



# Westmeath County Council

## Climate Change Risk Assessment



LACAP

Final Report  
30<sup>th</sup> June 2023



KPMG  
Sustainable  
Futures





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# Executive Summary



# Executive Summary

## Context and Scope of this Report

Climate change poses a critical challenge for Westmeath County Council. It will result in a wide range of impacts across Westmeath, from damaging infrastructure such as roads and bridges, to biodiversity, and limits on water supply. These bring substantial implications for Westmeath County Council.

Internationally, national and local governments are increasingly compelled to take ambitious action to increase resilience to climate change within their organisations and their functional areas through adaptation and mitigation measures.

Ireland's Climate Action and Low Carbon Development (Amendment) Act, 2021 highlights the role of the Local Authority in meeting national emission reductions targets and achieving climate resilience. The Act stipulates that local authorities need to prepare a Local Authority Climate Action Plan (LACAP) that will drive local response to the challenges posed by climate change, translating the national climate policy to the local level.

This report provides an assessment of Westmeath's climate change risks and the impacts of these on the delivery of services by Westmeath County Council. The aim of the report is to provide the evidence base and inform the development of the LACAP for Westmeath County Council.

## Key Results and Findings

As illustrated in the climate risk matrix on the right the frequency and intensity of some hazards (e.g., river

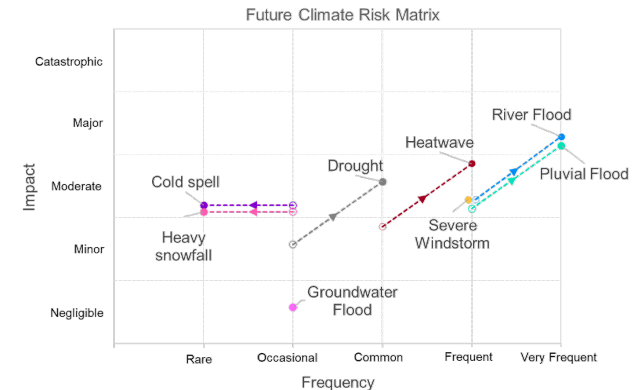
and pluvial flooding, heatwaves and drought) will increase while others will remain the same (e.g., severe windstorms and groundwater flooding). Some hazards are expected to decrease in frequency, such as cold spells and heavy snowfalls.

- Recent experiences of **river and pluvial flooding** events in **2020**, resulted in the inundation of residential properties, damage to recreational areas, closure of businesses, disruption of transport networks and inundation of farmland. Projected increases in the frequency of extreme precipitation events will result in increased surface water and riverine flood risk for Westmeath.
- Severe windstorms** are currently experienced on a frequent basis in Westmeath and result in wide-ranging impacts, including disruption to energy supply and transport networks. Projections indicate no significant change to this frequency.
- Westmeath experienced both a **heatwave and drought** in 2018, with a heatwave recorded again in 2021. These events resulted in damage to road surfaces, disruption of public transport network, the imposition of restrictions on water supply and increased demand on recreational areas. Projected increases in the frequency of heatwaves and drought conditions will mean that events currently experienced on an infrequent basis will become more frequent. As the population ages, there will also be an increase in the number of vulnerable people exposed to heat-related risks.
- Recent experiences of **cold spells and heavy snowfall** events in 2018 (e.g. Storm Emma) demonstrated the wide range of impacts for County Westmeath. These included, amongst others, road

closures, disruption to public transport, power outages, reduction in agricultural production and disruptions to water supply. Projected increases in average temperature and decreases in the frequency of snowfall indicate a decrease in the frequency of cold spells, heavy snowfall, and their associated impacts.

- Groundwater flooding** is currently experienced on occasional basis in Westmeath and results in road damages, isolation of communities and inundation of farmland. Projections indicate no substantial change in this frequency.

To increase resilience, Westmeath County Council will need to proactively plan for and adapt to the **current and future climate change risks** identified through this report.



The risk matrix above shows the current and future level of risk associated with climate hazards for Westmeath. The hollow marker showing the current level of risk and the solid marker the future level of risk. The dotted line shows the change between the current and future risk.



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# Introduction

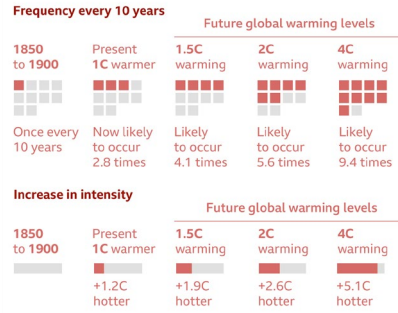


# Global Response to the Challenge of Climate Change

## Global Climate Change Challenge

### Extreme heat becomes more frequent

Projected increase in frequency and intensity of high temperatures which only occurred once in every 10 years on average in a climate without human influence



Source: IPCC, 2021: Summary for Policymakers

It is unequivocal that human influence has warmed the atmosphere, land and ocean since pre-industrial times, affecting many weather and climate extremes in every region across the globe. Each of the last four decades has been successively warmer than any decade that preceded it since instrumental records began in 1850.

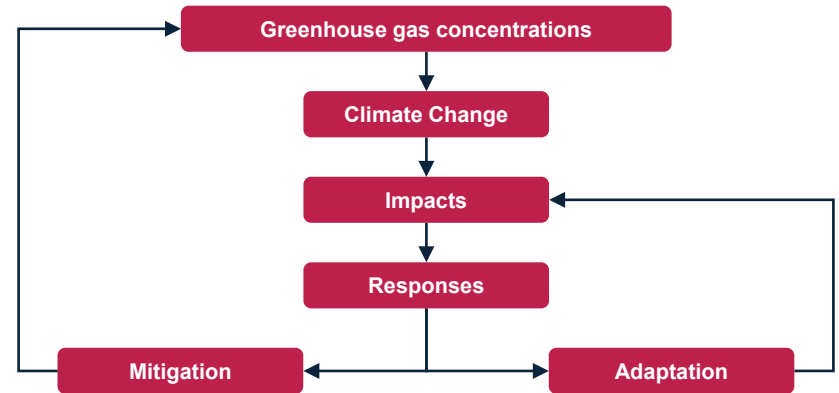
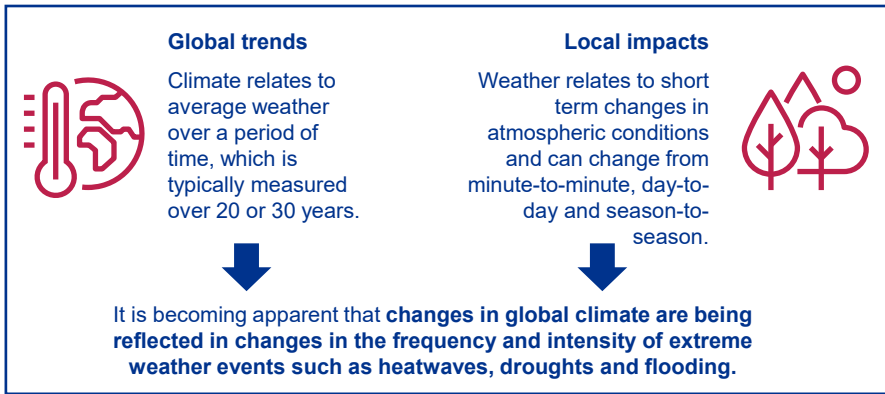
Since 1990, the Intergovernmental Panel on Climate Change (IPCC) have published a series of assessment reports which provide a synthesis of the most up-to-date science and evidence of climate change. The most recent assessment report shows that the global average temperature has increased by 1.1°C when compared with pre-industrial conditions (1850-1900).

## Global Climate Change Response Framework

In response to the challenges posed by climate change, two complementary approaches are being adopted.

**Mitigation:** Making the impacts of climate change less severe by preventing or reducing the emission of greenhouse gases (GHGs) into the atmosphere. Mitigation is achieved either by reducing the sources of these gases (e.g. by increasing the share of renewable energies, or establishing a cleaner mobility system) or by enhancing the storage of these gases (e.g. by increasing levels of afforestation). In short, mitigation is a human intervention that reduces the sources of GHG emissions and/or enhances GHG sinks.

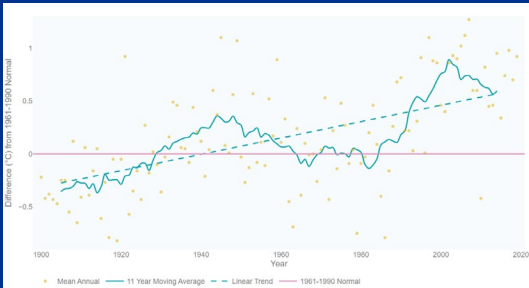
**Adaptation:** Anticipating the adverse impacts of climate change and taking appropriate action to prevent or minimise the damage they can cause, or taking advantage of opportunities that may arise. Examples of adaptation measures include large-scale infrastructure changes, such as building defences to protect against sea-level rise, as well as behavioural shifts, such as individuals reducing their food waste. In essence, adaptation can be understood as the process of adjusting to the current and future effects of climate change.





# Ireland's Challenge of Climate Change

## Observed Impacts of Climate Change on Ireland



The mean annual observed temperature for Ireland (1900-2019) (Source: Cámaro García and Dwyer, 2021)

According to the Environmental Protection Agency (EPA) Ireland's climate is changing in line with global trends, with an increase in annual average temperature of 0.9 °C between 1900 and 2018. Ireland has seen an increase in annual average rainfall of approx. 6% for the period 1989-2018 when compared to 1961-1990. Global sea level is rising at an increasing rate with the average global rate of sea level rise for the period 2006-2015 being about 2.5 times the rate for the period 1901-1990.



- Surface air temperature has increased, on average, by 0.9 °C during the past 120 years.



- Yearly precipitation was, on average, 6% higher in the 30 years from 1989-2018 as compared to 1961-1990.
- The period 2006 to 2015 was shown to be the wettest in Ireland since records began.



- Due to limited analysis, no long-term change in windiness have been observed.



- For the seas around Ireland, there has been a rise in sea level of approximately 2-3 mm per annum since 1990.
- Sea surface temperature at Malin Head has been, on average, 0.47 °C higher over the period 2009 to 2018 when compared to the average for the period 1981 to 2010.

## Projected Impacts of Climate Change on Ireland

Climate projections indicate that observed changes in Ireland's climate will continue and likely intensify into the future. It is expected that Ireland's climate will become warmer and drier, sea levels will continue to increase at a faster rate and that extreme weather events will occur more frequently. Even if mitigation actions are taken over the next 30 years, a level of projected changes are locked in for the foreseeable future as a result of historical GHG emissions. As a result, temperatures will continue to increase globally until at least 2050, even under low emissions scenarios.



- By 2050, average annual temperatures are expected to increase by up to 1.6°C under a high emissions scenario.

- The frequency and intensity of heatwave events are projected to increase.



- By 2050, Levels of summer precipitation are expected to decrease by up to 17% under a high emissions scenario.

- During winter and autumn months, there is expected to be an increase of up to 19% in the occurrence of heavy precipitation events.

- By 2050, Projections indicate a small reduction in overall wind speed (10m) by up to -3.3% under a high emissions scenario.



- Projections of severe windstorms show a high degree of uncertainty with some projections indicating an increase in very severe windstorms. However, more work is required to increase confidence in these projections.

- Global sea level is expected to continue to and by up to 1m by 2100.



- Projections indicate that the Irish Sea could warm by a further 1.9 °C before the end of the 21st Century

Source: Local Authority Climate Action Plan Guidelines, pages 26-29.

# National and Local Response

## Paris Agreement, 2015

The Paris Agreement, adopted in 2015 provides an internationally accepted and legally binding global framework to address climate change challenges. It has two clearly defined goals aimed at supporting progressive and ambitious climate action to avoid dangerous climate change:

- I. holding global average temperature increase to well below 2°C and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels (i.e., **mitigation**);
- II. increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience (i.e., **adaptation**).

## European Climate Law, 2021

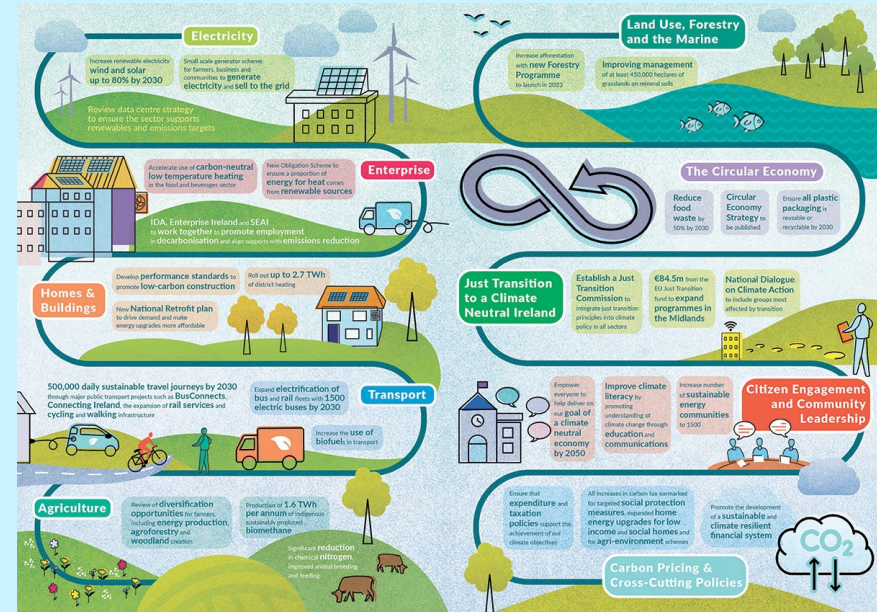
The EU adopted a legislative proposal for the European Climate Law in June 2021 to frame the climate neutrality objective by 2050 across the EU with an intermediate target of **reducing net greenhouse gas emissions by at least 55% by 2030**. The European Commission (EC) is clear in the commitment required by all Member States, and the use of all policy levers and instruments, to fight against the urgent challenge of climate change and to activate leadership efforts to reach climate neutrality by 2050.

## Climate Action and Low Carbon Development (Amendment) Act, 2021

Climate policy in Ireland reflects the ambition of the EU and that required to confront the challenges of climate change. The Climate Action and Low Carbon Development (Amendment) Act, 2021 frames Ireland's legally binding climate ambition to delivering a **reduction in greenhouse gas emissions of 51% by 2030**, and to achieve climate neutrality by the end of 2050.

Through progressive economy-wide carbon budgets, sectoral ceilings, a suite of strategies devised to promote a **combination of adaptation and mitigation measures**, and robust oversight and reporting arrangements, climate policy is working to scale up efforts across all of society and deliver a step change on ambitious and transformative climate action to 2030 and beyond to 2050.

## Climate Action Plan 2021 - Infographic





# Project Overview



## Legislative context

Climate Policy in Ireland is aligned with the EU's ambitions to combat Climate Change. The Climate Action and Low Carbon Development (Amendment) Act 2021 enshrines the National Climate Objective to “pursue and achieve, by no later than the end of 2050, the transition to a climate resilient, biodiversity rich, environmentally sustainable and climate neutral economy.”

The importance of place-based approaches and the role of the Local Authority is highlighted in the Act, which stipulates that “each local authority shall prepare and make a plan relating to a period of five years (in this section referred to as a ‘local authority climate action plan’) which shall specify the **mitigation measures** and the **adaptation measures** to be adopted by the local authority.”

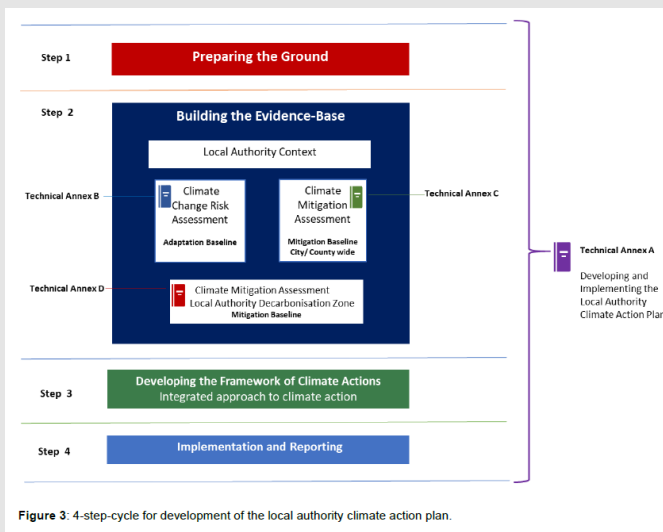
These plans will drive the mitigation and adaptation measures at the local level and see Local Authorities translate national climate policy to local circumstances and to support the delivery of the National Climate Objective at local and community levels.



## Preparing local authorities' climate action plans

To support local authorities in meeting their legislative requirements, the Climate Action Regional Offices (CAROs) developed the draft Local Authority Climate Action Plan (LACAP) Guidelines.

