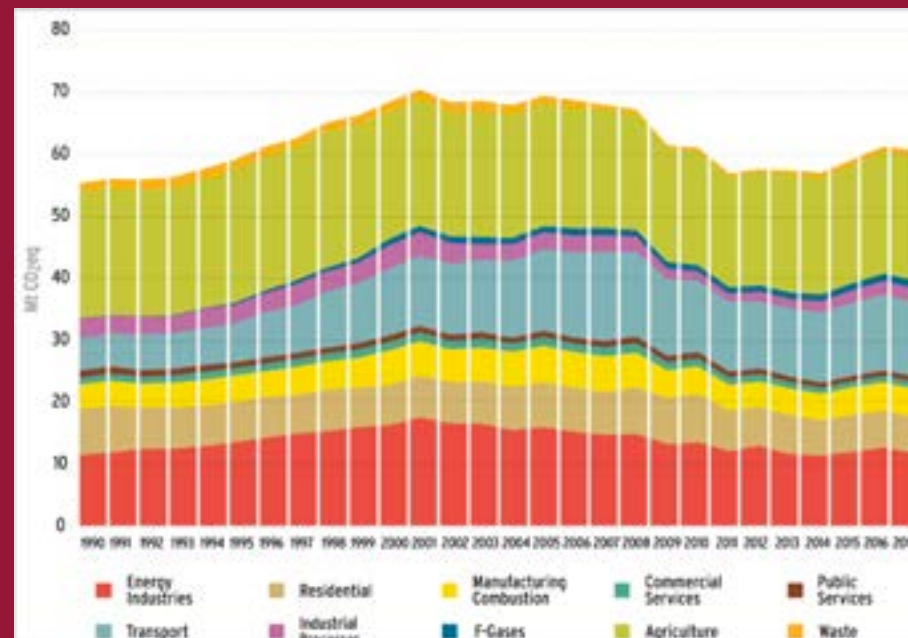
## National Picture

Irish greenhouse gas emissions are rising rather than falling. Instead of achieving the required reduction of 1 million tonnes per year in carbon dioxide emissions, consistent with the National Policy Position, Ireland is currently increasing emissions at a rate of 2 million tonnes per year.

The EPA report on 'Ireland's Provisional Greenhouse Gas Emissions 1990-2017' shows that emissions for Transport, Energy Industries and Residential sectors decreased, however, emissions in the Agriculture, Commercial and Public Services sectors are heading in the wrong direction.

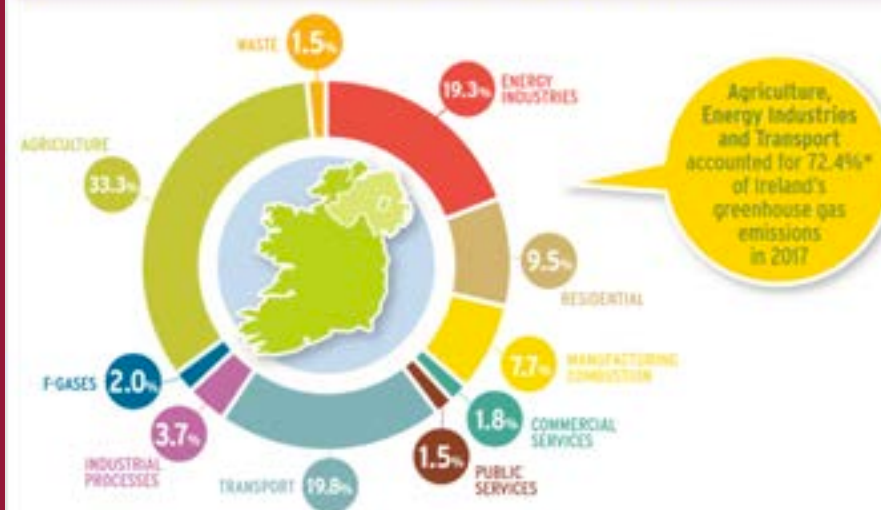
Projected emissions in the 'With Additional Measures' scenario indicate that Ireland remains off-target to achieving a 20% reduction on 2005 levels by 2020.

