



Sligo County Council

Climate Change Risk Assessment



LACAP
Final Report
5th May 2023



KPMG
Sustainable
Futures



Future Analytics

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01

Executive Summary

Executive Summary

Context and Scope of this Report

Climate change poses a critical challenge for Sligo. It will result in a wide range of impacts across Sligo, from damaging infrastructure such as roads, to biodiversity, and limits on water supply. These bring substantial implications for Sligo 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 Sligo's climate change risks and impacts on the delivery of services by Sligo County Council. The aim of the report is to provide the evidence base and inform the development of the LACAP for Sligo County Council.

Key Results and Findings

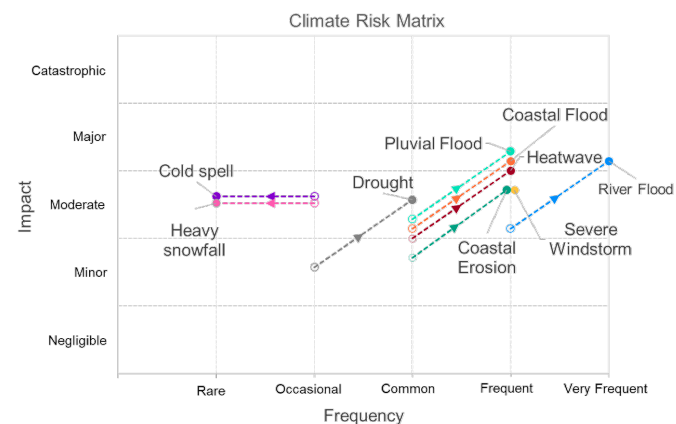
As illustrated in the climate risk matrix on the right the level of risk associated with some hazards (e.g., coastal, river and pluvial flooding, coastal erosion, heatwaves and drought) will increase while others will remain the same (e.g., severe windstorms).

Projections indicate a decrease in the frequency of some hazard (such as cold spells and heavy snowfalls) with decreases in levels of associated risk.

- Recent experiences of **river and pluvial flooding** events in 2020 and 2021, resulted in damages to residential properties, closure of businesses (Mowlam Nursing Home, 2018), disruption to public services and closure of transport networks. Projected increases in the frequency of extreme precipitation events will result in increased surface water and riverine flood risk for Sligo.
- **Coastal erosion and coastal flooding** already pose a significant risk for County Sligo and have resulted in disruption of transport networks and damage to coastal habitats (e.g. Strandhill). Rising sea levels will increase the rate of coastal erosion and frequency of coastal inundation, resulting in an increased coastal erosion and flood risk for County Sligo.
- **Severe windstorms** are currently experienced on a frequent basis in Sligo and result in wide-ranging impacts, including disruption to energy supply and transport networks. Projections indicate no significant change to this frequency.
- **Heatwaves and droughts** have contributed to the imposition of restrictions on water supply, damage to road surfaces (e.g., N15 in 2018) and have placed an 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.
- Recent experiences of **cold spells and heavy snowfall** events in 2018 and 2022, demonstrated

the wide range of impacts for County Sligo. These included, amongst others, disruption to public transport networks (e.g. rail and Bus Eireann bus services) and road closures. 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.

To increase resilience, Sligo 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 Sligo. 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.



02

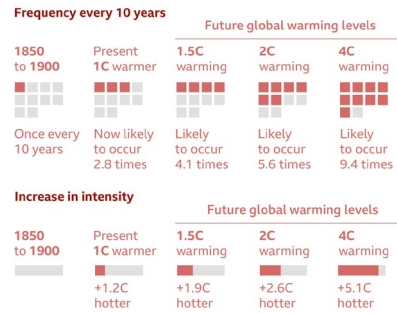
Introduction

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.

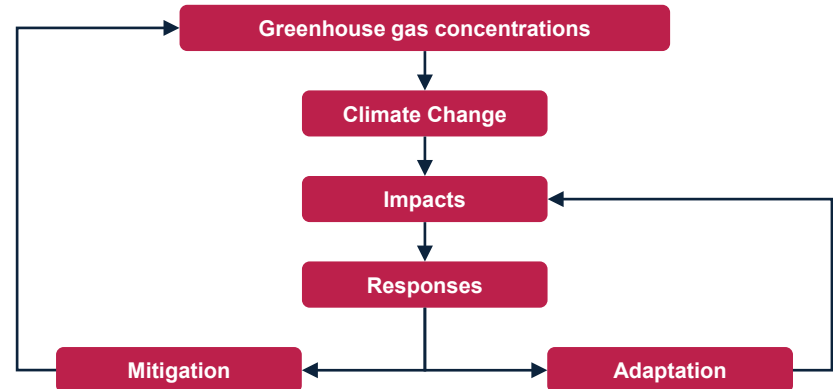
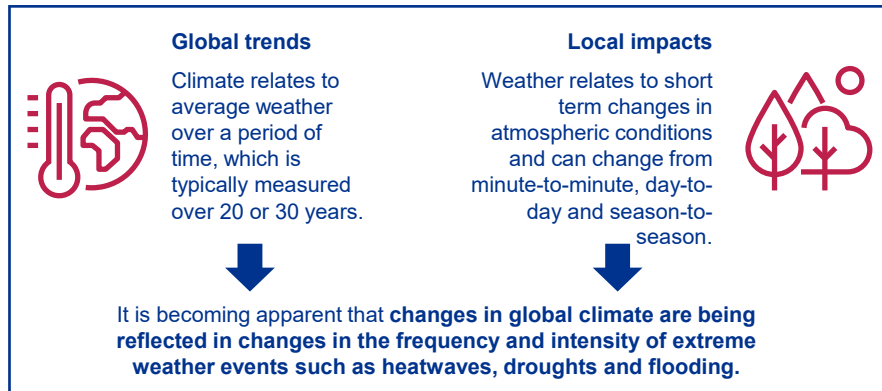
Since 1990, the Intergovernmental Panel on Climate Change (IPCC) have published a series of assessment reports which provide a synthesis of the most up-to-date science and evidence of climate change. The most recent assessment report shows that the global average temperature has increased by 1.1°C when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