These guidelines structure the development and implementation of climate action plans (CAPs) around a 4-step cycle, which is supported by four technical annexes<sup>1</sup>.



<sup>1</sup> Source: *Local Authority Climate Action Plan Guidelines*, page 5.

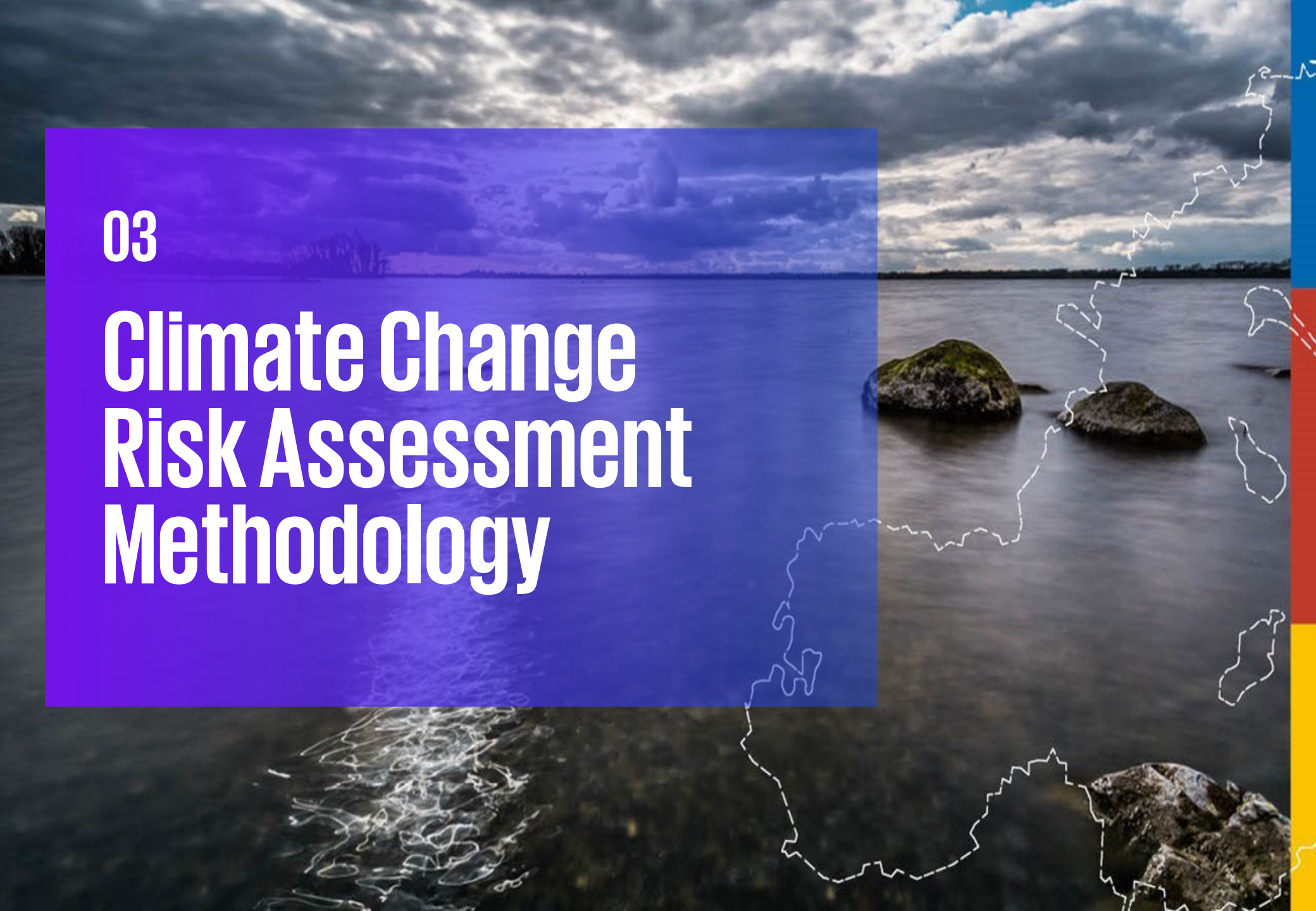


## Scope of this report

Per Westmeath County Council's request, the KPMG team is supporting the council in Step 2 to build the adaptation baseline and develop a climate change risk assessment (CCRA) following **Technical Annex B of the LACAP Guidelines** in order to understand current and future risks posed by climate change for County Westmeath and the implications of these for Westmeath County Council.

03

# Climate Change Risk Assessment Methodology





# 3.1 Introduction, Scope and Methodology

# Understanding of Climate Change Risk Assessment

## Purpose of Climate Change Risk Assessment

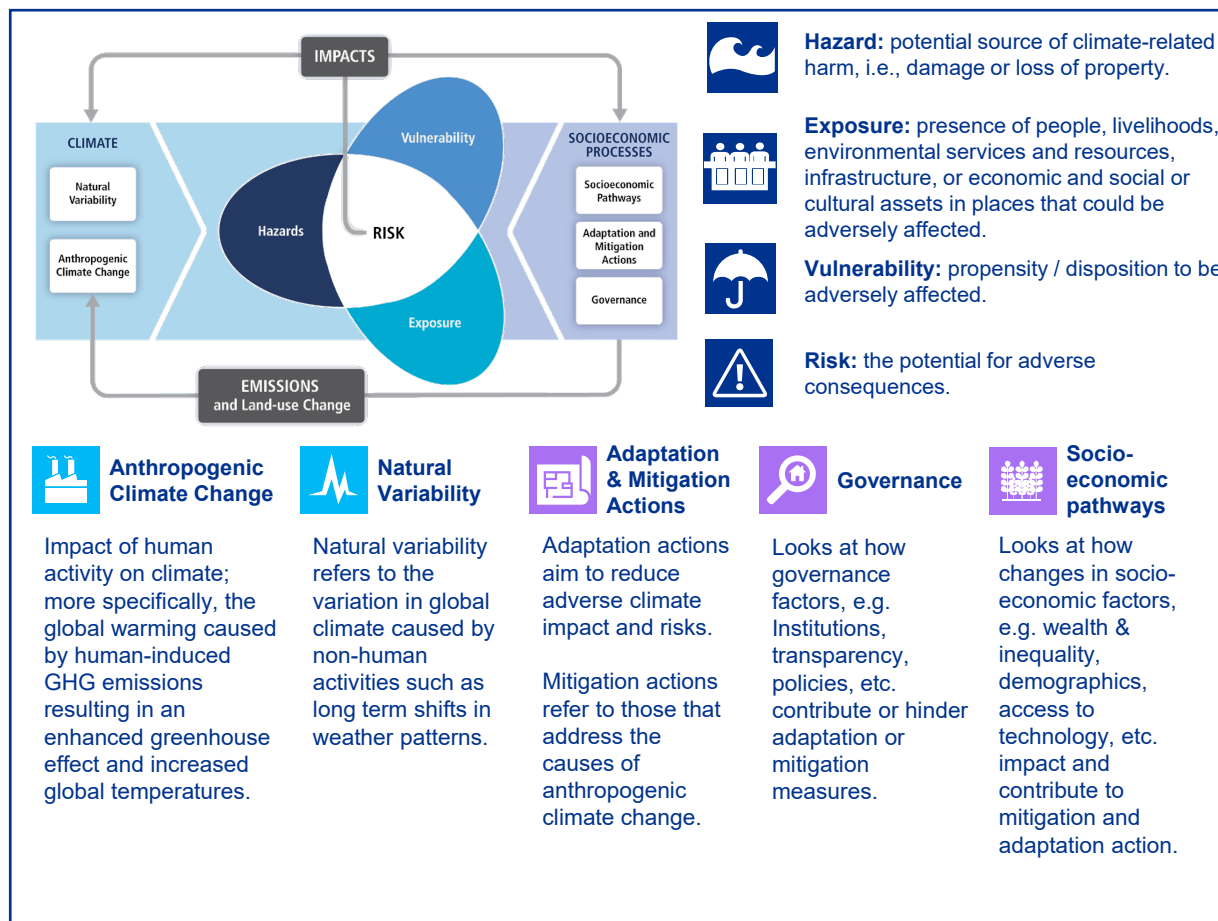
Responding to climate change impacts involves taking adaptation actions to reduce the adverse risks posed by current and projected climate change.

Climate change risk assessments identify the likelihood of future climate hazards and their potential impacts. This is fundamental for informing the prioritisation of climate action and investment in climate action.

## Nature of Climate Change Risk Assessment

Conventional 'predict and act' approaches to risk assessment are challenged by the inherent uncertainty associated with climate change, the spatial and temporal dynamics of climate change, the amplification of risk through societal preferences and values and through the interaction of multiple risk factors.

In assessing climate change risk for Westmeath County Council, the risk assessment framework of the Intergovernmental Panel on Climate Change (IPCC) has been adopted. This framework identifies three key components of climate risk: hazard, exposure and vulnerability. Details of the framework are provided to the right.



Source: Local Authority Climate Action Plan Guidelines, Technical Annex B, Figure 1. (page 5)



# Methodology Climate Change Risk Assessment (CCRA)

## Qualitative Assessment

This Climate Change Risk Assessment has been undertaken in accordance with *Technical Annex B Climate Change Risk Assessment* of the Local Authorities Climate Action Plan Guidelines and provides a qualitative assessment of climate risk for County Westmeath.

A qualitative risk assessment provides the evidence base to identify potential climate risks for the administrative area of Westmeath County Council and for the delivery of services by Westmeath County Council.

The Technical Annex B provides a stepped approach to carrying out a climate change risk assessment:

1. Assess the climate impact baseline, identifying, assessing and characterising the climate and weather-related impacts already being experienced by the authority, and
2. Identify and assess potential future climate impacts and risks.

In assessing climate change risk, we employ climate information derived from *Nolan and Flanagan (2020)* and *Climate Ireland* for two climate scenarios, RCP4.5 and RCP 8.5.

- RCP4.5 represents an 'intermediate emissions' scenario with an average global warming of 1.4°C for the 2046-2065 period.
- RCP8.5 represents a 'very high emissions' scenario with an average global warming of 2°C for the 2046-2065 period.

The RCP8.5 scenario was used as it represents a 'worst-case' scenario which allows for a conservative risk assessment approach.

### Qualitative

- A qualitative assessment is developed based on readily available information and provides for a screening of climate change related hazards and risks.
- This type of assessment helps to:
  - Identify the full range of climate-related risks;
  - Communicate identified risks to relevant stakeholders;
  - Prioritise risks for further more detailed analysis; and
  - Provide a broad understanding of where adaptation actions could be required.

### Semi-quantitative

- A semi-quantitative risk assessment builds upon a qualitative screening assessment and provides a more detailed assessment of climate change risks. Semi-quantitative risk assessments use national and regional information and data along with expert judgement to explore potential risks in further detail.
- This type of assessment helps to:
  - Provide semi-quantitative risk analysis insights;
  - Identify on a spatial basis climate risk hotspots;
  - Identify where adaptation measures may be required.

### Quantitative

- A quantitative risk assessment uses site-specific data and expert knowledge to establish a detailed understanding of risks and identify the point in time in the future when the risk will pass the tolerable limit and when implementation of action will be necessary.
- This type of assessment helps to:
  - Detail an estimation of rate of change (when the risk will cross the limit and need action); and
  - Identify the extent of impact (how badly it will affect the system).

# Methodology Overview

As detailed below, **Technical Annex B Climate Change Risk Assessment** provides for a proportionate and stepped approach for undertaking a Tier 1 Climate Change Risk Assessment. An assessment of the current climate hazards, exposure, vulnerabilities and impacts leads to the '**Current Climate Risks and Impacts**'. This is followed by an assessment of future climate risks and impacts, resulting in the '**Future Climate Risks and Impacts**'. The detailed steps for both current and future climate risk and impacts are discussed in further pages.

## Step 1. Current Climate Risks and Impacts

- Develop Profile of Climate Hazards
- Characterise Climate Hazards Frequency
- Exposure, Vulnerability and Impacts for County Westmeath
- Impact Assessment (Service Delivery)
- Current Climate Risk Matrix

## Step 2. Future Climate Risks and Impacts

- Assess Future Changes in Climate Hazards Frequency and Intensity
- Assess Future Change in Exposure and Vulnerability
- Assess Emerging Hazards and Potential Future Climate Risks
- Future Climate Risk Matrix
- Uncertainty Assessment



# Step 1: Assess Current Climate Risks and Impacts

In assessing current climate risks and impacts, developing an understanding of the range of climate and weather related events currently affecting County Westmeath and the consequence of these for Westmeath County Council is essential. To achieve this, a number of steps have been undertaken as detailed below:

## 1.1

### Develop Profile of Climate Hazards

The climate hazard profile provides an overview of climate and weather-related hazards to have impacted the County Westmeath.

We have updated the climate hazard profile developed through the existing Westmeath County Council Climate Adaptation Strategy (2019) in accordance with recent experiences of extreme weather and climate variability.

Section 3.2.1

## 1.2

### Characterise Climate Hazards-Frequency

On the basis of the most up-to-date information on extreme weather events and observed climate changes for Ireland, the frequency of occurrence of the climate hazards identified through the climate hazard profile has been assessed according to the criteria provided through **Technical Annex B: Climate Change Risk Assessment**.

Section 3.2.1

## 1.3

### Exposure, Vulnerability and Impacts for County Westmeath

For each of the climate hazards identified through the climate hazard profile, an assessment of the local-scale impacts, exposure, and vulnerability has been performed based on reported impacts and in discussion with the local authority.

Section 3.2.2

## 1.4

### Impact Assessment (Service Delivery)

The level of disruption to the delivery of services by the council has been assessed for each of the identified climate hazards following the criteria provided through **Technical Annex B: Climate Change Risk Assessment**.

Section 3.2.3

## 1.5

### Current Climate Risk Matrix

The overall impact of the identified climate hazards has been assessed according to the following categories of exposure: Asset Damage, Health and Wellbeing, Environment, Social, Financial, Reputation and Cultural Heritage. A summary of current climate impacts has been provided through a current climate risk matrix.

Section 3.2.4

# Step 2: Assess Future Climate Risks and Impacts

Building on the assessment of current climate impacts, assessing future climate risks and impacts is concerned with understanding and characterising how projected changes in the frequency and intensity of climate hazards may exacerbate existing climate impacts and risks for County Westmeath. To achieve this, a number of steps have been undertaken and as detailed below:

## 2.1

### Assess Future Changes in Climate Hazards- Frequency and Intensity

The most up- to-date climate change projections have been employed to assess the changes in frequency and intensity of climate hazards identified through our assessment of current climate impacts.

Section 3.3.1

## 2.2

### Assess Future Change in Exposure and Vulnerability

To identify and assess the potential future changes in exposure and vulnerability, projections of potential changes in non-climatic factors (e.g. *County Development Plans, Regional Social and Economic Strategies*) have been examined. The assessment of the projected future impacts have been provided.

Section 3.3.2

## 2.3

### Assess Emerging Hazards and potential Future Climate Risks

In addition to those hazards and impacts identified through the current climate impact and risk assessment, projected climate change may result in new or emerging risks. Emerging risks for County Westmeath have been identified and considered as part of the CCRA.

Section 3.3.2

## 2.4

### Future Climate Risk Matrix

Accounting for projected changes in hazard, exposure and vulnerability, future climate risk has been assessed according to the following categories of exposure: Asset Damage, Health and Wellbeing, Environment, Social, Financial, Reputation and Cultural Heritage. A summary of potential future climate impacts is provided through a future climate risk matrix.

Section 3.3.3

## 2.5

### Uncertainty Assessment

In assessing future climate risks, there will be uncertainty in how hazards, exposure, and vulnerability will change. The level of uncertainty in projected changes in climate hazards, exposure, and vulnerability is assessed.

Section 3.3.4

# Data and Information Sources

As detailed below, a wide range of qualitative and quantitative and information was employed to inform the development of the CCRA for Westmeath County Council. The Westmeath Council Adaptation Strategy 2019-2024 was reviewed and updated using a range of national and local data sources. Climate Ireland was employed to access data and information on projected changes in the frequency and intensity of climate hazards accessed while the National Planning Framework, Westmeath County Council Development Plan 2021-2027 and the Regional Spatial and Economic Strategy for the Eastern and Midland Region were employed to assess future development patterns. In addition, a stakeholder workshop was held to garner further insights from Westmeath County Council.