*Greenhouse gas emissions from the Residential sector decreased in 2017 by 5.0% or 0.30 Mt CO2eq due to a milder winter*



EPA: Ireland's Provisional Greenhouse Gas Emissions, 1990-2017

## SOURCES OF GREENHOUSE GASES



# MITIGATION

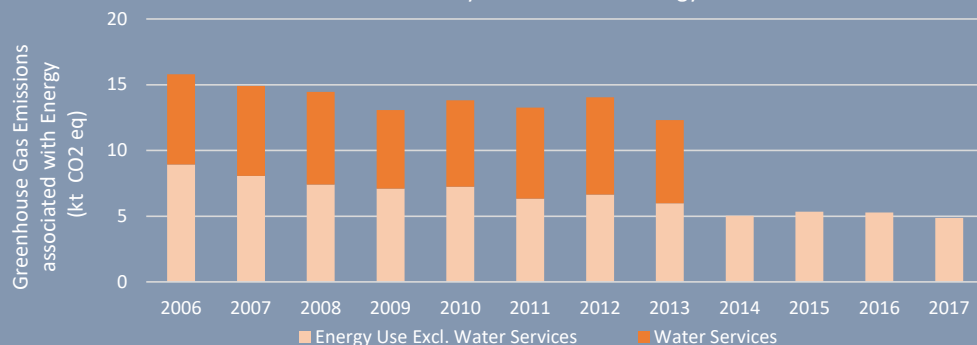
## Mitigation Actions by Galway City Council

Public bodies have an exemplary role to play with regard to energy efficiency, in pursuit of the targets and actions contained in the National Energy Efficiency Action Plan. Public Bodies including local authorities have a target of improving energy efficiency by 33% from 2009 baseline by 2020.

**The SEAI Annual Report on Public Sector Energy Efficiency Performance 2018 highlights that Galway City Council has achieved energy efficiency improvements of 30% between 2009 and 2017.**

### Energy Efficiency- Reduction in Greenhouse Gas Emissions 2006 - 2017

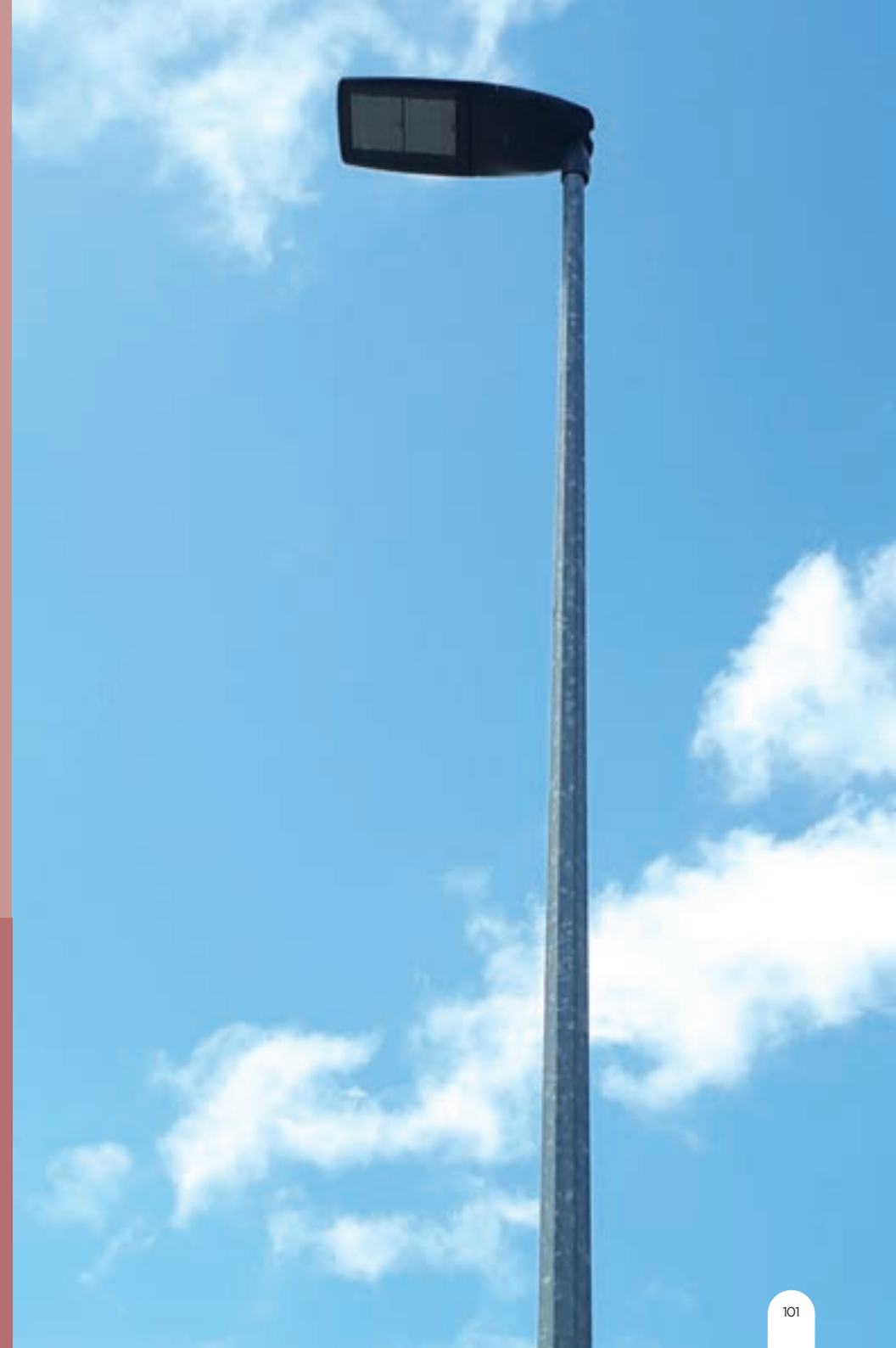
Greenhouse Gas Emissions associated with City Council's Own Energy Use has fallen since 2006.