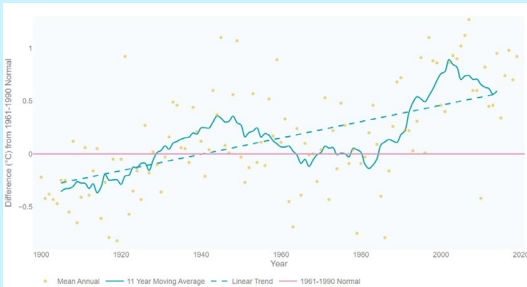
Mitigation: Making the impacts of climate change less severe by preventing or reducing the emission of greenhouse gases (GHGs) into the atmosphere. Mitigation is achieved either by reducing the sources of these gases (e.g. by increasing the share of renewable energies, or establishing a cleaner mobility 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

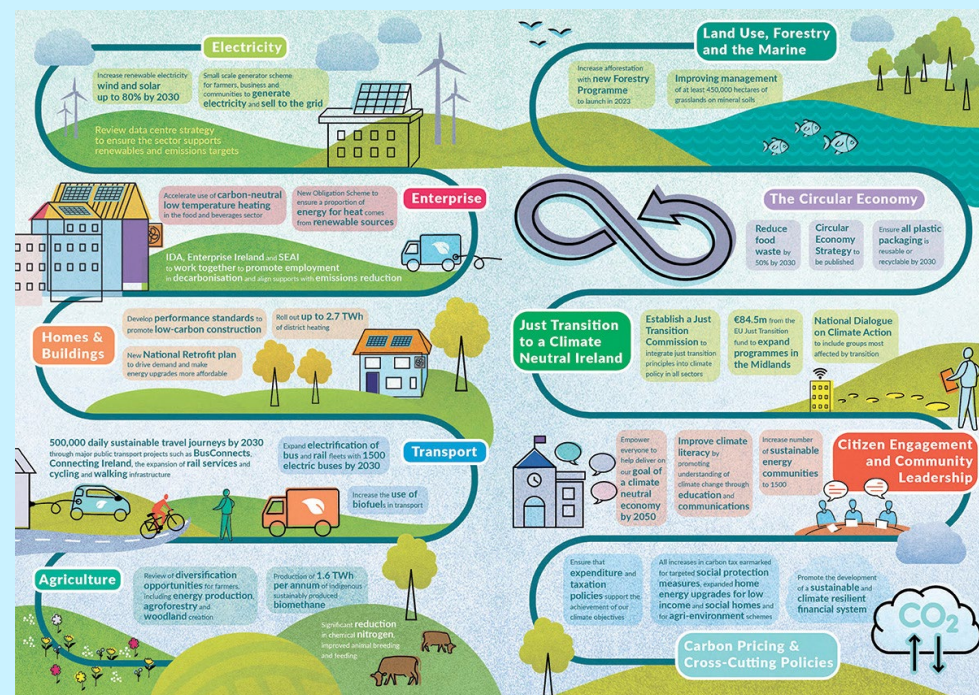
The EU adopted a legislative proposal for the European Climate Law in June 2021 to frame the climate neutrality objective by 2050 across the EU with an intermediate target of **reducing net greenhouse gas emissions by at least 55% by 2030**. The European Commission (EC) is clear in the commitment required 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.”

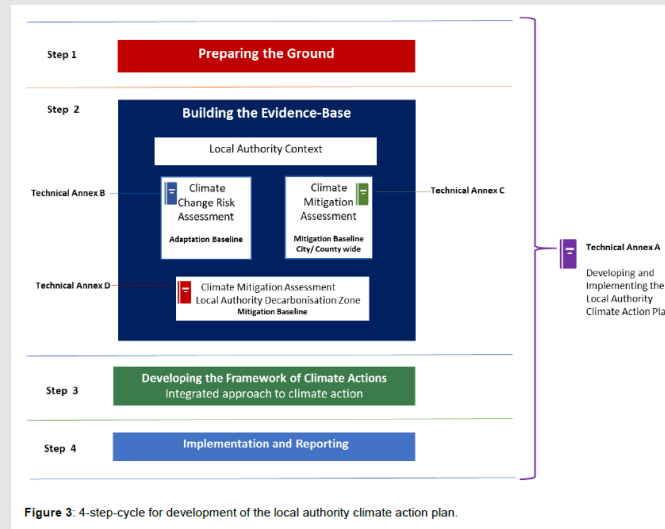
These plans will drive the mitigation and adaptation measures at the local level and see local authorities translate national climate policy to local circumstances and to support the delivery of the National Climate Objective at local and community levels.



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 LACAP around a 4-step cycle, which is supported by four technical annexes¹:



¹ Source: *Local Authority Climate Action Plan Guidelines*, page 5.