Report Section	Sources
<b>Introduction and scope</b>	<ul style="list-style-type: none"> <li>Local Authority Climate Action Plan Guidelines, Technical Annex</li> </ul>
<b>Step 1: Current Climate Risks and Impacts</b>	<ul style="list-style-type: none"> <li>Environmental Protection Agency (EPA)</li> <li>Catchments.ie (EPA)</li> <li>Climate Status Report 2020 (<a href="#">Cámaro García and Dwyer, 2021</a>)</li> <li>Floodinfo.ie (Office of Public Works)</li> <li>Data.gov.ie</li> <li>Department of Transport</li> <li>Department of Housing, Local Government and Heritage</li> <li>Department of Culture, Heritage, and the Gaeltacht</li> <li>Department of Transport, Sport and Tourism</li> <li>National Directorate for Fire and Emergency Management</li> <li>Teagasc</li> <li>Westmeath County Council Website</li> <li>Westmeath County Council Adaptation Strategy 2019-2024</li> <li>Sectoral Climate Change Adaptation Strategies (2018)</li> <li>Stakeholder Workshop</li> <li>Met Éireann</li> <li>RTE News</li> <li>Irish Independent</li> <li>Irish Examiner</li> <li>The Irish Times</li> <li>The Irish Mirror</li> <li>The Journal</li> <li>The Farmers Journal</li> <li>Former Midland</li> <li>Westmeath Independent</li> <li>Westmeath Examiner</li> </ul>
<b>Step 2: Future Climate Risks and Impacts</b>	<ul style="list-style-type: none"> <li>High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (<a href="#">Nolan and Flanagan, 2020</a>) accessed via Climate Ireland</li> <li>Regional Spatial &amp; Economic Strategy for the Eastern and Midland Region</li> <li>Transport Infrastructure Ireland</li> <li>Westmeath County Development Plan 2021-2027</li> </ul>



# 3.2

# Current Climate Risks and Impacts

# 3.2.1 Profile of Climate Hazards (incl. Frequency)

# Characteristics of County Westmeath

County Westmeath, known as the Lake County, is in the 'Midland Region' of the Eastern and Midlands Regional Assembly (EMRA) and serves 95,840 people (2022 Census). The county has a tradition of beef and dairy production and its geographic centrality ensures it is an easily accessible place and a focal point for economic development within the Midlands.

## Physical & Environmental Characteristics

Located in the centre of the Irish Midlands, Westmeath covers an area of 1,756 km<sup>2</sup> and is bounded by counties Cavan, Meath, Offaly, Roscommon and Longford.

The county supports a wide range of habitat types and landscapes including peatlands, lakes, canals, woodlands, wetlands, grasslands, eskers and hedgerows. Important natural sites include the Hill of Uisneach, Cavestown and Knockeyon Woods, Rivers Shannon and Brosna, Loughs Ree, Owel, Ennell, Derravaragh, Lene and Sheelin. Peatlands are a prominent part of Westmeath's landscape and cover about 17,000 ha or 9% of the county.

The county has an established waterway network, including the Royal Canal Paddling Trails which is part of the Blueways, a network of navigable inland waterways. The county is also part of the Royal Canal Greenway, an off-road cycling trail along the canal banks which extends from the River Shannon in Cloondara Co. Longford all the way towards Dublin.

The county also has an extensive and diverse range of geological heritage sites including Mount Temple Esker and Clonthead Mushroom Rock.

## Socioeconomic Characteristics

As of the 2022 Census, Westmeath has a population of 95,840 people, increasing by 7,070 since the 2016 Census. The county has experienced relatively steady population growth over recent years and has an almost exactly equal gender breakdown. There are four electoral areas in the county, including Mullingar, Kinnegad, Moate and Athlone which form the Mullingar-Kinnegad and Athlone-Moate Municipal Districts.

In 2016, 53.8% (2011: 48.54%) of people were living in urban settlements while 46.1% (2011: 51.46%) were living in smaller towns, villages and rural areas. Approximately 70% of the county's total land area is employed for agriculture, with the remaining land used for purposes including equine, recreation and tourism.

During the period 2011-2016, the two main towns, Athlone and Mullingar, experienced a population increase of 5.9% and 4.1%, respectively with both town's populations now exceeding 20,000. Athlone, located partially in County Westmeath and County Roscommon, has been designated a "Regional Growth Centre" (i.e. a large town with a high level of self-sustaining employment and services). As a result, the town both acts as a regional economic driver and

plays a significant role for a wide catchment area. Mullingar, meanwhile, is classified as a "Key Town" and plays an important role in the region.

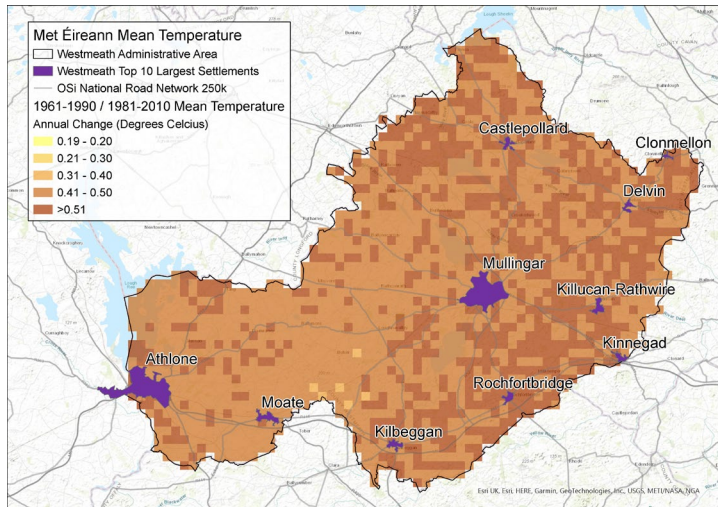
Within the Midlands region, County Westmeath is a focal point for economic development and modern industry. In 2016, the county's employment was largely concentrated in the Professional Services (23%), Commerce and Trade (22%) and Manufacturing Industries (13%). Notable industry in the county include Ericsson, Alexion Pharma, and Technological University of the Shannon. A recently approved energy plant project by Lumcloon Energy is expected to provide future 'green' jobs.

Westmeath lies on the road network of the M6 to the West and M4 to the Northeast. In addition, the Dublin-Galway and Dublin-Sligo railway passes through the County, with stops in Athlone and Mullingar. These high quality transport connections have ensured that Westmeath remains accessible, and have helped the county to grow.

As of 2016, the County had an average age of 36.3 years, with a substantial proportion of its population (almost 65%) of working age (i.e. persons aged 15 to 64). In 2016, 36% of the population had completed a Level 6 or higher on the National Framework of Qualifications. The county's Household Median Gross Income in 2016 was €42,332 and in 2021 the council provided 945 Housing Assistance Payments.



# Observed Changes in Westmeath's Climate



To assess changes in climatic conditions across County Westmeath, we have employed data from Met Éireann's network of meteorological and climatological stations, specifically 'Mullingar'. To establish a long-term climatology, a 30-year period of data is required.

In line with global trends, the climate of Ireland and Westmeath is changing, temperatures are increasing and patterns of precipitation are changing. A summary of key climate and weather-related changes already observed for County Westmeath are detailed below.

## Highlights of Observed Climate Change for Ireland and Westmeath

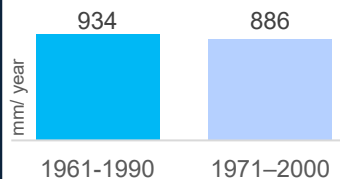
### Droughts



The 2018 Drought was one of the Westmeath's longest running absolute droughts, lasting 14 days in total

### Rainfall

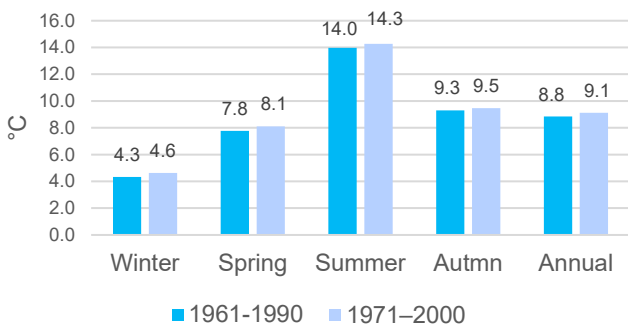
Average annual rainfall at Mullingar station decreased by 0.3% for the most recent period of observations (1971-2000) compared to the 1961-1990 baseline of the station\*



# 0.3°C

Average temperature increase for the period 1971-2000 has increase by 0.3°C when compared to the 1961-1990 baseline\*

### Mean Seasonal Temperatures\*



# 30.4°C

Highest temperature on record for West Meath, recorded on July 18<sup>th</sup> 2022 at Mullingar station

**2012 was the wettest year on record for Westmeath with the average annual precipitation levels across all stations being 108% above the 1961-1990 baseline\***

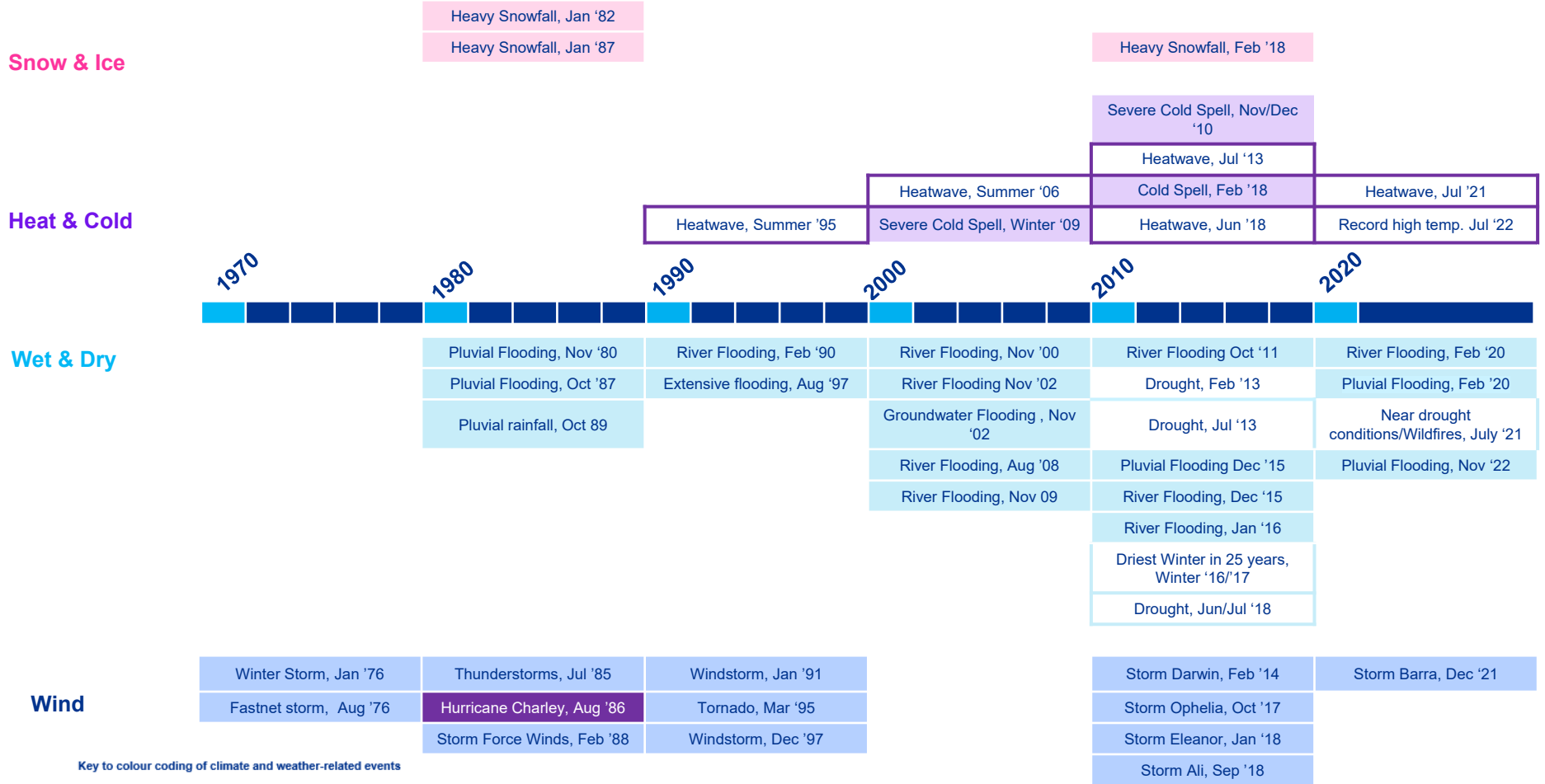
\*Source: Met Éireann Long term weather station : Mullingar (Closed 2008)



**2020 Saw the river Shannon bursting it's banks which caused flooding and property damage to in several areas including Athlone and Castletown Geoghegan.**

# Climate Hazard Profile

In addition to observed changes in Westmeath's climate, we have identified significant climate and weather-related events to have impacted on County Westmeath over the period 1976-2022. To do this, we have further developed the existing climate hazard profile developed through the existing Westmeath County Council Adaptation Strategy (2019) and expanded the analysis to cover the period 2018-2022



Key to colour coding of climate and weather-related events

- Snowfall
- Cold spell
- Heatwave
- Hurricane
- Pluvial/ Fluvial Flooding
- Windstorm
- Drought

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# Frequency of Climate Hazards

For each of the climate hazards that have been identified through the climate hazard profile, an assessment of their frequency of occurrence has been conducted. Each hazard was assigned a frequency category according to Table 2 of the **Technical Annex B Climate Change Risk Assessment Guidelines** (top right).

Based on the climate hazard baseline, severe windstorm events have impacted upon County Westmeath most frequently over the period 2006-2022, with river and pluvial flooding and heatwaves also affecting the County on a number of occasions. Cold spells, heavy snowfall events, and droughts have also impacted County Westmeath, but less frequently.

The hazard frequency for each hazard is shown in the bottom right table, informed by past event occurrence and information received from County Westmeath Council.

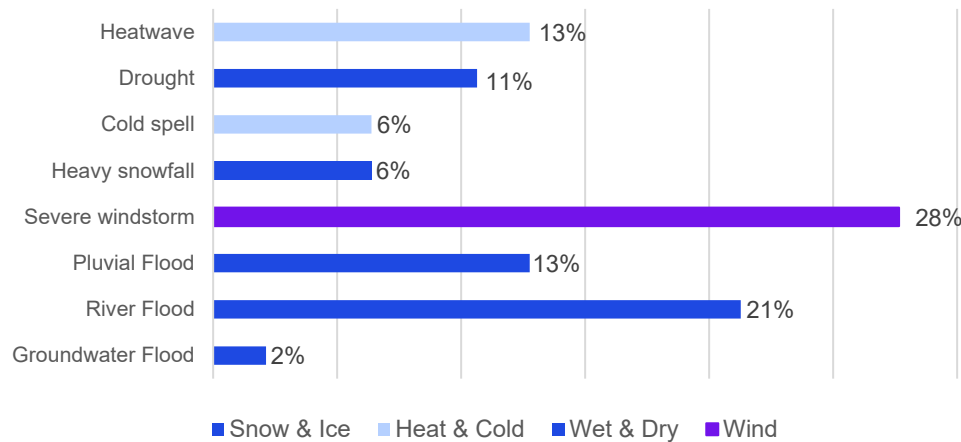
**Frequency classification from Technical Annex B Climate Change Risk Assessment Guidelines**

Frequency	Frequency Occurrence in a Year	Description
Very Frequent	> 100%	Occurs several times in a single year
Frequent	50 to 100%	Occurs once in a 1-to-2-year period
Common	10 to 50%	Occurs once in a 2-to-10 years period
Occasional	1 to 10%	Occurs once in a 10-to-100-year period
Rare	< 1%	Occurs once in over 100 years

**Current hazard frequency for County Westmeath, based upon analysis of past events and workshop feedback**

Hazard Type	Current Frequency
Heatwave	Common
Drought	Occasional
Cold Spell	Occasional
Heavy Snowfall	Occasional
Severe Windstorm	Frequent
Pluvial Flood	Frequent
River Flood	Frequent
Groundwater Flood	Occasional

**Frequency of Identified Events According to Category (1976-2022)**





# 3.2.2 Exposure, Vulnerability and Impacts for County Westmeath

# Exposure, Vulnerability and Impacts for County Westmeath

Key to colour coding of impact ratings
Catastrophic
Major
Moderate
Minor
Negligible

On the basis of identified exposures, vulnerabilities and impacts for County Westmeath, the impact of climate and weather-related hazards on key categories of exposure for County Westmeath was assessed according to the criteria provided through Technical Annex B: Climate Change Risk Assessment (catastrophic, major, moderate, minor and negligible) (Appendix 2). This assessment was undertaken on the basis of existing information on impacts and in consultation with Westmeath County Council.



Below we provide a summary of impacts across the key categories of exposure for the seven climate hazards identified. The following pages provides the information that informed this assessment with additional information provided in Appendix 3.