Galway City Council has improved energy efficiency in its Public Buildings with the installation of more efficient heating systems and fuel switching to Natural Gas at Leisureland, the Townhall Theatre, Renmore Community Centre and Westside Community Centre.

## Galway City - 13% of Public Lights are LED Efficient Lights

Galway City Council will continue to upgrade Public Lighting to energy efficient LED Lights.

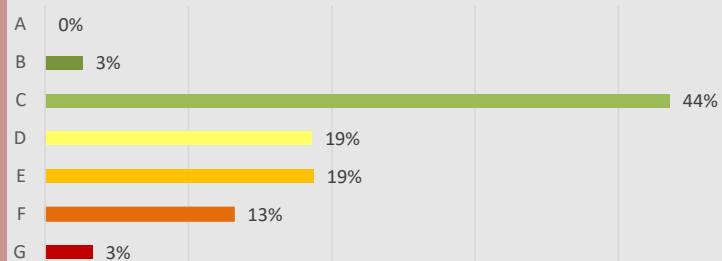


# MITIGATION

## Upgrading Social Housing

Galway City Council has been improving the building fabric of its social housing to save energy. Between 2013 and 2017, An investment of €3.6M was made to improve 2,089 social housing units in Galway City under the Department of Housing's Phase 1 Energy Efficiency Retrofit Programme.

Improved Building Ratings for Social Housing Stock After Phase 1 Energy Efficiency Retrofit Programme



## Carbon Capture - Planting Trees Terryland Millennium Forest Park

The Terryland Forest Park started in January 2000. Over a five year period, approximately 100,000 native Irish trees were planted. Voluntary groups played an important part in the development and planting trees in the Terryland Millennium Forest Park

A tree can sequester 1 ton of carbon dioxide by the time it reaches 40 years old. Potentially Terryland Park will have captured over 100kt CO<sub>2</sub>e<sub>q</sub> by 2050.