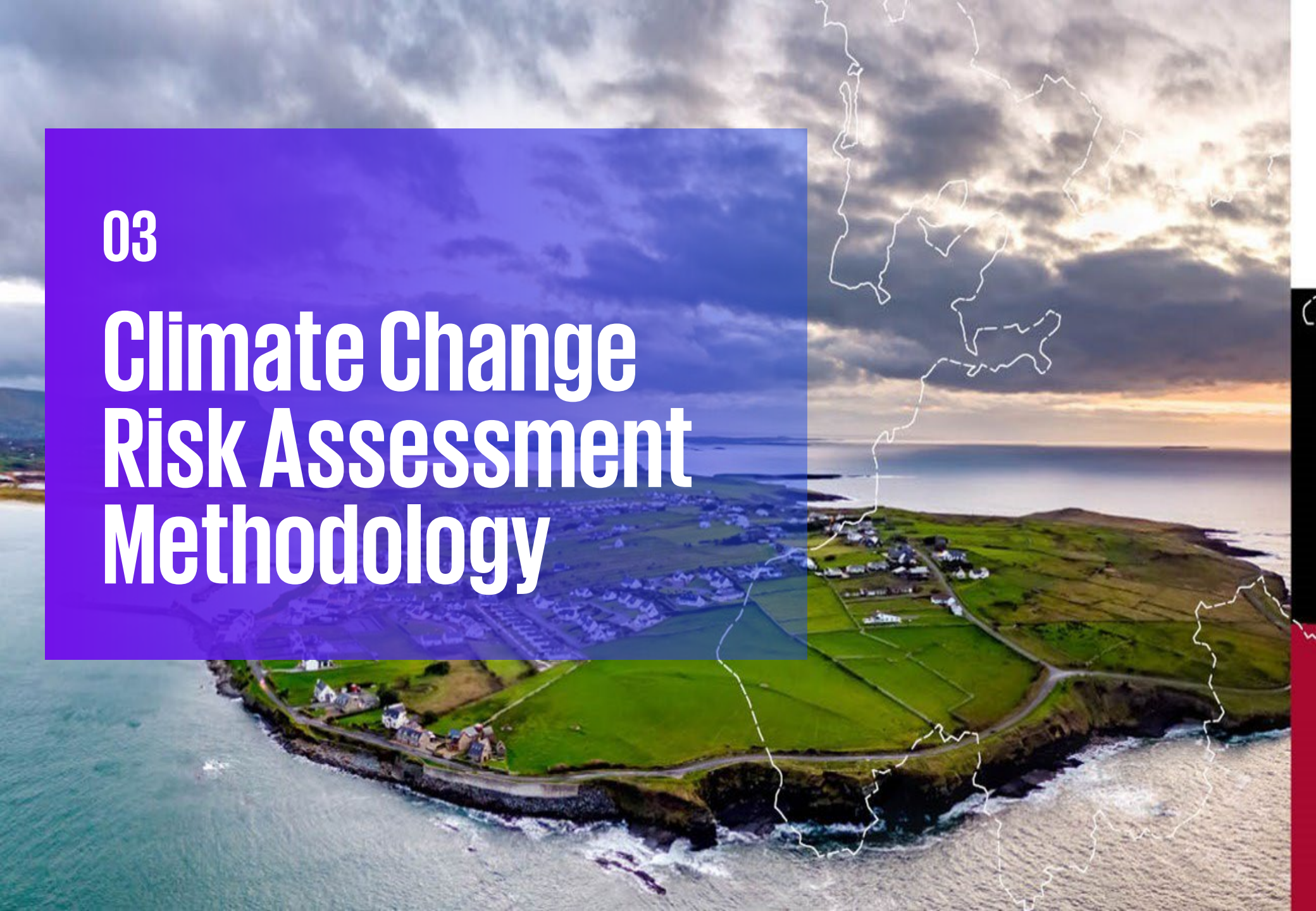


Scope of this report

Per Sligo 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 Sligo and the implications of these for Sligo 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

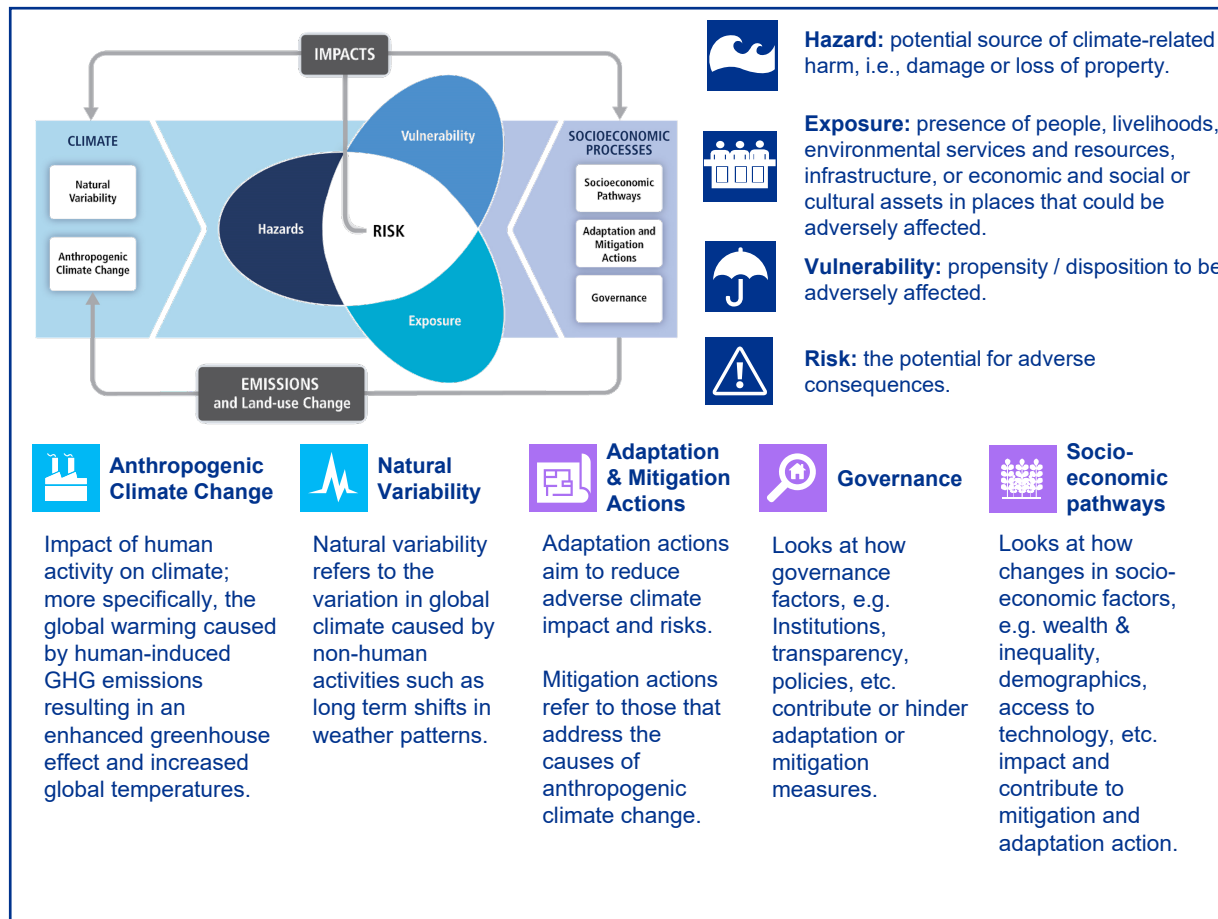
Responding to climate change impacts involves taking adaptation actions to reduce the adverse risks posed by current and projected climate change.