Hazard	Current Frequency	Assets	Health and Wellbeing	Environment	Social	Cultural Heritage	Financial	Reputational	Overall Impact Score
Heatwave	Common	Moderate	Negligible	Moderate	Minor	Negligible	Minor	Negligible	1.9
Drought	Occasional	Negligible	Negligible	Moderate	Minor	Minor	Negligible	Negligible	1.6
Cold Spell	Occasional	Moderate	Moderate	Negligible	Moderate	Negligible	Moderate	Negligible	2.1
Heavy Snowfall	Occasional	Minor	Moderate	Minor	Minor	Negligible	Moderate	Minor	2.1
Severe Windstorm	Frequent	Moderate	Minor	Negligible	Moderate	Minor	Moderate	Minor	2.3
Pluvial Flood	Frequent	Moderate	Minor	Minor	Minor	Negligible	Minor	Moderate	2.1
River Flood	Frequent	Moderate	Minor	Minor	Minor	Negligible	Moderate	Moderate	2.3
Groundwater Flood	Occasional	Negligible	None	Negligible	Negligible	None	Negligible	None	0.6

# Impacts of Current Climate Risks – Heatwaves & Drought

Key to colour coding of impact ratings
Catastrophic
Major
Moderate
Minor
Negligible

County Westmeath has been exposed to heatwave events (defined as 5 consecutive days with temperatures >25 deg. C) over the period 1976-2022 with a wide range of impacts across the county. The most notable and costly impact relates to repair and maintenance of road surfaces and responding to uncontrolled fires. In addition, County Westmeath has experienced drought conditions over the period as exemplified by the drought events in 2013, 2016/2017, 2018 and 2021.

Hazard & Frequency	Exposure	Impact Description	Rating
 Heatwave Common	<b>Assets</b>	<ul style="list-style-type: none"> <li>High temperatures have resulted in localised damage to road surfaces (tar and chip) across the County. In 2018, this resulted in Westmeath County Council spending €8,000 a day for two weeks carrying out repair work.</li> </ul>	Moderate
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>High indoor temperatures have resulted in uncomfortable working conditions for staff and public and has the potential for impacts on heat sensitive equipment (e.g., Council laboratories). This has resulted in the increased requirement for active/mechanical cooling.</li> </ul>	Negligible
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Heat waves provide suitable conditions for the ignition of uncontrolled fires, with high temperatures in 2021 leading to 27 wild fires reported throughout the county.</li> <li>High water temperatures associated with heatwave events have also had significant impacts on freshwater and marine environments.</li> </ul>	Moderate
	<b>Social</b>	<ul style="list-style-type: none"> <li>Heatwaves have resulted in congestion at key recreational areas with facilities (e.g., litter collection and parking) overwhelmed.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Extreme temperatures are recognised as contributing to the increased weathering of cultural heritage sites.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of heatwaves are primarily associated with road maintenance and repair.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Heatwaves have had a negligible reputational impact for Westmeath County Council</li> </ul>	Negligible
 Drought Occasional	<b>Assets</b>	<ul style="list-style-type: none"> <li>Drought conditions (e.g. Summer 2018) resulted in the imposition of restrictions on water supply on a national and county basis with implications for building operation.</li> </ul>	Negligible
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>Water restrictions, particularly in combination with extreme heat, have the potential to result in dehydration, this is particularly the case for vulnerable populations and outdoor workers.</li> </ul>	Negligible
	<b>Environment</b>	<ul style="list-style-type: none"> <li>High temperatures and dry conditions, often compounded by high levels of ignition activity, have resulted in uncontrolled fires. In 2021 this led to 27 wild fires throughout the county.</li> </ul>	Moderate
	<b>Social</b>	<ul style="list-style-type: none"> <li>Water restrictions can lead to inconvenience for local businesses and resident. Between 10pm on the 11<sup>th</sup> of July 2018 and 6am on the 12<sup>th</sup> of July 2018, Irish Water cut water supplies to customers in Athlone as a result of water levels dropping precipitously in the Annagh reservoir. Low water levels we also recorded at Lough Owel in 2018 resulting in the imposition of water restrictions.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Drought conditions results in damage to cultural heritage sites due to drying out of substrate.</li> </ul>	Minor
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of drought are limited and restricted to responding to wildfire and supporting the provision of water (e.g., tankering).</li> </ul>	Negligible
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>The reputational impacts of drought conditions are limited and localised.</li> </ul>	Negligible

# Impacts of Current Climate Risks – Cold Spells & Heavy Snowfall

County Westmeath experience cold spells and heavy snowfall events on an occasional basis with significant county wide events reported in 2010 and 2018 (the ‘Beast from the East’). These events have wide ranging impacts across the County including disruption of transport routes, damage to buildings, and significant repair and maintenance costs.

**Key to colour coding of impact ratings**

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
 <p>Cold spell</p> <p>Occasional</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Cold spells have resulted in road closure, transport disruption and increased maintenance and repair costs across the county. In February 2020 icy conditions were the cause of the closure of the N55 in Westmeath after a serious road accident.</li> <li>Freeze thaw action has resulted in damage to critical infrastructure (e.g., water infrastructure) and building stock.</li> <li>Extreme cold conditions in combination with snowfall have resulted in the widespread closure of business (incl. LA business services). Storm Emma in 2018 led to the shutdown of many businesses in the county for 3 days.</li> </ul>	Moderate
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>Extreme cold has resulted in treacherous conditions and increased incidence of slips and falls.</li> <li>Exposure to extreme cold has had detrimental impacts for outdoor workers and vulnerable populations.</li> </ul>	Moderate
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Cold spells have led to decreased water availability and have detrimental impacts for biodiversity and habitats, resulting in a decrease of ecosystem health.</li> </ul>	Negligible
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures have resulted in social isolation for remote communities.</li> <li>Elderly and vulnerable populations are required to stay in place resulting in isolation.</li> </ul>	Moderate
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Freeze thaw has been identified as having detrimental impacted on the structural integrity of cultural heritage sites.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and assets, and can be significant.</li> </ul>	Moderate
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Isolation of communities and council response (e.g., gritting) across the county receives media attention but with limited reputational impact for County Westmeath.</li> </ul>	Negligible
 <p>Heavy snowfall</p> <p>Occasional</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Heavy snowfall has resulted in road closures and transport disruption as evidenced with the closure of roads across the county as a result of Storm Emma (2018), which led to the N52 and many local roads being impassable and severe disruption to roads in Athlone and Mullingar.</li> <li>Accumulations of snowfall on roofs results in damage to buildings. Flooding post-heavy snowfall events results in the flooding of assets (e.g., roads and infrastructure).</li> </ul>	Minor
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>Extreme cold events have resulted in treacherous conditions and increased incidence of slips and falls amongst public and staff.</li> </ul>	Moderate
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Flooding post-heavy snowfall event results in overland flow of pollutants to habitats and ecosystems with detrimental effects.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for remote communities.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Accumulations of heavy snowfall can result in damage to cultural heritage sites.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and assets</li> </ul>	Moderate
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Isolation of communities and council response (e.g., gritting) across the county receives media attention but with limited reputational impact for the county.</li> </ul>	Minor



# Impacts of Current Climate Risks - Windstorms

County Westmeath has been frequently exposed to wind storms over the period 1976-2022, notable examples being Storms Eleanor, Barra and Ophelia. Impacts have been experienced across the county and primarily relate to disruption of transport, electricity and communication networks. Severe windstorms also result in health and safety risks, e.g. associated with treefall.

**Key to colour coding of impact ratings**

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
Severe windstorm	Assets	<ul style="list-style-type: none"> <li>Windstorms has caused direct damage to building stock and other assets, and disruption to their function. Storm Ophelia in 2017 resulted in Westmeath County Council offices being closed for a day.</li> <li>Windstorm damage to power and communication transmission infrastructure (e.g., tree fall on overhead lines) has resulted in disruption of communications and energy supply. Storm Barra in 2021 led to 800 homes in Moate and 246 homes in Ballykeeran going without power. Mullingar suffered power outages due to Storm Ali in 2018 and Storm Elsa in 2019.</li> <li>Windstorms have caused disruption of transport routes as a result of treefall. Storm Ali in 2018 led to delays to train services to and from Athlone.</li> </ul>	Moderate
	Health and Wellbeing	<ul style="list-style-type: none"> <li>Windstorms posed a health and safety risk with potential for injury.</li> </ul>	Minor
Frequent	Environment	<ul style="list-style-type: none"> <li>Windstorms have resulted in loss of trees and this is particularly the case for vulnerable tree species.</li> <li>Windstorms prevent council staff from safely taking accurate water samples from lakes, hindering monitoring of water quality.</li> </ul>	Negligible
	Social	<ul style="list-style-type: none"> <li>Severe windstorms and disruption of transport and communication networks has resulted in isolation of communities.</li> </ul>	Moderate
	Cultural Heritage	<ul style="list-style-type: none"> <li>Severe wind storms can cause structural damage to cultural heritage sites.</li> </ul>	Minor
	Financial	<ul style="list-style-type: none"> <li>The financial impacts of severe wind storm are associated with clean-up and repair cost.</li> </ul>	Moderate
	Reputational	<ul style="list-style-type: none"> <li>Reputational damage as a result of wind storms is limited and associated with short term media reporting on council preparedness and response.</li> </ul>	Minor





# Impacts of Current Climate Risks - Pluvial and River Flooding

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

For County Westmeath in the period 1976-2022, pluvial and river flooding have occurred on a frequent basis. Areas of exposure to river flooding are limited geographically but with the potential for frequent exposure.


Hazard & Frequency	Exposure	Impact Description	Rating
 Pluvial flood  Frequent	<b>Assets</b>	<ul style="list-style-type: none"> <li>Pluvial flooding has resulted in the temporary inundation of assets. In 2019, properties in the Killucan/Rathwire settlement are inundated, as are properties in in Tyrrellspass.</li> <li>Pluvial flooding results in damage to road surfaces and disruption of transport. Flooding in Athlone in 2020 saw major disruption to multiple routes including the Ballymahon Road railway bridge, Coosan Road, the junction of Auburn and Millmount Road, and Ballindery near the Dog Track. Heavy rainfall in November 2022 resulted in multiple roads in Mullingar being flooded, including the Ballindery road and the junction of Auburn and Millmount Road.</li> </ul>	Moderate
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public</li> </ul>	Minor
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Pluvial flooding has resulted in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems.</li> <li>Pluvial flooding can lead to issues with sewage systems. During periods of heavy rainfall in 2019 the contents of combined sewers in Athlone, a mixture of raw sewage and storm water, were released into the Shannon and the Athlone Canal.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for communities.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Pluvial flooding puts built heritage with stone cavities at risk of soakage and leakage.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of emergency response (e.g. pumping and emergency co-ordination, clean-up and repair) can be significant.</li> <li>Increased budget pressure to adapt to impact of climate change, e.g. flood protection measures and upgrading of existing drainage systems.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Pluvial flooding issues are localised but can result in reputational damage to the council.</li> </ul>	Moderate
 River flood  Frequent	<b>Assets</b>	<ul style="list-style-type: none"> <li>River flooding has resulted in the temporary inundation of buildings. February 2020 saw multiple areas of Athlone affected by floodwaters from the River Shannon bursting its banks. Castletown Geoghegan was also affected. Heavy rains in November 2022 caused the Brosna river to overflow in Mullingar town, flooding properties.</li> <li>River flooding results in transport disruption and road closures.</li> <li>River flooding and fast flowing rivers can cause damage to bridges through hydrodynamic scour or inundation.</li> </ul>	Moderate
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public</li> <li>Fluvial floods can carry debris which can lead to injury of residents and pedestrians</li> </ul>	Minor
	<b>Environment</b>	<ul style="list-style-type: none"> <li>River flooding can result in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for communities</li> <li>Inhibited development of communities as a result of frequent river flooding</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>A number of the county's cultural heritage and archaeological sites are situated near river systems and are particularly exposed to river flooding.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of fluvial flooding are associated with Increased costs associated with preparedness (e.g., sandbags and demountable defences) emergency response (e.g. pumping and emergency co-ordination), clean-up and repair.</li> </ul>	Moderate
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>For areas that are subject to frequent inundation, there is the potential for localised reputational damage.</li> </ul>	Moderate

# Impacts of Current Climate Risks – Groundwater Flooding

For the period 1976-2022, groundwater flooding has occurred on an occasional basis with limited impact.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact description	Rating
 <p>Groundwater Flood</p> <p>Occasional</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Ground water flooding has resulted in repeated flooding of farmland. The turlough at the western edge of Moate has been record as flooding following heavy rain, notably in 2019.</li> </ul>	Negligible
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	None
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Potential for detrimental environmental impact.</li> </ul>	Negligible
	<b>Social</b>	<ul style="list-style-type: none"> <li>Potential to result in social isolation.</li> </ul>	Negligible
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	None
	<b>Financial</b>	<ul style="list-style-type: none"> <li>Response but limited amounts.</li> </ul>	Negligible
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	None

# 3.2.3 Impact Assessment (Service Delivery)



# Summary of Service Level Impacts

**Key to colour coding of impact ratings**

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

The impacts of climate change hazards on County Westmeath will have direct and indirect consequences for the delivery of services by Westmeath County Council before, during and after climate and weather-related event.

On the basis of reported information and in consultation with Westmeath County Council, an assessment of the impacts of identified climate change hazards and impacts on the delivery of services by Westmeath County Council was undertaken in accordance with the criteria provided through Technical Annex B: Climate Change Risk Assessment (Appendix 2), with each service delivery area assigned an impact category of either negligible, minor, moderate, major, or catastrophic.

Below we provide a summary of the impacts on the delivery of services of Westmeath County Council as a result of the climate hazards identified within the climate hazard profile. This assessment was undertaken in accordance with the criteria provided through **Technical Annex B: Climate Change Risk Assessment (see appendix 1)**, with each service delivery area assigned an impact category of either negligible, minor, moderate, major, or catastrophic. The following pages provide the detailed information that informed this assessment.

Hazard	Business Services	Roads, footpaths, bridges: construction and maintenance	Building Stock	Community Infrastructure	Cultural Heritage	Stormwater / Sewerage	Wastewater*	Water Supply*	Water Quality	Biodiversity	Community Development	Emergency Response
Heatwave	Minor	Moderate	Minor	Minor	Minor	None	None	Moderate	Minor	Minor	Minor	Moderate
Drought	None	None	None	None	Minor	None	None	Minor	Minor	Minor	Minor	Moderate
Cold spell	Minor	Moderate	Minor	Minor	Minor	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Heavy snowfall	Moderate	Moderate	Moderate	Moderate	Moderate	None	None	Minor	Minor	Minor	Moderate	Moderate
Severe Windstorm	Moderate	Moderate	Moderate	Moderate	Moderate	None	Moderate	Moderate	Negligible	Moderate	Moderate	Moderate
Pluvial Flood	Minor	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Moderate	Moderate	Minor
River Flood	Minor	Moderate	Moderate	Moderate	Moderate	None	None	Minor	Minor	Moderate	Moderate	Moderate
Groundwater Flood	None	Minor	None	None	None	None	None	None	None	None	None	Minor

\*Delivered through a Service Level Agreements (SLA) with Irish Water

# Service Level Impacts (Heatwaves & Drought)

**Key to colour coding of impact ratings**

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Heatwaves and drought result in a range of impacts for service provision by Westmeath County Council. The primary impacts relate to increased maintenance and repair requirements of road surfaces and increased pressure on emergency response as a result of the increased incidence of uncontrolled fire. Decreased levels of water supply due to drought conditions put increased pressure on LA staff working under the Service Level Agreement (SLA) with Irish water. In addition, high temperatures result in staff and public discomfort and an increased requirement for mechanical and passive cooling. Heatwaves and drought put additional pressure on community infrastructure such as parks.

	Heatwaves	Drought
<b>Business Services</b>	<ul style="list-style-type: none"> <li>Decreased staff productivity and increased staff and customer discomfort.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Roads, footpaths, bridges, construction and maintenance</b>	<ul style="list-style-type: none"> <li>Increased costs associated with repair of road surfaces at a county wide level.</li> <li>Increased health and safety risk for outdoor staff members.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Building Stock</b>	<ul style="list-style-type: none"> <li>Increased requirement for cooling in council offices/buildings.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Community Infrastructure</b>	<ul style="list-style-type: none"> <li>Increased requirement for wate collection and traffic management at key recreational sites.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Increased requirements for monitoring and maintenance of cultural heritage sites.</li> </ul>	<ul style="list-style-type: none"> <li>Localised degradation of cultural heritage sites due to drying out.</li> <li>Increased requirements for monitoring and maintenance of cultural heritage sites.</li> </ul>
<b>Stormwater / Sewerage</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Wastewater</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Supply</b>	<ul style="list-style-type: none"> <li>Increased supply demand for water to cool infrastructure, communities, and livestock.</li> <li>Implementation of water conservation measures (e.g., hosepipe bans).</li> </ul>	<ul style="list-style-type: none"> <li>Increased requirement to support provision of water to local communities suffering loss of water supply (e.g., Tankering).</li> <li>Impact on waterbodies level.</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>Reduced water flows impacting on water quality in local areas with increased requirement for monitoring and remediation.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced water flows impacting on water quality in local areas with increased requirement for monitoring and remediation.</li> <li>Impact on waterbodies levels.</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>Decreased ecosystem health in local areas with potential for loss of priority habitats resulting in increased requirement for monitoring and remediation.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced water flows impacting on biodiversity with potential for loss of priority species and habitats necessitating increased monitoring and remediation.</li> </ul>
<b>Community Development</b>	<ul style="list-style-type: none"> <li>Increased requirement for management at congested sites.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced grass growth causing increased supplementary feed requirement for cattle reducing farm incomes and the wider industry.</li> </ul>
<b>Emergency Response</b>	<ul style="list-style-type: none"> <li>Increase in number of wildfire call-outs across the county.</li> <li>Increase in number of call out to bathing areas throughout the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increase in number of uncontrolled fire call-outs across the county.</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Health and Safety of Staff</li> </ul>	

# Service Level Impacts (Cold Spell & Heavy Snowfall)

Key to colour coding of impact ratings

Catastrophic

Major

Moderate

Minor

Negligible

Cold spells and heavy snowfall have significant impacts across County Westmeath with direct and indirect consequences for the delivery of services by Westmeath County Council. Impacts are related primarily to maintenance and repair of assets and infrastructure, closure of local authority offices and services, and increased demand on emergency response.