# APPENDICES

## ENGAGE | PLAN | ADAPT



# REFERENCES:

1. IPCC, climate change 2014: Mitigation of climate change, Summary for Policy makers and Technical Summary.
2. World Meteorological Organisation. State of Climate in 2017 – Extreme Weather and High impacts. Available from: [https://library.wmo.int/doc\\_num.php?explnum\\_id=4453](https://library.wmo.int/doc_num.php?explnum_id=4453)
3. European Commission. Non-Paper Guidelines for Project Managers: Making Vulnerable Investments Climate Resilient (Internet). Available from <http://climate-adapt.eea.europa.eu/metadata/guidances/non-paper-guidelines-for-project-managers-making-vulnerable-investments-climate-resilient/guidelines-for-project-managers.pdf>
4. Irish Statute book. Climate Action and Low Carbon Development Act 2015. Available from <http://www.irishstatutebook.ie/eli/2015/act/46/enacted/en/html>
5. Department of Communications, Climate Action and environment. National Adaptation Framework 2018. Available from: <https://www.dccae.gov.ie/documents/National%20Adaptation%20Framework.pdf>
6. Department of Housing, Planning and Local Government. Project Ireland 2040 – National Planning framework 2018. <https://www.gov.ie/en/campaigns/09022006-project-ireland-2040/>
7. The Citizens Assembly. Third Report and Recommendation of the Citizens Assembly: How the State can make Ireland a leader in tackling climate change. available from : <https://www.citizensassembly.ie/en/How-the-State-can-make-Ireland-a-leader-in-tackling-climate-change/Final-Report-on-how-the-State-can-make-Ireland-a-leader-in-tackling-climate-change/Climate-Change-Report-Final.pdf>
8. N. Dwyer, 2012. The Status of Irelands climate 2012. Environmental Protection Agency. Wexford, Ireland. Available from <http://www.epa.ie/pubs/reports/research/climate/CCRP26%20-%20Status%20of%20Ireland's%20Climate%202012.pdf>
9. County and city Management Association. 2017. Business case for Regional climate Change Offices. Dublin: CCMA
10. Coll, J & Sweeney, J. 2013. current and future Vulnerabilities to climate change in Ireland. Wexford. Environmental Protection Agency. <https://www.epa.ie/pubs/reports/research/climate/sweeney-report-strive-12-for-web-low-res-pdf>
11. A Summary of the State of Knowledge on Climate Change Impacts for Ireland Report 11 (2010–2016) (2014-CCRP-FS.19). EPA Research Report No 223. Environmental Protection Agency by MaREI Centre, Environmental Research Institute, University College Cork Authors: Margaret Desmond, Phillip O'Brien and Frank McGovern
12. Galway City Council, 2017, City Development Plan 2017-2023.
13. National Steering Group for Major Emergency Management. A framework For Major Emergency Management. 2006 Available from <http://mem.ie/wp-content/uploads/2015/05/A-Framework-For-Major-Emergency-Management.pdf>
14. Galway City Council – Major Emergency Plan
15. Report No 159 EPA. Ensemble of regional climate model projections for Ireland (2008-FS-CC-m) Prepared for the Environmental Protection Agency by Irish Centre for High End Computing and Meteorology and Climate Centre, School of Mathematical Sciences, University College Dublin Author: Paul Nolan. Available from: [http://www.epa.ie/pubs/reports/research/climate/EPA%20159\\_Ensemble%20of%20regional%20climate%20model%20projections%20for%20Ireland.pdf](http://www.epa.ie/pubs/reports/research/climate/EPA%20159_Ensemble%20of%20regional%20climate%20model%20projections%20for%20Ireland.pdf)