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 Sligo 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 Sligo.

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

We have updated the climate hazard profile developed through the existing Sligo 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 Sligo

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 Sligo. 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 Sligo 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 information was employed to inform the development of the CCRA for Sligo County Council. The Sligo 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, Sligo County Council Development Plan 2017-2023 and the Regional Spatial and Economic Strategy for the Northern and Western Region were employed to assess future development patterns. In addition, a stakeholder workshop was held to garner further insights from Sligo County Council.

| Report Section | Sources |
|---|---|
| Introduction and scope | <ul style="list-style-type: none"> Local Authority Climate Action Plan Guidelines, Technical Annex |
| Step 1: Current Climate Risks and Impacts | <ul style="list-style-type: none"> Environmental Protection Agency (EPA) Catchments.ie (EPA) Climate Status Report 2020 (Cámaro García and Dwyer, 2021) Floodinfo.ie (Office of Public Works) Data.gov.ie Department of Transport Department of Housing, Local Government and Heritage Department of Transport, Sport and Tourism Teagasc Inland Fisheries Ireland Sligo County Council Website Sligo County Council Adaptation Strategy 2019-2024 Sectoral Climate Change Adaptation Strategies (2018) Stakeholder Workshop Met Éireann Bus Éireann RTE News Irish Independent The Irish Times The Irish Mirror The Journal Irish News Archive Joe.ie Extra.ie The Sun Agriland The Farmers Journal Midwest Radio Sligo Weekender Ocean FM |
| Step 2: Future Climate Risks and Impacts | <ul style="list-style-type: none"> High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (Nolan and Flanagan, 2020) accessed via Climate Ireland National Planning Framework population projections Regional Spatial & Economic Strategy for the Northern and Western Region Assembly Transport Infrastructure Ireland |

3.2

Current Climate Risks and Impacts

3.2.1 Profile of Climate Hazards (incl. Frequency)

Characteristics of County Sligo

Sligo County Council is a member of the Atlantic Seaboard North Climate Action Regional Office (CARO) which supports and coordinates climate action undertaken by the five Local Authorities of Donegal, Sligo, Mayo, Galway County and Galway City. According to the Census 2022, the county council serves 69,819 people (2022 Census). The county is known for its rich natural and built heritage, a wide range of recreational amenities and tourist attractions, as well as its mix of both rural and urban-based industries.

Physical & Environmental Characteristics

County Sligo is approximately 1,838 km², making it the 22nd largest county in Ireland. The County is bordered by counties Leitrim, Roscommon and Mayo, and flanked to the west by almost 200 km of Atlantic coastline.

Sligo is part of the Wild Atlantic Way and has seven Discovery Points: Mullaghmore Head, Streedagh Beach, Rosses Point Beach, Strandhill Beach, Aghris Head, Easkey Pier and Enniscrone Pier. The County has a diverse coastline comprising low-lying cliffs, indented shoreline and sandy beaches, including Rosses Point, a Blue Flag status beach and Streedagh Beach, a Green Coast Awarded beach.

In terms of landscape, Sligo consists of a varied mix of spectacular limestone mountains (e.g. Benbulbin and Benwiskin), unique upland terrain (e.g. the Ox and Bricklieve Mountains), enclosed farmland, and numerous lakes and rivers (e.g. Gill / Garavogue, Arrow, Glencar, Easkey, Gara and Talt, Owenmore, Owenbeg). The county also has a unique archaeological and historical remains, with more than 5,000 recorded archaeological sites dating back over 6,000 years (including the prehistoric sites of Carrowmore, Carrowkeel and Creevykeel).

Socioeconomic Characteristics

As of the 2022 Census, County Sligo has a population of 69,819 people (2016: 65,535), which represents an increase of 4,284 since 2016. The county has experienced relatively steady population growth over recent years and has an almost exactly equal gender breakdown (2016).

Sligo County is predominantly a rural county, with 60.2% living in rural areas and 39.8% in urban areas in 2016. Sligo Council has 2 municipal districts: the Municipal District of Sligo and the Municipal District of Ballymote -Tobercurry. The major towns in the county, as per 2016 Census: Sligo town (19,452), Tubbercurry (1,986), Strandhill (1,753), Collooney (1,610) and Ballymore (1,549).

In terms of infrastructure, the main national roads from/to Sligo are M4/N4 - Dublin to Sligo, N17 - Galway to Sligo, N15 - Sligo to Donegal and the N16 - Sligo to Northern Ireland. The county is accessible to and from Dublin by railway while Sligo Airport, located in Strandhill, serves as the North-West base of the Irish Coast Guard Search & Rescue Helicopter. The nearest airport to Sligo for commercial flights, meanwhile, is Knock Airport which is located over 50 km away.

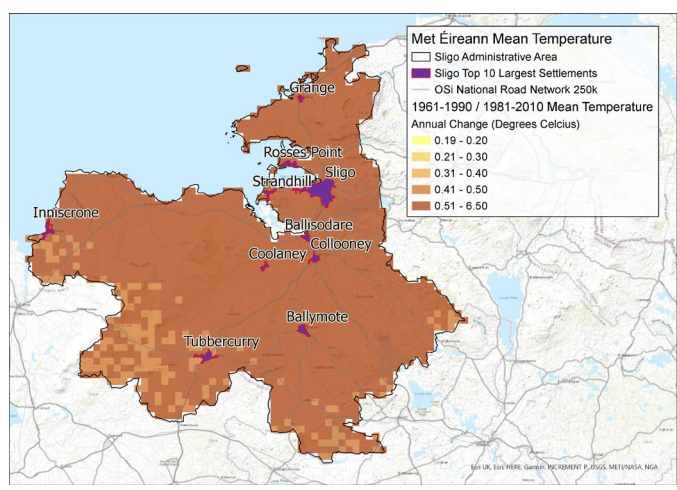
The county's tourism sector is an important component and driver of the economy. In 2016, Fáilte Ireland reported that tourism contributed over €93 million to the local economy and generated over 400,000 visitors.