	Cold Spell	Heavy Snowfall
<b>Business Services</b>	<ul style="list-style-type: none"> <li>Localised closure of business services.</li> <li>Impact on vehicle fleet (e.g. diesel engines, EVs)</li> <li>Health and safety risks for public and staff.</li> </ul>	<ul style="list-style-type: none"> <li>Closure of business services across the county</li> <li>Impact on vehicle fleet (e.g. diesel engines, EVs)</li> <li>Health and safety risks for public and staff</li> </ul>
<b>Roads, footpaths, bridges, construction and maintenance</b>	<ul style="list-style-type: none"> <li>Increased costs associated with gritting and salting roads across the county.</li> <li>Increased repair/maintenance costs.</li> </ul>	<ul style="list-style-type: none"> <li>Transport disruption and road closures</li> <li>Increased costs associated with gritting and salting roads and footpaths around the county.</li> </ul>
<b>Building Stock</b>	<ul style="list-style-type: none"> <li>Increased energy costs for buildings at a localised level.</li> <li>Increased health and safety risks for public and staff.</li> </ul>	<ul style="list-style-type: none"> <li>Increased energy costs for buildings county wide.</li> <li>Increased health and safety risks for public and staff county wide.</li> </ul>
<b>Community Infrastructure</b>	<ul style="list-style-type: none"> <li>Increased energy costs in community buildings.</li> <li>Increased health and safety risks for public and staff working in community buildings.</li> </ul>	<ul style="list-style-type: none"> <li>Increased health and safety risks for public and staff.</li> <li>Closure of services throughout local communities.</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Increased energy costs for cultural heritage sites.</li> <li>Increased health and safety risks for public and staff at community heritage sites.</li> </ul>	<ul style="list-style-type: none"> <li>Increased health and safety risks for public and staff.</li> <li>County wide closure of sites.</li> </ul>
<b>Stormwater / Sewerage</b>	<ul style="list-style-type: none"> <li>Reduced capacity for drainage resulting in standing water due to post cold spell events.</li> <li>Damage to stormwater infrastructure with increased requirement for maintenance and repair across the county.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Wastewater</b>	<ul style="list-style-type: none"> <li>Overland flows of pollutants due to post freezing events, causing contamination of water supplies necessitating increased monitoring and remediation.</li> <li>Damage to wastewater infrastructure with increased requirement for maintenance and repair.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Supply</b>	<ul style="list-style-type: none"> <li>Countywide water supply issues due damaged water supply infrastructure (e.g., burst pipes).</li> <li>Increased maintenance and repair costs of water service infrastructure across the county.</li> </ul>	<ul style="list-style-type: none"> <li>Localised water supply issues due damaged water supply infrastructure (e.g., burst pipes).</li> <li>Increased maintenance and repair costs of water service infrastructure.</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>Reduction and disruption of water supplies across the county due to decreased water quality necessitating increased requirement on council to supply water to affected communities.</li> </ul>	<ul style="list-style-type: none"> <li>Reduction and disruption of water supplies across the county due to decreased water quality necessitating increased requirement on council to supply water to affected communities.</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>Prolonged cold spells impacting species not protected from the frigid temperatures, with increased monitoring and remediation required across the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increased runoff resulting in mobilisation of pollutants to environmentally sensitive/biodiversity rich areas.</li> </ul>
<b>Community Development</b>	<ul style="list-style-type: none"> <li>Increased instances of community isolation county wide.</li> </ul>	<ul style="list-style-type: none"> <li>Increased instances of local community isolation.</li> </ul>
<b>Emergency Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response units across the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response units across the county.</li> <li>Increase in response times due to heavy snowfall on roads around the county.</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Redeployment of staff</li> </ul>	

# Service Level Impacts (Severe Windstorm)

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Severe windstorms can result in the closure and/or disruption of Westmeath County Council Offices and services. Primary impacts of severe windstorms are associated with disruption of services and infrastructure due to loss of power supply and communications, damage to local authority assets and infrastructure, increased pressure on emergency response and redeployment of staff to support clean-up following a severe windstorm event.

	Severe Windstorm
<b>Business Services</b>	<ul style="list-style-type: none"> <li>Widespread closure of business services.</li> <li>Health and safety risks for public and staff.</li> </ul>
<b>Roads, footpaths, bridges, construction and maintenance</b>	<ul style="list-style-type: none"> <li>County wide transport disruption and road closures affecting the wider community and local authority operations.</li> <li>Increased clean-up and repair costs after an event.</li> </ul>
<b>Building Stock</b>	<ul style="list-style-type: none"> <li>Closure of buildings and disruption of services as a result of direct damage to buildings and disruption of power.</li> </ul>
<b>Community Infrastructure</b>	<ul style="list-style-type: none"> <li>Disruption to delivery of community services across the county.</li> <li>Increased clean-up and repair costs after an event.</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Increased maintenance and repair costs due to storm damage to cultural heritage sites.</li> </ul>
<b>Stormwater / Sewerage</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Wastewater</b>	<ul style="list-style-type: none"> <li>Increased drain maintenance costs for wastewater infrastructure across the county.</li> </ul>
<b>Water Supply</b>	<ul style="list-style-type: none"> <li>Water supply issues due to damaged water supply infrastructure.</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>Negligible disruption to water quality monitoring.</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>High winds result in damage to habitats.</li> <li>Increased cost to protect habitats from wind damage.</li> </ul>
<b>Community Development</b>	<ul style="list-style-type: none"> <li>Increased power outages and damages to infrastructure result in an impact on local economy.</li> </ul>
<b>Emergency Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency services across the county.</li> <li>Increase in response times due to heavy snowfall on roads around the county</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Staff redeployment</li> </ul>



# Service Level Impacts (Pluvial & River Flood)

Pluvial and river flooding have resulted in a wide range of impacts for Westmeath County Council. Impacts are primarily associated with clean-up and repair costs, water quality issues due to overland flows of pollutants into water courses, damage to environmentally sensitive areas, increased pressure on emergency response services and supporting communities during and following flood events.

Key to colour coding of impact ratings
Catastrophic
Major
Moderate
Minor
Negligible

	Pluvial Flood	River Flood
<b>Business Services</b>	<ul style="list-style-type: none"> <li>Localised disruption and closure of local authority services.</li> </ul>	<ul style="list-style-type: none"> <li>Localised disruption and closure of local authority services.</li> </ul>
<b>Roads, footpaths, bridges, construction and maintenance</b>	<ul style="list-style-type: none"> <li>Widespread transport disruption and road closures.</li> <li>Increased clean-up and repair costs after an event.</li> </ul>	<ul style="list-style-type: none"> <li>Widespread transport disruption and road closures.</li> <li>Increased clean-up and repair costs after an event.</li> </ul>
<b>Building stock</b>	<ul style="list-style-type: none"> <li>Increased maintenance and repair costs</li> <li>Increased requirement for flood defence measures.</li> </ul>	<ul style="list-style-type: none"> <li>Increased maintenance and repair costs.</li> <li>Increased requirement for flood defence measures.</li> </ul>
<b>Community infrastructure</b>	<ul style="list-style-type: none"> <li>Closure of community infrastructure and services at a localised level.</li> <li>Increased repair and maintenance costs.</li> </ul>	<ul style="list-style-type: none"> <li>Countywide closure of community infrastructure and services.</li> <li>Increased repair and maintenance costs.</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Damage to heritage sites due to pluvial flooding requiring repair work.</li> <li>Increased maintenance and repair costs.</li> </ul>	<ul style="list-style-type: none"> <li>Damage to heritage sites due to river flooding requiring repair work</li> <li>Increased maintenance and repair costs.</li> </ul>
<b>Stormwater / Sewerage</b>	<ul style="list-style-type: none"> <li>Reduced capacity for drainage resulting in standing water.</li> <li>Damage to stormwater infrastructure at a localised level.</li> <li>Increased maintenance and repair costs.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Wastewater</b>	<ul style="list-style-type: none"> <li>Damage to wastewater treatment plants.</li> <li>Increased maintenance and repair costs.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Supply</b>	<ul style="list-style-type: none"> <li>Water supply issues at a localised level requiring supplemental water provision (e.g., tankering).</li> <li>Increased water treatment costs.</li> </ul>	<ul style="list-style-type: none"> <li>Water supply issues at a localised level requiring supplemental water provision (e.g., tankering)</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>Deterioration of water quality due to overland flow of pollutants resulting in water supply issues and environmental degradation and an increased requirement for monitoring and remediation.</li> </ul>	<ul style="list-style-type: none"> <li>Deterioration of water quality due to overland flow of pollutants resulting in water supply issues and an increased requirement for monitoring and remediation.</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>Severe damage across the county to environmentally sensitive areas requiring monitoring and/or restoration work.</li> </ul>	<ul style="list-style-type: none"> <li>Widespread damage to environmentally sensitive areas requiring monitoring and/or restoration work.</li> </ul>
<b>Community Development</b>	<ul style="list-style-type: none"> <li>Inhibited development of communities at a county wide level.</li> <li>Damage to buildings and travel disruptions across the county.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibited development of communities at a county wide level.</li> <li>Damage to buildings and travel disruptions impact on local economies across the county.</li> </ul>
<b>Emergency Response</b>	<ul style="list-style-type: none"> <li>Localised increased pressure on emergency response.</li> </ul>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response across the county.</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Staff redeployment</li> </ul>	

# Service Level Impacts (Groundwater Flood)

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Groundwater flooding result in a range of impacts for service delivery by Westmeath County Council. The impacts are primarily associated with repair of road surfaces, increased pressure on emergency response services and supporting communities during and following flood events.

	Groundwater Flood
<b>Business Services</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Roads, footpaths, bridges, construction and maintenance</b>	<ul style="list-style-type: none"> <li>Localised transport disruption and road closures affecting the wider community and local authority operations.</li> <li>Increased clean-up and repair costs after an event.</li> </ul>
<b>Building stock</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Community infrastructure</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Stormwater / Sewerage</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Wastewater</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Supply</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Community Development</b>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Emergency Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response services.</li> </ul>
<b>Crosscutting</b>	<ul style="list-style-type: none"> <li>Staff redeployment</li> </ul>

# 3.2.4 Current Climate Risk Matrix

# Current Climate Impact Matrix

Based on reported information and in consultation with Westmeath County Council, a current climate risk matrix for County Westmeath has been developed based on the frequency of hazard and the associated level of impact.

The assessment identified **river flood** and **severe windstorm** as posing the highest level of risk for County Westmeath with of river flood associated with damage to assets and infrastructure and potential for isolation of communities and vulnerable populations and impacts of severe windstorm primarily associated with disruption and damage to energy, communication and transport networks.

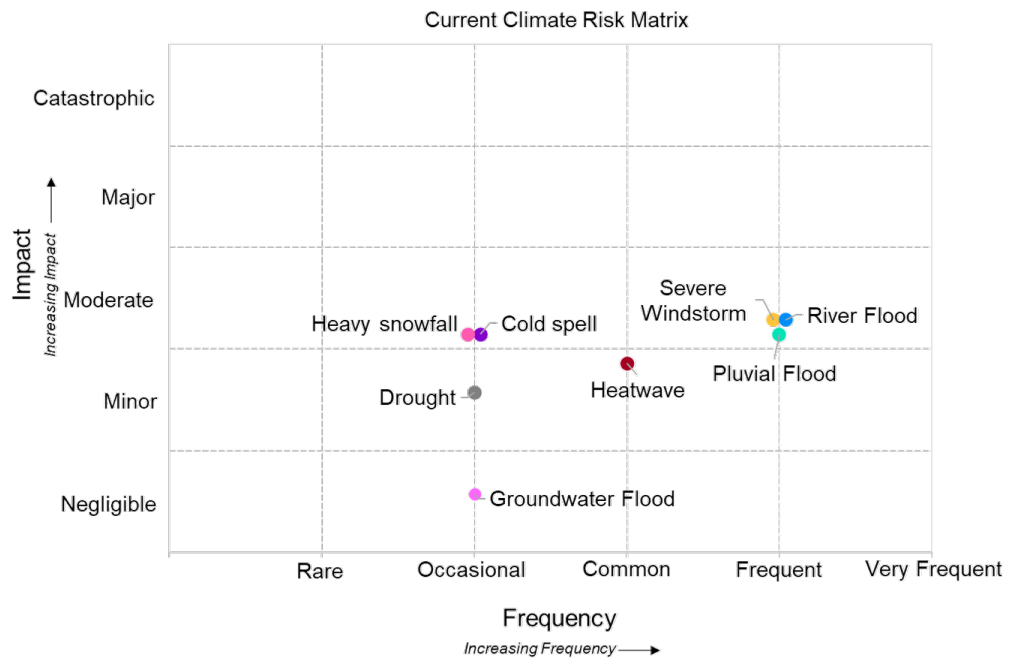
**Pluvial flooding** have been identified as posing a relatively high risk for County Westmeath with impacts associated with damages to road surfaces, disruption of transport networks and mobilisation of pollutants.

**Heatwaves** occur on a common basis across County Westmeath; however, the overall impact is currently considered minor. The impacts of heatwaves are associated with an increase in the frequency of uncontrolled fire, damage to road surfaces and increased pressure on recreational sites.

**Cold spells and heavy snowfall** also occur on an occasional basis across County Westmeath resulting in damages to critical energy, communication and water infrastructure while closure of transport infrastructure has the potential to result in isolation of remote communities.

During the current period, **droughts** have occurred on occasional basis but with relatively minor impacts and are associated with increases in the frequency of uncontrolled fires and disruption of water supply.

**Groundwater flooding** is considered to occur occasionally in County Westmeath with impacts associated with disruption of road transport and community isolation.



The risk matrix above shows the current risk for the identified hazards within County Westmeath.

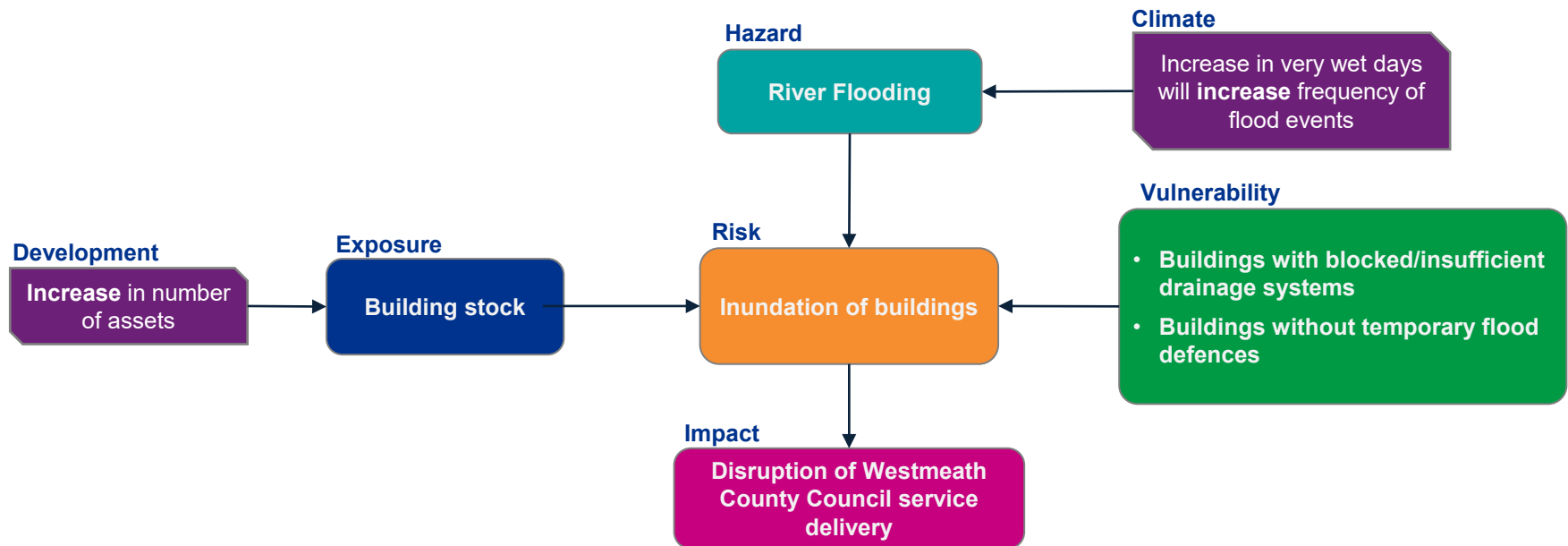


# 3.3 Future Climate Risks and Impact Assessment

# Future Climate Risk and Impact

Climate risks may increase, decrease, or emerge in the future due to a change in either the frequency and severity of climate hazards and/or changes in exposure and vulnerability. In the example below, the risk of inundation due to river flooding will increase due to an increase in the number of very wet days (> 30 mm precipitation) leading to an increase in the frequency of river flood events. Furthermore, there is likely to be an increased population in the region, possibly resulting in new buildings being constructed. This will potentially increase the number of assets exposed to river flooding. Therefore, due to changes in both the hazard and exposure, the risk of inundation of Westmeath County Council buildings will increase in the future.