16. Nolan, P., 2015. Ensemble of regional climate model projections for Ireland. Environmental Protection Agency. Wexford, Ireland.
17. S, Grey, 2016. Local Authority Adaptation Strategy Development Guidelines. Environmental Protection Agency Research Report No 223. EPA, Wexford, Ireland. Available from: <http://www.epa.ie/pubs/reports/research/climate/researchreport164.html>
18. Climate change – Refining the Impacts for Ireland (2001-CD C3-M1) STRIVE Report Prepared for the Environmental Protection Agency by National University of Ireland, Maynooth. Available from: <https://www.epa.ie/pubs/reports/research/climate/sweeney-report-strive-12-for-web-low-res-pdf>
19. NASA Website. <https://climate.nasa.gov/evidence/>
20. National Geographic Report, <https://www.nationalgeographic.com/environment/2018/10/ipcc-report-climate-change-impacts-forests-emissions/>
21. <https://www.climateireland.ie/#/aboutAdaptationClimateChange/learnClimateChange>
22. IPCC, 2007. Summary for Policymakers. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. B. Metz, O.R. Davidson, P.R. Bosch, R. Dave & L.A. Meyer. Cambridge, UK. Cambridge University Press (PDF). The United Nations Framework Convention on Climate Change. Retrieved 23 May 2016.
23. World Meteorological Organisation. State of Global Climate Annual Report 2017, 2018. WMO Geneva, Switzerland
24. Department of Communications, climate Action and Environment. 2018. Local Authority Adaptation Strategy Development Guidelines.
25. Shaw, R., Colley, M., and Connell, R. (2007) Climate change adaptation by design: a guide for sustainable communities TCPA, London Chapter 6
26. Figueres C. & Ivanova M., Climate Change: National Interests Or a Global Regime. From: <https://environment.yale.edu/publication-series/documents/downloads/a-g/figueres-ivanova.pdf>
27. CSO, 2017. Census of Population 2016 - Preliminary Results. [online Available at: <<http://www.cso.ie/en/releasesandpublications/ep/p/cpr/censusofpopulation2016-preliminaryresults/geochan/>> [Accessed September 2018].
28. Met Éireann, n.d. Major Weather Events. Online: Available at: < <https://www.met.ie/climate-ireland/major-events.asp>>. Accessed: October 2018.
29. Walsh, S. & N. Dwyer, 2012. Rainfall. The Status of Ireland's Climate 2012. N. Dwyer. Wexford. Environmental Protection Agency. pp.14-16.
30. DEHLG, 2006. A Framework for Major Emergency Management Dublin: Department of the Environment, Heritage & Local Government.
31. EEA, 2012. Climate Change, Impacts and Vulnerabilities in Europe European Environment Agency. Copenhagen.
32. Dwyer, N. & R. Devoy, 2012. Sea Level. The Status of Ireland's Climate 2012. N. Dwyer. Wexford. Environmental Protection Agency. pp.73-76.
33. Nolan, N. & N. Dwyer, 2012. Ocean Surface and Sub-surface Temperature. The Status of Ireland's Climate 2012. N. Dwyer. Wexford Environmental Protection Agency. pp.65-67.
34. Walsh, S. & N. Dwyer, 2012. Surface Air Temperature. The Status of Ireland's Climate 2012. N. Dwyer. Wexford. Environmental Protection Agency. pp.10-13.
35. Nolan, G., Dwyer, N. & J. Gault, 2012. Sea State. The Status of Ireland's Climate 2012. N. Dwyer. Wexford. Environmental Protection Agency pp.69-72.
36. Walsh, S. & N. Dwyer, 2012. Surface Wind. The Status of Ireland's Climate 2012. N. Dwyer. Wexford. Environmental Protection Agency pp.19-21.
37. County and City Management Association. 2017. Business Case for Regional Climate Change Offices. Dublin: CCMA.