According to the 2016 Census, the county's main industries of employment include Professional Services (28%), Commerce and Trade (19%), Manufacturing (13%) Public Administration (8%) and Agriculture, Forestry and Fishing (7%). Other industries include Construction, Transport and Communications.

In 2016, there were 19 multinational companies located in IDA business parks in County Sligo (Finisklin and Ballytivnan in the town, Collooney, Tubbercurry and Ballymote). Some of the main employers in Sligo include Abbvie, Abbott, Amcor, Braun, Bruss and Hospira. In recent years, Sligo town has grown to be a regionally important urban centre, serving as the administrative, commercial, service, health and educational focus for a large hinterland.

The county's Household Median Gross Income in 2016 was €38,695 and in 2021 the council provided a total of 413 Housing Assistance Payments.

Observed Changes in Sligo's Climate



To assess changes in climatic conditions across County Sligo, we have employed data from Met Éireann's network of meteorological and climatological stations. To establish a long-term climatology, a 30-year period of data is required. Due to no designated long-term weather station being located in Sligo, the Belmullet station situated in County Mayo was used for long-term temperature baselines. Cloonacool (Lough Easkey) station was used for long-term precipitation baselines.

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

Highlights of Observed Climate Change for Ireland and Sligo

Sea Level Rise

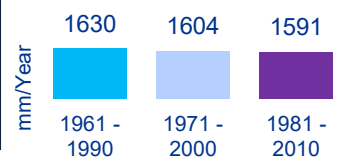
Sea levels in Ireland have risen by approximately 2-3 mm per year since the early 1990s according to satellite measurements**

Highest temperature on record for Sligo, recorded on July 13th 2013 at Ardtarmon

30.3°C

Rainfall

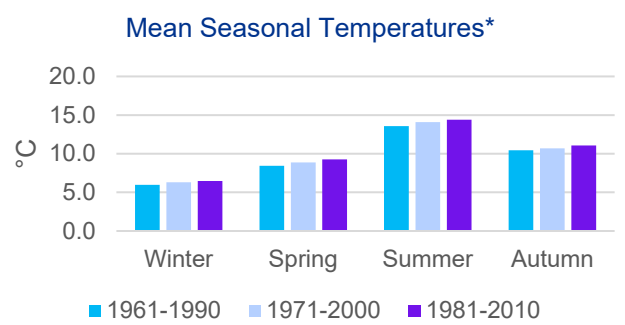
Average annual rainfall at Cloonacool (Lough Easkey) decreased by 2.4% for the most recent period (1981-2010) when compared to the 1961-1990 baseline.**



0.7°C

Average temperature increase for the period 1981-2010 when compared to the 1961-1990 baseline.*

4 of the wettest years on record dating back to 1954 have occurred since the year 2000**



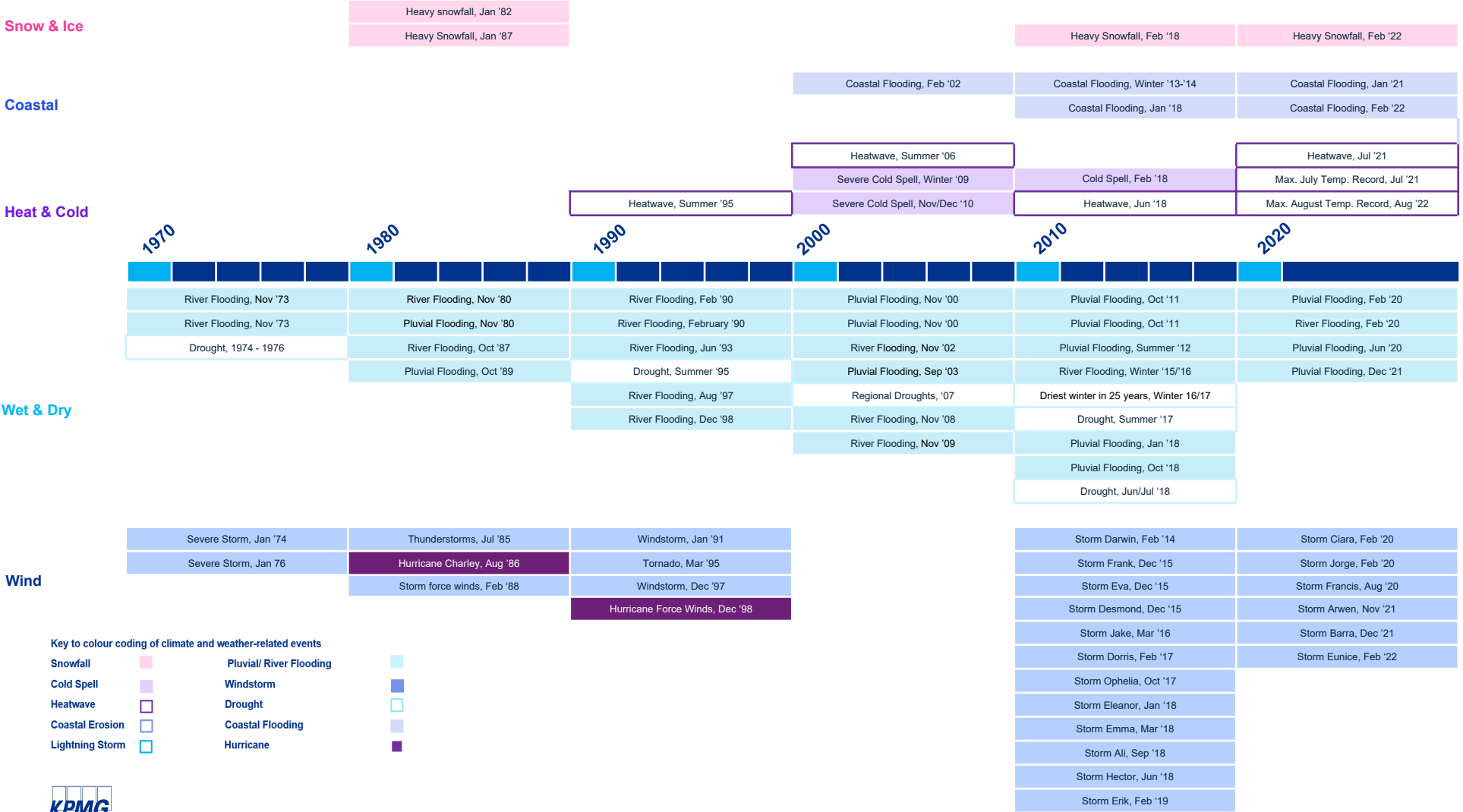
*Source: Met Éireann Long term weather station : Belmullet
 **Source: EPA: Climate Status Report for Ireland, 2020
 ***Source: Met Éireann weather station data: Cloonacool (Lough Easkey)
 ****Source: Independent.ie, 2020