In the following sections, we provide an assessment of potential future changes in the climate of County Westmeath by 2050 and its effects on the frequency of hazard occurrence. An assessment of the future changes in the population and development in the region by 2050 that could affect exposure and vulnerability was also undertaken. Finally, considering all three components, the future climate risk was assessed.

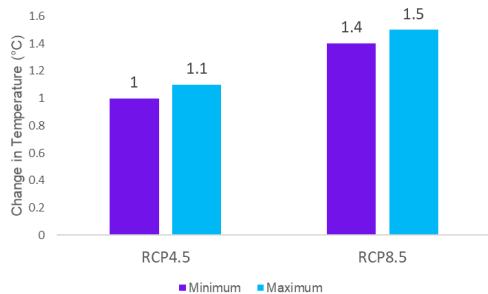


# 3.3.1 Future Changes in Climate Hazards

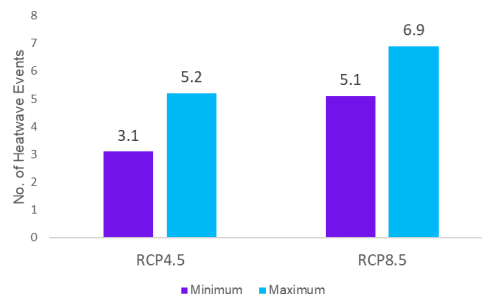
# Climate Projections for County Westmeath in 2050 (1/2)

Having identified and assessed the range of climate hazards already experienced by Westmeath County Council, the projected changes in the frequency and intensity of climate hazards was assessed to understand how existing climate impacts and risks faced by Westmeath County Council may be exacerbated. The information below summarizes the climate projections for each hazard based on Nolan and Flanagan (2020).

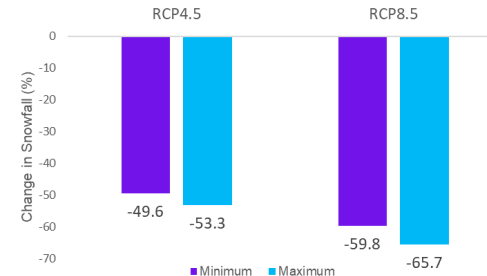
Hazard	Projected Change	Future Frequency
 <b>Heatwaves</b>	<ul style="list-style-type: none"> <li>Projections indicate an <b>overall increase in average temperature</b> (bottom left) of between 1.0 and 1.5°C for County Westmeath relative to the 1981-2000 period.</li> </ul>	Frequent 
 <b>Droughts</b>	<ul style="list-style-type: none"> <li>Under a high emission scenario, projections indicate that <b>heatwaves will become more frequent</b> (bottom middle) by mid-century.</li> <li><b>Summer rainfall is expected to reduce</b> by between 5 and 11% in the future when compared with the baseline period of 1981 to 2000, in both the RCP4.5 and RCP8.5 scenario contributing to potential drought conditions.</li> </ul>	Common 
 <b>Cold Spell</b>	<ul style="list-style-type: none"> <li>As a consequence of the increasing temperatures, a <b>decrease in the number of frost days and ice days</b> in the period 2041-2060 when compared with the baseline period of 1981 to 2000, is projected for both the RCP4.5 and RCP8.5 scenario.</li> </ul>	Rare 
 <b>Heavy Snowfall</b>	<ul style="list-style-type: none"> <li>The annual <b>snowfall</b> in the region is projected to decrease substantially by the middle of the century for the RCP4.5 and RCP8.5 scenarios (bottom right).</li> </ul>	Rare 
 <b>Severe Windstorms</b>	<ul style="list-style-type: none"> <li><b>Projections of storms are subject to a high level of uncertainty.</b> By mid century, projections indicate that average wind speed will remain similar to those currently experienced. There is limited evidence of a potential increase in the frequency of more intense storms which are currently rare events. However, more research is needed to confirm this increase.</li> </ul>	Frequent 



The projected minimum and maximum **increase in the mean annual temperature** for the area of County Westmeath for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario (Source: Nolan and Flanagan, 2020)









The projected minimum and maximum **number of heatwaves** for the area of County Westmeath for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario (Source: Nolan and Flanagan, 2020)

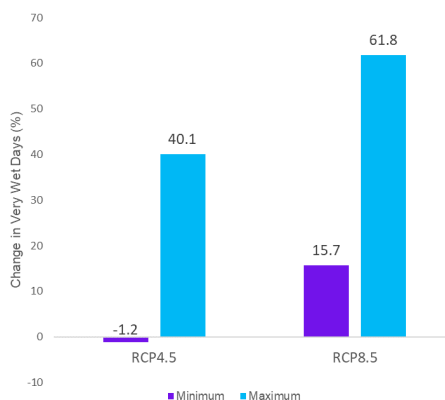


The projected minimum and maximum **reduction in snowfall** for the area of County Westmeath for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario (Source: Nolan and Flanagan, 2020)

# Climate Projections for County Westmeath in 2050 (2/2)

Having identified and assessed the range of climate hazards already experienced by Westmeath County Council, the projected changes in the frequency and intensity of climate hazards was assessed to understand how existing climate impacts and risks faced by Westmeath County Council may be exacerbated. The information below summarizes the climate projections for each hazard based on Nolan and Flanagan (2020).

Hazard	Projected Change	Future Frequency
 <b>Pluvial Flooding</b>	<ul style="list-style-type: none"> <li>Projections indicate an <b>increase in the frequency of heavy rainfall days</b> (days with precipitation &gt;30mm) for County Westmeath with some areas projected to see increase of up to 62% (bottom). This will likely result in an increased frequency of associated river and pluvial flooding.</li> </ul>	Very Frequent 
 <b>River Flooding</b>		Very Frequent 
 <b>Groundwater Flooding</b>	<ul style="list-style-type: none"> <li>Projections of changes in groundwater flooding are currently not available, therefore there is <b>uncertainty in the change</b> in groundwater flooding frequency that can be expected.</li> </ul>	Occasional 



The projected **increase in very wet days (> 30 mm)** for the area of County Westmeath for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario (Source: Nolan and Flanagan, 2020)



# 3.3.2 Future Changes in Exposure and Vulnerability (incl. Emerging Risk)

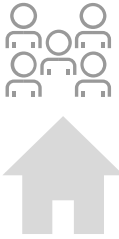
# Projected Changes in Exposure and Vulnerability

In the future, County Westmeath will also change in terms of its population and developments. This will potentially affect the exposure and vulnerability of people and assets within the region. National, regional and local strategies that outlined expected and possible sociodemographic and infrastructure developments within County Westmeath were reviewed to understand how exposure and vulnerability may change by 2050. A summary of the results of this review are shown below.

## How is Ireland projected to change by 2040?



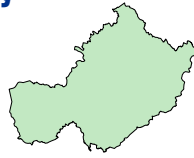
- Extra **1m population**, 500,000 in rural areas / regional centres
- Extra 660,000 jobs
- Extra **550,000 homes**
- ‘Housing for All’ promotes a ‘town centre first’ approach



### Cross-Sectoral National Priorities:

- Infrastructure and Services
- Climate Change Adaptation & Mitigation
- Regeneration, Repopulation, Resilience

## How is County Westmeath projected to change?



- Population is projected to increase from 88,700 in 2016 to **105,710 in 2027** (CDP)
- Athlone’s population is expected to **increase by c.5,100** between 2016 and 2027. (CDP)
- **4,983** new housing units required by 2028. (CDP)
- Westmeath’s total road network of **2,388 km** consists of 175 km national roads, 313 km regional roads and 1,900 km local roads (TII/DoT)

**RSES Objectives:** “at least 30% of all new homes that are targeted in settlements with a population of at least 1,500..., within the existing built-up footprints.”

“...68% of lands provided under this Plan for residential development are Brownfield/Infill lands.”

*Westmeath County Development Plan (2021-27)*

## Planning for adaptation

### Flood Defence Schemes:

The Office of Public Works-Council projects includes the Athlone Flood Alleviation Scheme which aims to protect 554 properties.



### Key national road infrastructure projects include focus for council:

- N4 Mullingar to Longford (Roosky)
- N52 Tullamore to Kilbeggan and Delvin Bypass
- N55 N6 Athlone to Ballymahon



### Notable clean energy initiatives:

- Lumcloon Energy: planning permission granted for **€500m project** to support the national grid at Rochfortbridge - facilities incl. 275MW Flexgen gas power plant and 65MW battery storage plant.
- Wind farm proposals at Moyvoughley, Coole, and Bracklyn
- 17 X Sustainable Energy Communities (e.g. Mullingar Sustainable Community, Athlone Tidy Towns Ltd.)

## Planning for mitigation



## Case Study in Urban

### Planning: Athlone Town

### Centre Regeneration & Enhancement

A **€4.1m** redevelopment funded under the Urban Regeneration Development Fund (URDF). The project is focussed on public realm and streetscape enhancement of a derelict prominent site in the town centre. The project includes the following objectives:

- Athlone Town Centre Public Realm Enhancement Scheme – including street enhancement works at Church Street.
- Site assembly and remediation in the Town Centre
- Commercial Area Enhancement - general improvement of streetscape

# Future Exposure and Vulnerability (1/2)

In addition to the changes in the frequency of hazard events, future risk is also driven by the changes in exposure and vulnerability of assets. In order to estimate the potential change in risk, a number of assumptions have been made in relation to the seven impact areas, which are outlined below.

<h2>Assets</h2>	<ul style="list-style-type: none"> <li>• Due to the expected increase in County Westmeath’s population, there will be an <b>increase in the associated households and infrastructure</b> resulting in an increase in the number of assets exposed to hazard events</li> <li>• Due to the expected increase in the frequency of heatwaves, <b>road assets will be more regularly exposed to extreme temperatures and drought</b> conditions with the potential for increased damage to roads</li> <li>• Pluvial and river flooding events that were once considered extreme, will become more frequent. This will <b>increase damage in the areas already exposed to these hazards</b> and also expose new areas and therefore assets that were previously unaffected</li> </ul>
<h2>Health and Wellbeing</h2>	<ul style="list-style-type: none"> <li>• Due to the expected increase in the elderly population in County Westmeath there will be a <b>greater number of vulnerable people who are more sensitive to hazards</b>, particularly heatwaves</li> <li>• Pluvial and river events that were once considered extreme, will become more frequent. Consequently, people will be more frequently exposed to flooding hazards, and higher flood levels which will mean <b>people previously unaffected by flooding may become exposed</b>. This could impact on both physical and mental health and wellbeing</li> </ul>
<h2>Environment</h2>	<ul style="list-style-type: none"> <li>• The potential increasing occurrence of heatwaves and drought conditions within County Westmeath will mean <b>increased temperatures in water bodies and lower water levels</b> which can decrease water quality resulting in short and long term impacts on the environment</li> <li>• Due to the potential increased frequency of exposure to hazards in County Westmeath, there could be an <b>increase in the impact on environmental assets</b> as the time/ability for the habitat/environment to recover is reduced</li> <li>• Pluvial and river flooding events that were once considered extreme, will become more frequent. Consequently, environmental assets will be more frequently exposed to flooding hazards, and higher flood levels will mean <b>environmental assets previously unaffected by flooding may become exposed</b>- resulting in short and long term damage to habitats/environment by these hazards</li> </ul>

# Future Exposure and Vulnerability (2/2)

In addition to the changes in the frequency of hazard events, future risk is also driven by the changes in exposure and vulnerability of assets. In order to estimate the potential change in risk, a number of assumptions have been made in relation to the seven impact areas, which are outlined below.

<b>Social</b>	<ul style="list-style-type: none"> <li>• Due to the expected increase in the total and elderly population in County Westmeath there will be an <b>increase in the number of people affected by social isolation during some hazard events</b></li> <li>• In response to heatwaves, there will be an increased use of blue/green spaces by the public <b>putting increased pressure on local amenities</b> e.g. littering, traffic problems</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>• Due to the potential increase in frequency of heatwave and drought events, <b>degradation rates will potentially increase resulting in an increase in the impact of cultural heritage assets</b></li> <li>• Pluvial and river flooding events that were once considered extreme, will become more frequent. Consequently, <b>cultural heritage assets will be more frequently exposed to flooding hazards</b>, and higher flood levels will mean cultural heritage assets previously unaffected by flooding may become exposed resulting in short and long term damage to habitats/environment by these hazards</li> </ul>
<b>Financial</b>	<ul style="list-style-type: none"> <li>• Due to the potential increase in frequency of hazard events and exposure across County Westmeath, there will be an <b>associated increase in the actions the local authority takes before, during, and after an event.</b></li> <li>• As a consequence, there will be an <b>increase in the costs associated with dealing with the events</b>, e.g. air conditioning, emergency service response, temporary and permanent flood defences, staff, training, and equipment purchase/maintenance</li> </ul>
<b>Reputational</b>	<ul style="list-style-type: none"> <li>• Due to the potential increase in frequency of hazard events and exposure across County Westmeath during an event there will be an <b>increase in demand/pressure on services/resources</b> potentially reducing the level of service delivery and harming the reputation of the local authority</li> <li>• For hazards which are existing long-term issues in County Westmeath, e.g. river flooding, if the response to the increased frequency and severity events is deemed insufficient by the public, this <b>may negatively impact on the reputation of the local authority</b></li> </ul>

# Future Impacts

Taking into account the changes in exposure and vulnerability, the future change in impacts for each of the eight hazards was assessed. The potential future changes in impact are outlined below with the change in impact shown in bold.