# GLOSSARY

**Adaptation:** a change in natural or human systems in response to the impacts of climate change. These changes moderate harm or exploit beneficial opportunities and can be in response to actual or expected impacts.

**Adaptive capacity:** describes the ability of a sector to design or implement effective adaptation measures, using information on possible future climate change and extreme weather to moderate potential damage, take advantage of opportunities or to cope with the consequences.

**Baseline:** a baseline is a state against which a change is measured. For example, a 'current baseline' is made up of observable, present-day conditions.

**Biodiversity:** The variability among living organisms from terrestrial, marine and other ecosystems. Biodiversity includes variability at the genetic, species and ecosystem levels.

**Capacity:** the combination of all the strengths and resources available within a community, society or organisation which can reduce the level of risk, or the effects of a disaster. It can also be described as capability.

**Climate:** the climate can be described simply as the 'average weather', typically looked at over a period of 30 years. It can include temperature, rainfall, snow cover, or any other weather characteristic.

**Climate change:** refers to a change in the state of the climate, which can be identified by changes in average climate characteristics which persist for an extended period, typically decades or longer.

**Confidence:** in a scientific context, confidence describes the extent to which the findings of an assessment are considered valid, based on the type, amount, quality, and consistency of evidence.

**Ecosystem Services:** the benefits to society from resources and processes provided by ecosystems can be described as ecosystem services. These can include pollination and disease control, providing food and fuel, regulating the flow of water through land to both prevent flooding and filter clean drinking water and the aesthetic and amenity value of the countryside.

**Extreme weather:** includes unusual, severe or unseasonal weather or weather at the extremes of the range of weather observed in the past.

**Greenhouse gases:** a number of gases whose presence

in the atmosphere traps energy radiated by the Earth; this is called the greenhouse effect. These gases can be produced through natural or human processes. Carbon dioxide is the most important greenhouse gas. Other greenhouse gases are methane, fluorinated gases, ozone and nitrous oxide. See also Section 1 of the Climate Action and Low Carbon Development Act 2015 for a legal definition.

**Green Infrastructure:** a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas.

**Hazard:** a situation or event which could cause harm. A hazard does not necessarily cause harm.

**Impact:** in the context of climate change, an effect of climate change (e.g. flooding, rails buckling, etc.).

**Just Transition:** bringing together of workers, communities, employers and government in social dialogue to drive the plans, policies and investments needed for a fair transformation to a low-carbon economy.

**Likelihood:** the chance of an event or outcome occurring, usually expressed as a probability.

**Mitigation:** describes action to reduce the likelihood of an event occurring or reduce the impact if it does occur. This can include reducing the causes of climate change (e.g. emissions of greenhouse gases) as well as reducing future risks associated with climate change.

**Model:** is a representation of how a system works and can be used to understand how the system will respond to inputs and other changes.

**No regret actions:** could be activities which would provide immediate economic and environmental benefits and continue to be worthwhile regardless of future climate. They would be justified under all plausible future scenarios, including without climate change.

**Probability:** is used to describe the chance or relative frequency of particular types of event occurring. It can also include sequences or combinations of such events.

**Projection:** any plausible description of the future and the pathway that leads to it. A specific interpretation of a 'climate projection,' refers to an estimate of future

climate developed using models of the Earth's climate. Projections are not predictions. Projections include assumptions, for example, on future socio-economic and technological developments, which might or might not happen. They therefore come with some uncertainties.

**Radiative forcing:** the difference between sunlight absorbed by the Earth and energy radiated back to space.

**Resilience:** describes the ability of a social or ecological system to absorb disturbances while retaining the same basic ways of functioning, and a capacity to adapt to stress and change

**Risk:** combines the chance that an event will occur with how large its impact could be, in social, economic or environmental terms. For example: the costs of damage, number of people affected or areas of land affected by a specific climate effect.

**Risk Assessment:** is an analysis of risks and their impacts to provide information for decision making. Often, risk assessment will consider a particular impacted party, like a building or population. The process usually includes identifying hazards which could have an impact; and assessing the likelihoods and severities of impacts.

**Risk Management:** putting in place plans to avoid unacceptable consequences of risks.

**Scenario:** is a plausible description of a possible future state of the world. These use specific assumptions on how aspects of the world might change e.g. economies, social trends, changes in technology, environmental changes, etc., based upon the best understanding available.

**Sensitivity:** the degree to which a system is affected, either adversely or beneficially, by climate variability or change.

**Severe weather:** refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption or loss of life.

**Sink:** Any process, activity or mechanism that removes a greenhouse gas (GHG), an aerosol or a precursor of a GHG or aerosol from the atmosphere.

**Weather:** Weather refers to the state of the atmosphere with regard to temperature, cloudiness, rainfall, wind, and other meteorological condition.







# **CLIMATE RESILIENT GALWAY CITY**

ENGAGE | PLAN | ADAPT

GALWAY CITY COUNCIL  
**Climate Adaptation Strategy**  
September 2019