62.6 mm of precipitation fell in one day due to Storm Ciara which *. Major disruptions were caused throughout the county, including a landslide in Castlebaldwin and 250 mm flooding on the R293.*******

Climate Hazard Profile

In addition to observed changes in Sligo's climate, we have identified significant climate and weather-related events to have impacted on the CARO ASBN region and County Sligo over the period 1973-2022. To do this, we have further developed the existing climate hazard profile developed for the CARO ASBN region and County Sligo through the Sligo County Council Adaptation Strategy (2019) and expanded the analysis to cover the period 2018-2022.



Frequency of Climate Hazards

For each of the climate hazards that have been identified through the climate hazard profile and in consultation with Sligo County Council, 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).

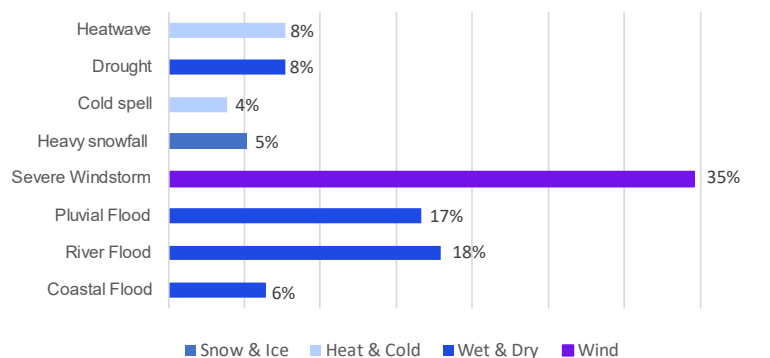
Based on the climate hazard baseline, severe storm events have impacted upon County Sligo most frequently over the period 1973-2022, with river and pluvial flooding also affecting the County on a number of occasions. Coastal flooding, cold spells, heavy snowfall events, heatwaves and droughts have also impacted County Sligo, but less frequently. Although individual events were not identified in the timeline, coastal erosion has occurred within County Sligo.

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

Frequency of identified hazard events for the ASBN region and County Sligo(1973 -2022)



Current hazard frequency for County Sligo, 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 |
| Coastal Flood | Common |
| Coastal Erosion | Common |
| Pluvial Flood | Common |
| River Flood | Frequent |

3.2.2 Exposure, Vulnerability and Impacts for County Sligo

Exposure, Vulnerability and Impacts for County Sligo

Key to colour coding of impact ratings

Catastrophic

Major

Moderate

Minor

Negligible

On the basis of identified exposures, vulnerabilities and impacts for County Sligo, the impact of climate and weather-related hazards on key categories of exposure for County Sligo 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 Sligo 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 | Minor | Minor | Moderate | Minor | Minor | Minor | Negligible | 2.0 |
| Drought | Occasional | Negligible | Negligible | Moderate | Minor | Minor | Negligible | Negligible | 1.6 |
| Cold Spell | Occasional | Moderate | Moderate | Minor | Moderate | Minor | Moderate | Minor | 2.6 |
| Heavy Snowfall | Occasional | Moderate | Moderate | Minor | Moderate | Minor | Moderate | Minor | 2.6 |
| Severe Windstorm | Frequent | Major | Moderate | Minor | Moderate | Minor | Moderate | Minor | 2.7 |
| Coastal Flood | Common | Moderate | Minor | Minor | Minor | Minor | Minor | Minor | 2.1 |
| Coastal Erosion | Common | Minor | Negligible | Moderate | Negligible | Negligible | Minor | Minor | 1.7 |
| Pluvial Flood | Common | Moderate | Moderate | Moderate | Minor | Negligible | Minor | Minor | 2.3 |
| River Flood | Frequent | Moderate | Minor | Minor | Minor | Minor | Minor | Minor | 2.1 |

Impacts of Current Climate Risks – Heatwaves & Drought

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


County Sligo has been exposed to heatwave events (defined as 5 consecutive days with temperatures >25 deg. C) over the period 1973-2022 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 Sligo has experienced drought conditions over the period as exemplified by the drought events in 2007, 2017 and July 2018.