Hazard	Assets		Health and Wellbeing		Environment		Social		Cultural Heritage		Financial		Reputational	
	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)	Current	Future (2050)
Heatwave	Moderate	<b>Major</b>	Negligible	Minor	Moderate	<b>Major</b>	Minor	Moderate	Negligible	Minor	Minor	Moderate	Negligible	Minor
Drought	Negligible	Minor	Negligible	Minor	Moderate	<b>Major</b>	Minor	Moderate	Minor	Moderate	Negligible	Minor	Negligible	Minor
Cold Spell	Moderate	Moderate	Moderate	Moderate	Negligible	Negligible	Moderate	Moderate	Negligible	Negligible	Moderate	Moderate	Negligible	Negligible
Heavy Snowfall	Minor	Minor	Moderate	Moderate	Minor	Minor	Minor	Minor	Negligible	Negligible	Moderate	Moderate	Minor	Minor
Severe Windstorm	Moderate	Moderate	Minor	Minor	Negligible	Negligible	Moderate	Moderate	Minor	Minor	Moderate	Moderate	Minor	Minor
Pluvial Flood	Moderate	<b>Major</b>	Minor	Moderate	Minor	Moderate	Minor	Moderate	Negligible	Minor	Minor	Moderate	Moderate	<b>Major</b>
River Flood	Moderate	<b>Major</b>	Minor	Moderate	Minor	Moderate	Minor	Moderate	Negligible	Minor	Moderate	<b>Major</b>	Moderate	<b>Major</b>
Groundwater Flood	Negligible	Negligible	None	None	Negligible	Negligible	Negligible	Negligible	None	None	Negligible	Negligible	None	None



# 3.3.3 Future Climate Risk Matrix

# Future Climate Risk Matrix

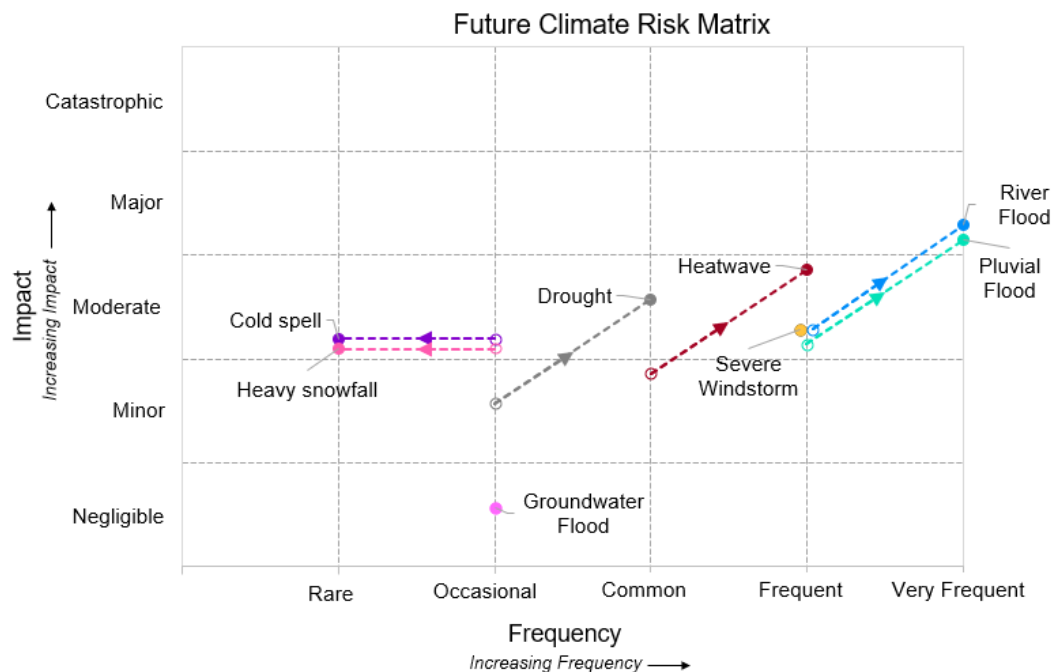
The future changes in the hazard, exposure, and vulnerability, combine to form an assessment of future risks across County Westmeath. The risk matrix on the right shows the future change in risk with the hollow marker showing the current risk and the solid marker the future risk. The dotted line shows the change between the current and future risk.

The **risk** of existing hazards such as **river and pluvial flooding** is likely to **increase** in the future because of changes in both hazard frequency as a result of climate change and impact due to changes in exposure and vulnerability.

**Heatwaves and droughts** although already experienced in County Westmeath, are expected to occur more frequently due to climate change and with a greater impact on County Westmeath in the future.

Although the frequency and impact of **severe windstorms** is thought to be **unchanged in the future**, these events will remain a risk for County Westmeath. The risk of **groundwater flooding** is also unchanged in the future, however, there is uncertainty associated with how climate change will impact the occurrence of this hazard.

The impact of **heavy snowfall and cold spells** on County Westmeath remains constant, however, due to the potential decrease in hazard frequency, the overall risk of these hazards is likely to reduce in the future, resulting in less risk.



The risk matrix above shows the future changes in risk for the identified hazards within County Westmeath. For each hazard there is a solid marker, which identifies the future risk, and a hollow marker showing the current risk. The dotted line in between these markers shows the change between the current and future risk.

# 3.3.4 Uncertainty Assessment

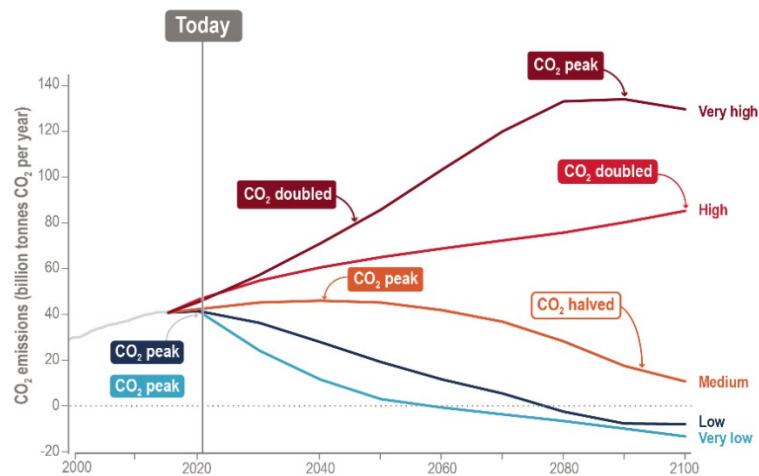
# Uncertainty

In assessing future climate risks there are levels of uncertainty related to each of the three elements of risk, i.e., not only the magnitude and frequency of hazards but also the exposure and vulnerability to any given hazard.

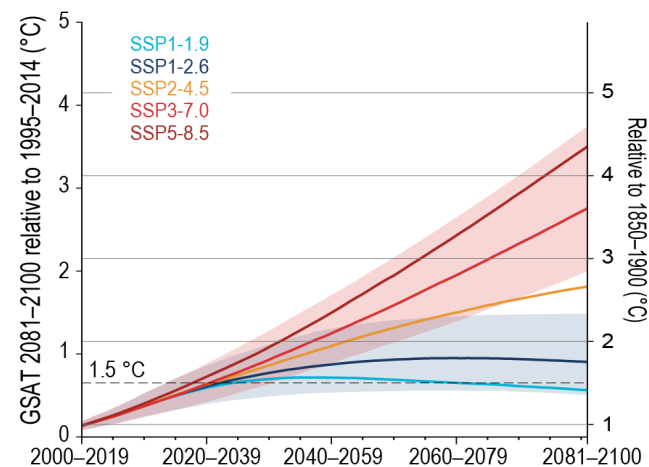
Different social and economic developments can lead to substantially different future emissions of carbon dioxide and other greenhouse gases (bottom left) resulting in uncertainty in what the future global climate will be. As an example of the possible future ranges in mean global surface temperature (bottom right) vary from below 1.5°C to over 4°C by 2100.

As a result of this uncertainty, climate projections include a range of scenarios, with SSP5-8.5 (AR6) or RCP8.5 (AR5) being the highest emission scenario and therefore the greatest change in future climate. When assessing climate risks with a qualitative approach, it is best practice to take a conservative or ‘worst case scenario’ to ensure that climate risks are not underestimated and dismissed as low or no risk. Climate risks identified within a qualitative risk assessment should be subsequently assessed using semi-quantitative or quantitative approaches to evaluate the risk in further detail.

Uncertainty also exists in relation to how County Westmeath will develop into the future. Although, in the near-term there is relatively good understanding as a result of strategies, such as the Westmeath County Development Plan 2021-2027, developments up to 2050 are less certain. A ‘worst case scenario’ approach has been taken here also, with the potential future impact being increased according to the indicative near-term trend and the assumption that adaptation actions are not implemented.



Annual emissions of CO<sub>2</sub> for the five core Shared Socio-economic Pathway (SSP) scenarios (very low: SSP1-1.9, low: SSP1-2.6, intermediate: SSP2-4.5, high: SSP3-7.0, very high: SSP5-8.5) (Source: IPCC AR6 Infographic TS.1).








Assessed projected change in mean global surface temperature for five future climate scenarios. Future global temperatures can vary from below 1.5°C to over 4°C by 2100 depending on the amount of future emissions (Source: IPCC AR6 Cross-Chapter Box TS.1, Figure 1).

# 3.4 Summary



# Summary

This CCRA detailed within this report provides an assessment of County Westmeath’s climate change risks to support Westmeath County Council’s efforts to prepare its LACAP. The CCRA has been carried out in line with the Local Authority Climate Action Plan Guidelines, Technical Annex B, drafted by the Climate Action Regional Offices (CAROs). The key results are summarised below:

- 
 • Recent experiences of **river and pluvial flooding** events in **2020**, resulted in the inundation of residential properties, damage to recreational areas, closure of businesses, disruption of transport networks and inundation of farmland. Projected increases in the frequency of extreme precipitation events will result in increased surface water and riverine flood risk for Westmeath.
- 
 • **Severe windstorms** are currently experienced on a frequent basis in Westmeath and result in wide-ranging impacts, including disruption to energy supply and transport networks. Projections indicate no significant change to this frequency.
- 
 • Westmeath experienced both a **heatwave and drought** in 2018, with a heatwave recorded again in 2021. These events resulted in damage to road surfaces, disruption of public transport network, the imposition of restrictions on water supply and increased demand on recreational areas. Projected increases in the frequency of heatwaves and drought conditions will mean that events currently experienced on an infrequent basis will become more frequent. As the population ages, there will also be an increase in the number of vulnerable people exposed to heat-related risks.
- 
 • Recent experiences of **cold spells and heavy snowfall** events in 2018 (e.g. Storm Emma) demonstrated the wide range of impacts for County Westmeath. These included, amongst others, road closures, disruption to public transport, power outages, reduction in agricultural production and disruptions to water supply. Projected increases in average temperature and decreases in the frequency of snowfall indicate a decrease in the frequency of cold spells, heavy snowfall, and their associated impacts.
- 
 • **Groundwater flooding** is currently experienced on occasional basis in Westmeath and results in road damages, isolation of communities and inundation of farmland. Projections indicate no substantial change in this frequency.

To increase resilience, Westmeath County Council will need to proactively plan for and adapt to the current and future climate change risks identified through this CCRA.





04

# Appendices



# 4.1

# Appendix 1

# Glossary

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

**Climate:** The long-term average weather of area, usually taken over 30 years

**Climate projection:** A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases (GHGs) and aerosols, generally derived using climate models

**Coastal erosion** is the breaking down of land and removal of sediment and rocks by coastal processes. Factors affecting the rate of coastal erosion include sea level rise, strong wave action, and storms

**Cold Spell:** A sustained period of cold weather, where extreme low temperatures are recorded

**Coastal Flooding:** Coastal flooding occurs when sea levels along the coast or in estuaries exceed neighbouring land levels, or overcome coastal defences where these exist, or when waves overtop over the coast

**Drought:** A period of abnormally dry weather long enough to cause a serious hydrological imbalance

**Exposure:** The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected

**Extreme weather event:** An extreme weather event is an event that is rare at a particular place and time of year

**Fluvial flooding** occurs when rivers and streams break their banks and water flows out onto the adjacent low-lying areas (the natural floodplains)

**Groundwater flooding** occurs when the water table rises above the land surface. It generally requires sustained rainfall over relatively longer duration than other forms of flooding, its location is discontinuous, and they can last for weeks or months

# Glossary

**Hazard:** The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.

**Heat wave:** A period of abnormally and uncomfortably hot weather

**Heavy Snowfall:** A substantial prolonged snowfall event resulting in substantial accumulations of snow on the ground over a period of consecutive days.

**Landslide** describes a wide variety of processes that result in the downward and outward movement of materials under the force of gravity

**Pluvial flooding** occurs when the amount of rainfall exceeds the capacity of urban storm water drainage systems or the ground to absorb it

**Representative Concentration Pathways (RCPs):** Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases (GHGs) and aerosols and chemically active gases, as well as land use/land cover

**RCP4.5 and RCP6.0:** Two intermediate stabilization pathways in which radiative forcing is stabilized at approximately 4.5 W/m<sup>2</sup> and 6.0 W/m<sup>2</sup> after 2100 (the corresponding ECPs assuming constant concentrations after 2150)

**RCP8.5** One high pathway for which radiative forcing reaches >8.5 W/m<sup>2</sup> by 2100 and continues to rise for some amount of time (the corresponding ECP assuming constant emissions after 2100 and constant concentrations after 2250)

**Risk:** The potential, when the outcome is uncertain, for adverse consequences on something of value (lives, ecosystems, assets, services, etc.)

**Severe Windstorm:** A windstorm is a wind that can cause at least light damage to trees and buildings, typically exceeds 34 mph (55 km/h), and may or may not be accompanied by rain

**Vulnerability:** The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt



# 4.2

# Appendix 2

# Service Area Descriptions

Acronym	Full form
<b>Business Services</b>	Corporate and customer facing services
<b>Roads, footpaths, bridges, construction and maintenance</b>	Road and active travel, bridges, piers and harbours
<b>Building Stock</b>	Local Authority buildings and social housing stock
<b>Community infrastructure</b>	Recreation (incl. libraries and parks), tourism and economic development infrastructure
<b>Cultural Heritage</b>	Arts and heritage protection
<b>Stormwater / Sewerage</b>	Stormwater and sewerage infrastructure
<b>Wastewater</b>	Foul and surface water sewers, water treatment plants and wastewater pumping stations
<b>Water Supply</b>	Public water supply network (with Irish Water), public water treatment plant and pumping stations (with Irish Water)
<b>Water Quality</b>	Water quality (rivers, lakes and marine)
<b>Biodiversity</b>	Biodiversity and habitat protection
<b>Community Development</b>	Community development and co-ordination
<b>Emergency Response</b>	Fire and water safety services, emergency response during severe weather response

# Acronyms

Acronym	Full form
CAPS	Climate Action Plans
CAROs	Climate Action Regional Offices
CCRA	Climate Change Risk Assessment
CDP	County Development Plan
CRA	Climate Risk Assessment
EPA	Environmental Protection Agency
EU	European Union
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate Change
LA	Local Authority
NHA	National Heritage Area
RCP	Representative Concentration Pathways

# Description of the levels of impact due to disruption of Local Authority Services (Source: Technical Annex B: Climate Change Risk Assessment)

Impact	Description	Level of Impact
Catastrophic	Widespread service failure with services unable to cope with wide-scale impacts	5
Major	Services seen to be in danger of failing completely with severe widespread decline in service provision	4
Moderate	Service provision under severe pressure. Appreciable decline in service provision at community level	3
Minor	Isolated but noticeable examples of service decline	2
Negligible	Appearance of threat but no actual impact on service provision	1

# Characterisation of the magnitude of impact across various risk areas (Source: Technical Annex B: Climate Change Risk Assessment)

Risk Area	Negligible (Score; 1)	Minor (Score: 2)	Moderate (Score: 3)	Major (Score: 4)	Catastrophic (Score:5)
<b>Asset Damage</b>	Impact can be absorbed through normal activity	An adverse event that can be absorbed by taking business continuity action	A serious event that requires additional emergency business continuity actions	A critical event that requires extraordinary/ emergency business continuity actions	Disaster with the potential to lead to shutdown or collapse or loss of assets/ network
<b>Health and Wellbeing</b>	First aid case	Minor physical injury or mental health impact, medical treatment required	Serious physical or mental health impact, or lost work	Major or multiple injuries or mental health impact, permanent or physical disability	Single or multiple fatalities
<b>Environment</b>	No impact on baseline environment. Localised in the source area. No recovery required	Localised within site boundaries. Recovery measurable within one month of impact	Moderate harm with possible wider effect. Recovery in one year	Significant harm with local effect. Recovery longer than one year. Failure to comply with environmental regulations/ consent	Significant harm with widespread effect. Recovery longer than year. Limited prospect of full recovery
<b>Social</b>	No negative social impact.	Localised, temporary social impacts	Local, long-term impact on public opinion with adverse local media coverage	Failure to protect poor or vulnerable groups. National, long-term social impacts	Loss of social licence to operate. Community protests
<b>Financial (for single extreme event or annual average impact)</b>	x % IRR < 2% of turnover	x % IRR 2- 10% of turnover	x % of IRR 10-25% of turnover	x % IRR 25-50% of turnover	x % IRR > 50% of turnover
<b>Reputation</b>	Localised, temporary impact on public opinion	Localised, short-term impact on public opinion	Local, long-term impact on public opinion with adverse local media coverage	National, short-term impact on public opinion; negative media coverage	National, long-term impact with potential to affect stability of the government
<b>Cultural Heritage</b>	Insignificant impact	Short term impact. Possible recovery or repair	Serious damage with wider impact to tourism industry	Significant damage with national and international impact	Permanent loss with resulting impact on society

# 4.3

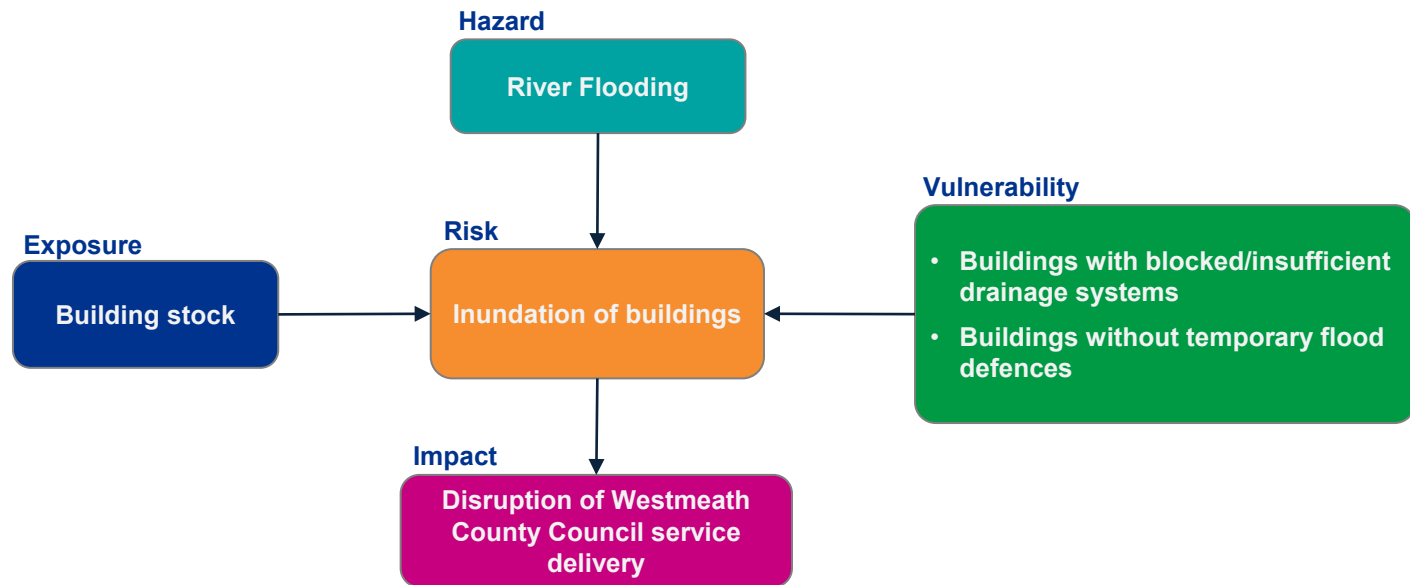
# Appendix 3



# Characterising Exposure, Vulnerability and Impacts of Climate Hazards

For County Westmeath and for each of the identified climate hazards, we characterised the exposures, vulnerabilities, and impacts associated with the relevant hazard events. For example, below shows the three risk components for a river flooding hazard which would pose an inundation risk to Westmeath County Council buildings. The buildings with insufficient drainage and with no temporary flood defences would be considered more vulnerable to this hazard. Consequently, if Westmeath County Council buildings were to be flooded, one of the possible impacts would be the disruption of Westmeath County Council's ability to deliver its services. This process was undertaken for each hazard and a range of exposures were identified along with their associated vulnerabilities.