| Hazard & Frequency | Exposure | Impact Description | Rating |
|--|---|---|------------|
|  <p>Heatwave Common</p> | <p>Assets</p> <p>Health and Well being</p> <p>Environment</p> <p>Social</p> <p>Cultural Heritage</p> <p>Financial</p> <p>Reputational</p> | <ul style="list-style-type: none"> High temperatures have resulted in localised damage to road surfaces (tar and chip) across the County. In 2018 road temperatures in Sligo exceeded 44°, causing melting damage to the L-3604 and the R284 between Sligo and Ballygawley. Sections of the N15 were also badly affected. | Minor |
| | | <ul style="list-style-type: none"> High indoor temperatures have resulted in uncomfortable working conditions for staff and public with the potential for impacts on heat sensitive equipment (e.g., Council laboratories). This has resulted in the increased requirement for active/mechanical cooling. | Minor |
| | | <ul style="list-style-type: none"> Heat waves provide suitable conditions for the ignition of uncontrolled fires. An extended warm and dry period in May 2017 contributed to a gorse fire in the Killery mountain area with 50 fire service personal required to bring the fire under control and impacting on over 4,000ha of land in an area of outstanding natural beauty. High water temperatures associated with heatwave events have also had significant impacts on freshwater and marine environments. In July 2021 a number of sightings of the potentially hazardous lion's mane jellyfish were recorded at Enniscrone Beach. | Moderate |
| | | <ul style="list-style-type: none"> Heatwaves have resulted in congestion at key recreational areas with facilities (e.g., litter collection and parking) overwhelmed. In July 2022 Strandhill Beach was found to be 'moderately littered', a deterioration in status since 2021. | Minor |
| | | <ul style="list-style-type: none"> Extreme temperatures are recognised as contributing to the increased weathering of cultural heritage sites. | Minor |
| | | <ul style="list-style-type: none"> The financial implications of heatwaves are primarily associated with responding to uncontrolled fire, road maintenance and repair. | Minor |
| | | <ul style="list-style-type: none"> Heatwaves, associated impacts and response have the potential for a localised and temporary impact on public opinion. | Negligible |
|  <p>Drought Occasional</p> | <p>Assets</p> <p>Health and Well being</p> <p>Environment</p> <p>Social</p> <p>Cultural Heritage</p> <p>Financial</p> <p>Reputational</p> | <ul style="list-style-type: none"> Drought conditions (e.g. Summer 2018) resulted in the imposition of restrictions on water supply on a national and county basis with potential implications for building operation. | Negligible |
| | | <ul style="list-style-type: none"> 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. | Negligible |
| | | <ul style="list-style-type: none"> High temperatures and dry conditions, often compounded by high levels of ignition activity, have resulted in uncontrolled fires as evidenced in 2017 and 2021. In 2017, gorse fire spread in Easkey. Irish Air Corps helicopter helped battle the fire by dropping 1000 litre- capacity 'Bambi' buckets of waters. | Moderate |
| | | <ul style="list-style-type: none"> Water restrictions can lead to inconvenience for local businesses and residents. In August 2018, Irish Water imposed a hosepipe ban on County Sligo in a bid to conserve depleted water resources. | Minor |
| | | <ul style="list-style-type: none"> Drought conditions results in damage to cultural heritage sites due to drying out of substrate. | Minor |
| | | <ul style="list-style-type: none"> The financial implications of drought are limited and restricted to responding to wildfire and supporting the provision of water (e.g., tankering). Droughts, associated impacts and response have the potential for a localised and temporary impact on public opinion. | Negligible |

Impacts of Current Climate Risks – Cold Spells & Heavy Snowfall

County Sligo experience cold spells and heavy snowfall events on an occasional basis with significant county wide events reported in 2018 and 2022. 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 |
|--|------------------------------|---|----------|
|  Cold spell Occasional | Assets | <ul style="list-style-type: none"> Cold spells have resulted in road closure, transport disruption and increased maintenance and repair costs across the county. Storm Emma in 2018 led to all rail and Bus Eireann bus services were halted due to a red snow-ice warning. Freeze thaw action has resulted in damage to critical infrastructure (e.g., water infrastructure) and building stock. Extreme cold conditions in combination with snowfall have resulted in the widespread closure of business (incl. LA business services). | Moderate |
| | Health and Well being | <ul style="list-style-type: none"> Extreme cold has resulted in treacherous conditions and increased incidence of slips and falls. Exposure to extreme cold has had detrimental impacts for outdoor workers and vulnerable populations. | Moderate |
| | Environment | <ul style="list-style-type: none"> Cold spells have led to decreased water availability with detrimental impacts for biodiversity and habitats, resulting in a decrease of ecosystem health. | Minor |
| | Social | <ul style="list-style-type: none"> Road closures have resulted in social isolation for communities. Elderly and vulnerable populations are required to stay in place resulting in isolation. | Moderate |
| | Cultural Heritage | <ul style="list-style-type: none"> Freeze thaw has been identified as having detrimental impacted on the structural integrity of cultural heritage sites. | Minor |
| | Financial | <ul style="list-style-type: none"> The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and infrastructure, and can be significant. | Moderate |
| | Reputational | <ul style="list-style-type: none"> Isolation of communities and council response (e.g., gritting) across the county receives media attention but with a limited short term impact on public opinion. | Minor |
|  Heavy snowfall Occasional | Assets | <ul style="list-style-type: none"> 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). Similarly Storm Eunice in 2022 led to the closure of roads across the county due to heavy snowfall, including the Ross Road in Riverstown. 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). | Moderate |
| | Health and Well being | <ul style="list-style-type: none"> Extreme cold events have resulted in treacherous conditions and increased incidence of slips and falls amongst public and staff. During heavy snowfall in Feb 2022, a car went off the road on the N4 Cloonamahon, Sligo partly blocking the road. | Moderate |
| | Environment | <ul style="list-style-type: none"> Flooding post-heavy snowfall event results in overland flow of pollutants to habitats and ecosystems with detrimental effects. | Minor |
| | Social | <ul style="list-style-type: none"> Road closures can result in significant social isolation for remote communities. Sligo Rovers' opening game of the 2022 SSE Airtricity Premier Division was postponed after heavy snowfall in Feb 2022. | Moderate |
| | Cultural Heritage | <ul style="list-style-type: none"> Accumulations of heavy snowfall can result in damage to cultural heritage sites. | Minor |
| | Financial | <ul style="list-style-type: none"> The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and assets. | Moderate |
| | Reputational | <ul style="list-style-type: none"> Isolation of communities and council response (e.g., gritting) across the county receives media attention but with limited reputational impact for the county. | Minor |

Impacts of Current Climate Risks - Windstorms

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

County Sligo has been frequently exposed to wind storms over the period 1973-2022, notable examples being Storms Ellen, Francis, Barra and Eleanor. Impacts have been experienced across the county and relate to disruption of transport, electricity and communication networks. Severe windstorms also result in health and safety risks, e.g. associated with treefall.