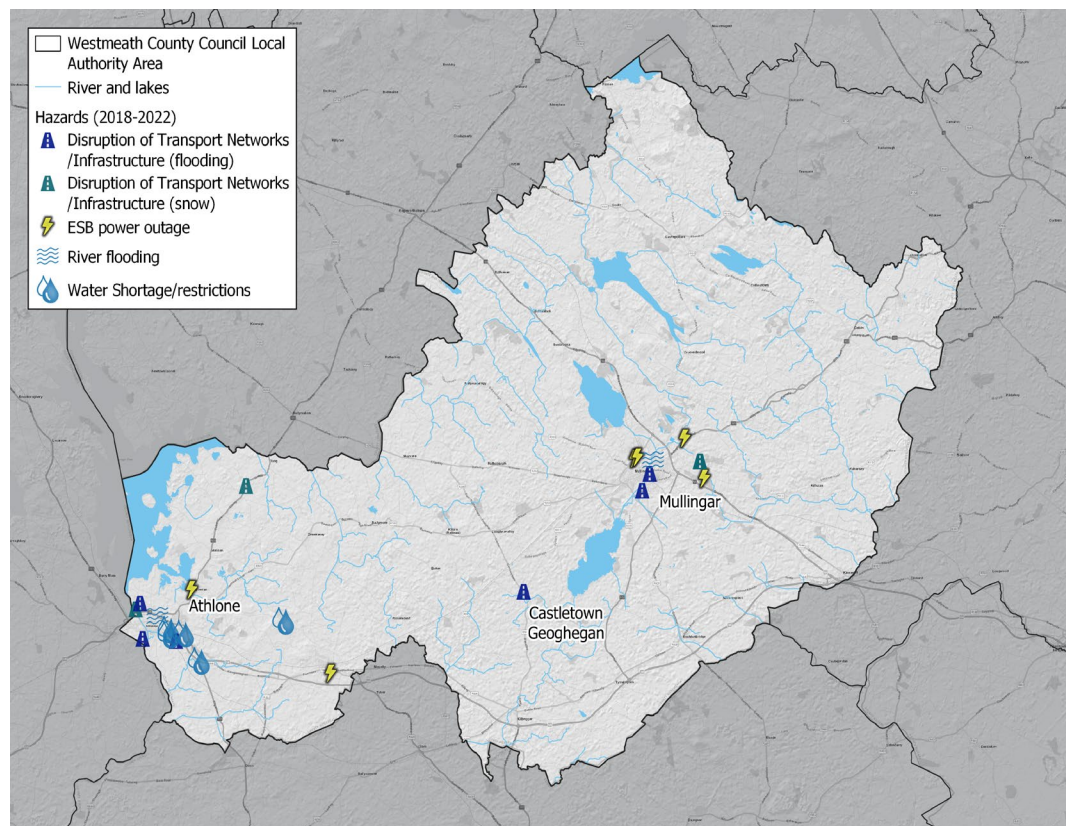
The following pages summarise the exposures, vulnerabilities and impacts for the hazards that exist within the County Westmeath region.



# Exposure, Vulnerability and Impacts of Climate Hazards

Employing and integrating information derived a wide range of sources, we have characterised the exposures, vulnerabilities, and impacts of the climate and weather-related hazards for Westmeath. Below and to the right we provide an example of exposures and impacts of hazard events experienced between 2018 and 2022.

- **Storm Barra** in 2021 brought power outages to **800 homes** in Moate and **246 homes** in Ballykeeran.
- Low levels at the Annagh reservoir in 2018 led to Irish Water **cutting off water supplies** to Athlone overnight between the 11<sup>th</sup> and 12<sup>th</sup> of July.
- During periods of **heavy rainfall** in 2019 the contents of combined sewers in Athlone, a mixture of raw sewage and storm water, were released into the Shannon and the Athlone Canal.
- In 2020, **heavy rainfall** caused flooding in Athlone, leading to major disruption to multiple routes including the Ballymahon Road railway bridge, Coosan Road, the junction of Auburn and Millmount Road, and Ballinderry near the Dog Track.
- Heavy rains in November 2022 caused the **Brosna river to overflow** in Mullingar town, flooding properties.
- In February 2020, heavy rainfall caused the **Shannon to burst its banks**, flooding multiple parts of Athlone and Castletown Geoghegan.
- In February 2020 **icy conditions** were the cause of the closure of the N55 in Westmeath after a serious road accident.
- In 2019, County Westmeath fire services were called out to **30 wildfires**, followed by **62** in 2020 and **27** in 2021.



# Impacts of climate hazards (1/4)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. Detailed information on exposure specific vulnerabilities (physical, social and environmental) are provided in the associated impacts and risks spreadsheet.

Hazard	Key Impacts	Key Exposures (and Key Vulnerabilities)
<b>Heatwave</b>	<ul style="list-style-type: none"> <li>Hot and uncomfortable working/living conditions</li> <li>Increased demand on recreational areas</li> <li>Damage to road surface, hazardous driving conditions and impact on road surface maintenance</li> <li>Disruption of public transport networks</li> <li>Heat stress for animals and livestock resulting in the adoption of unsustainable mitigation measures</li> <li>Increased demand on available water resources, leading to increasing pressure to share resources.</li> <li>Detrimental impacts on freshwater quality for fish populations</li> <li>Increase in the frequency of uncontrolled fire</li> <li>Increased strain on natural biodiversity</li> </ul>	<ul style="list-style-type: none"> <li>Housing, buildings (incl. LA offices), care home/leisure centres/recreational facilities, laboratory services (located in high density urban areas/without mechanical cooling), outdoor workers (elderly, with limited access to water, shade and sunscreen)</li> <li>Bathing areas, parks (with easy access to urban areas)</li> <li>Local roads (surface-dressed roads, located in areas of high solar radiation)</li> <li>National railway network</li> <li>Pasture (in marginal areas of production)</li> <li>Reservoirs/lakes (already depleted/under stress)</li> <li>Emergency response services (areas of growing vegetation)</li> <li>European/Irish designated sites (SPAs, SACs, Ramsar sites, NHAs)</li> <li>Recreational areas</li> </ul>
<b>Drought</b>	<ul style="list-style-type: none"> <li>Decreased grass growth and increased supplementary feed requirements for cattle</li> <li>Increased demand on available water resources, leading to increasing pressure to share resources</li> <li>Reduced river flow</li> <li>Increased degradation rates</li> </ul>	<ul style="list-style-type: none"> <li>Pasture (in marginal areas of production)</li> <li>Reservoirs/lakes/groundwater supplies (already depleted/under stress)</li> <li>Biodiversity (water bodies, areas with diverse wildlife populations)</li> <li>Cultural heritage (wooden/decomposable material based assets)</li> </ul>

# Impacts of climate hazards (2/4)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. Detailed information on exposure specific vulnerabilities (physical, social and environmental) are provided in the associated impacts and risks spreadsheet.

Hazard	Key Impacts	Key Exposures (and Key Vulnerabilities)
<b>Cold Spell</b>	<ul style="list-style-type: none"> <li>• Extreme cold results in increased requirement for heating and associated economic costs.</li> <li>• Cold conditions result in increased damage to vehicles</li> <li>• Disruption to road networks, including increases in costs associated with gritting fuel and overtime.</li> <li>• Disruption to public transport networks</li> <li>• Cold conditions leading to damage of road surfaces (i.e., freeze thaw)</li> <li>• Increase in the frequency of trips and falls.</li> <li>• Reduction in agricultural production</li> <li>• Difficulties in accessing land</li> <li>• Freeze thaw damage to critical infrastructure</li> <li>• Impacts on water resources and disruption of water supply</li> <li>• Increases in cold-related mortality and morbidity</li> <li>• Delay of infrastructure/development projects</li> <li>• Increased strain on natural biodiversity</li> <li>• Damage and disruption of electricity supply</li> <li>• Damage to built heritage</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings (poorly insulated, with elderly residents, in isolated locations)</li> <li>• Public/private transport vehicles (exposed vehicles)</li> <li>• Transport network (untreated road surfaces, near isolated communities)</li> <li>• Public/staff (elderly populations, people with pre-existing conditions)</li> <li>• Crops, livestock (cold-sensitive crops, areas with low solar radiation)</li> <li>• Land (marginal farms, areas of low solar radiation)</li> <li>• Water infrastructure/pipes (older pipes, in areas of freezing soil conditions)</li> <li>• Water resources (waterbodies in lower altitudes)</li> <li>• People at high risk of exposure to cold (people in insulated buildings, vulnerable communities)</li> <li>• Development projects (ongoing construction with loose materials)</li> <li>• European/Irish designated sites (areas with diverse wildlife populations)</li> <li>• Homes/businesses/local govt office/agricultural sites (without on-site electricity generation)</li> </ul>
<b>Heavy Snowfall</b>	<ul style="list-style-type: none"> <li>• Damage to buildings</li> <li>• Disruption of transport network</li> <li>• Heavy snowfall and freezing conditions impacting on livestock</li> <li>• Snow melt resulting in increased risk of flooding</li> <li>• Runoff from snow melt impacting on environmentally sensitive areas</li> <li>• Disruption to energy/electricity supply</li> <li>• Disruption to waste collection</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings (vacant/flat roof properties, higher elevation, elderly residents), offices (incl. LA) (single story/flat roof, higher elevation, impervious surfaces)</li> <li>• Public/staff (communities with limited access, elderly and young populations)</li> <li>• Transport network (in terrain with a with higher propensity of snow drifts, isolated roads)</li> <li>• Agricultural sites (livestock unprotected) (farms at higher elevations, marginal farms)</li> <li>• Natural resources/sensitive materials/water supply</li> <li>• Energy (energy infrastructure in need of maintenance, older infrastructure)</li> <li>• Waste collection routes (in terrain with a with higher propensity of snow drifts)</li> <li>• Employers, employees, customers, students (business in low-lying areas, lacking remote work/study options, etc.)</li> </ul>

# Impacts of climate hazards (3/4)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. Detailed information on exposure specific vulnerabilities (physical, social and environmental) are provided in the associated impacts and risks spreadsheet.

Hazard	Key Impacts	Key Exposures (and Key Vulnerabilities)
<b>Severe Windstorm</b>	<ul style="list-style-type: none"> <li>• Direct wind damage to buildings and infrastructure.</li> <li>• Wind damage to trees resulting in tree fall</li> <li>• Wind damage to habitats and sensitive species</li> <li>• Disruption of wind energy generation</li> <li>• Disruption of communications infrastructure</li> <li>• Disruption to energy supply across the county</li> <li>• Disruption of transport networks.</li> <li>• Closure of parks and public buildings</li> <li>• Disruption to waste collection</li> <li>• Disruption to water quality monitoring</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, development sites (buildings w. rooftop equip., vulnerable populations, high-rise structures)</li> <li>• Trees</li> <li>• Habitats and sensitive species</li> <li>• Wind turbines (turbines with lower shut-down thresholds for high winds)</li> <li>• Overhead communication lines (situated in upland and exposed sites)</li> <li>• Power supply (infrastructure in exposed locations, vulnerable populations, isolated communities)</li> <li>• Road and Rail Network (in exposed locations)</li> <li>• Parks, public buildings (populations requiring essential council services, exposed, locations)</li> <li>• Waste collection routes (terrain with a with higher propensity of snow drifts)</li> <li>• Waterbodies (exposed waterbodies and waterbodies in need of water quality monitoring)</li> </ul>
<b>Pluvial Flood</b>	<ul style="list-style-type: none"> <li>• Direct rain and surface water damage to buildings and infrastructure</li> <li>• Damage to amenities and recreational areas.</li> <li>• Pluvial debris</li> <li>• Disruption of transport networks/infrastructure.</li> <li>• Disruption to public transport networks.</li> <li>• Surface water (run-off) pollutants.</li> <li>• Impact on business and local economy.</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, local authority offices, heritage sites (blocked drainage systems, high levels of impervious surfaces, etc)</li> <li>• Recreational amenities (low-lying parks and other amenities, locate near water bodies such as lakes and rivers)</li> <li>• Stormwater infrastructure</li> <li>• People</li> <li>• Road/railways (low-lying roads with no alternative access routes and which allows for the pooling of water)</li> <li>• Public/ staff (located in low-lying areas, near water bodies, limited surrounding drainage and low-quality signage)</li> <li>• Natural resources/sensitive materials (enviro. sensitive areas, heavily fertilised agric. land close to water bodies)</li> <li>• Employers, employees, customers, students (business in low-lying areas, lacking remote work/study options, etc.)</li> <li>• Wastewater treatment infrastructure</li> </ul>

# Impacts of climate hazards (4/4)

The table below shows the key impacts and exposures associated with each climate and weather-related hazard. Detailed information on exposure specific vulnerabilities (physical, social and environmental) are provided in the associated impacts and risks spreadsheet.

Hazard	Key Impacts	Key Exposures (and Key Vulnerabilities)
<b>River Flood</b>	<ul style="list-style-type: none"> <li>• Flood damage to buildings and infrastructure.</li> <li>• Damage to amenities and recreational areas.</li> <li>• Disruption of transport Networks/Infrastructure.</li> <li>• Surface water (run-off) pollutants.</li> <li>• Fluvial debris</li> <li>• Impact on business and local economy.</li> <li>• Damage/degradation to automobiles and public transport.</li> <li>• Potential bridge failure</li> <li>• Inundation of farmland</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, local authority offices, heritage sites (blocked drainage, loc. on floodplains, vulnerable residents)</li> <li>• Recreational amenities (low-lying parks, located near water bodies, parks and amenities in need of investment)</li> <li>• People</li> <li>• Road/railways (low lying roads/railways, located near water bodies, limited drainage)</li> <li>• Natural resources/sensitive materials (env. sensitive areas, networks with polluting vehicles, near waterbodies)</li> <li>• Employers, employees, customers, students (located in at-risk areas, lack of access to early warning systems).</li> <li>• Council fleets, public transport, private vehicles (underground/low-lying carparks, fleets sensitive to submergence)</li> <li>• Bridges (older bridges, bridges in need of investment and maintenance)</li> <li>• Farmland situated on riverbanks (economically marginalised farmers, rivers susceptible to soil bank erosion, etc)</li> </ul>
<b>Groundwater Flood</b>	<ul style="list-style-type: none"> <li>• Inundation and damage to road infrastructure</li> <li>• Inundation of farmland</li> </ul>	<ul style="list-style-type: none"> <li>• National road (roads with limited drainage capacity)</li> <li>• Farmland situated in areas of ground water flood risk</li> </ul>





The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavour to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

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