| Hazard & Frequency | Exposure | Impact Description | Rating |
|---|------------------------------|---|-----------------|
|  <p>Severe windstorm Frequent</p> | Assets | <ul style="list-style-type: none"> Windstorms has caused direct damage to building stock and other assets. Storm Ellen and Francis in 2020 resulted in treefall into the Garyvogue river. This required removal for fear that it might wash downstream and cause damage to the Hyde bridge. High winds associated with Storm Barra in 2021 blew the lifeguard's hut in Ballymote off its base and onto the beach, as well as causing all schools and colleges to be closed. 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 c.1,023 homes and the Carns national school in north Sligo temporarily going without power. Storm Arwen in 2020 led to over 100 homes in the Enniscrone area going without power. Windstorms have caused disruption of transport routes as a result of treefall. Treefall associated with Storm Barra in 2021 caused blockages on the N15, R286 and R29, as well as the Drum Road, Harbour Road in Moneygold, Carncash Road in Rathcormac, and on the Collooney to Coolaney road. Storm Eunice in 2022 caused Bus Eireann to cancel multiple routes servicing Sligo town. | Major |
| | Health and Well being | <ul style="list-style-type: none"> Windstorms posed a health and safety risk with potential for injury. Storm Jorge in 2020 led to two surfers off the Sligo coast to get into trouble, requiring rescue by the Coast Guard. | Moderate |
| | Environment | <ul style="list-style-type: none"> Windstorms have resulted in loss of trees and this is particularly the case for vulnerable tree species. | Minor |
| | Social | <ul style="list-style-type: none"> Severe windstorms and disruption of transport and communication networks has resulted in isolation of communities. As a result of Storm Eleanor in 2018, Eir saw 50 sites affected nationally. Three and Vodafone had 71 and 30 affected sites respectively. | Moderate |
| | Cultural Heritage | <ul style="list-style-type: none"> Severe wind storms can cause structural damage to cultural heritage sites. | Minor |
| | Financial | <ul style="list-style-type: none"> The financial impacts of severe wind storm are associated with clean-up and repair cost. | Moderate |
| | Reputational | <ul style="list-style-type: none"> Reputational damage as a result of wind storms is limited and associated with a short term impact on public opinion. | Minor |

Impacts of Current Climate Risks - Coastal Flooding and Erosion

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

County Sligo is exposed to coastal storms resulting in inundation of coastal communities. A number of areas are subject to frequent and recurring flooding. County Sligo has 195 km of coastline, of which 132 km is soft coastline with 59km considered at risk of coastal erosion.

| Hazard & Frequency | Exposure | Impact Description | Rating |
|---|------------------------------|--|------------|
|  <p>Coastal erosion</p> <p>Common</p> | Assets | <ul style="list-style-type: none"> Assets and communities are currently at risk from coastal erosion, as has been observed at Strandhill, threatening the village as well as the local golf course and caravan park. Storms in January 2022 caused up to 5ft of land to be lost in a week at Rosses Point. | Minor |
| | Health and Well being | <ul style="list-style-type: none"> Coastal erosion results in the loss of land, impacting the health and wellbeing of the community affected. Damage to recreational amenities poses a health and safety risk to the members of the public, including the walkway at Strandhill and the second beach at Rosses Point. | Negligible |
| | Environment | <ul style="list-style-type: none"> Coastal erosion results in damage to coastal habitats. Storm Eleanor in 2018 damaged up to 300m of dunes around the Rosses Point golf club. | Moderate |
| | Social | <ul style="list-style-type: none"> Road closures as a result of coastal erosion can result in significant isolation for communities. | Negligible |
| | Cultural Heritage | <ul style="list-style-type: none"> Erosion of sand dune systems can take place in protected areas, such as Special Areas of Conservation. | Negligible |
| | Financial | <ul style="list-style-type: none"> The financial implications of coastal erosion are primarily related to the development and maintenance of coastal defence works. | Minor |
| | Reputational | <ul style="list-style-type: none"> Coastal erosion issues are localised but can result in a limited short term impact on public opinion. | Minor |
|  <p>Coastal flood</p> <p>Common</p> | Assets | <ul style="list-style-type: none"> Coastal flooding can result in transport disruption, road closures and direct damage to building stock and other assets. For example, tidal flooding associated with Storm Eunice in February 2022 rendered public roads in the Gibraltar area being impassable to traffic. High tide arisings from Storm Barra in December 2021 forced access to the Strandhill promenade to be closed. | Moderate |
| | Health and Well being | <ul style="list-style-type: none"> Coastal flooding poses risks to the health and well being of public and staff working in exposed areas. | Minor |
| | Environment | <ul style="list-style-type: none"> Coastal flooding has detrimental impacts on coastal ecosystems, causing an overall reduction in ecosystem health. Coastal flooding results in damage to amenities located in coastal habitats, e.g. the storm beach in Raghly. | Minor |
| | Social | <ul style="list-style-type: none"> Closure of transport routes due to coastal flooding results in significant social isolation of communities. For example, coastal flooding in November 2015 resulted in the townland of Raghly being nearly cutoff from the mainland. | Minor |
| | Cultural Heritage | <ul style="list-style-type: none"> Coastal flooding can cause structural damage to cultural heritage sites located in coastal areas. | Minor |
| | Financial | <ul style="list-style-type: none"> Financial implications associated with coastal flooding relate to increased costs associated with emergency response (e.g. pumping), clean-up and repair. | Minor |
| | Reputational | <ul style="list-style-type: none"> For those areas subject to frequent inundations, there is a the potential for adverse impact on public opinion on a localised basis . | Minor |

Impacts of Current Climate Risks - Pluvial and Fluvial Flooding

Key to colour coding of impact ratings

Catastrophic



Major

Moderate

Minor

Negligible

For County Sligo in the period 1973-2022, pluvial and fluvial flooding have occurred on a common basis. County Sligo was impacted multiple times by fluvial flooding over the last two decades (e.g. 2002, 2008, 2009, 2015, 2016 and 2020) and these events have a wide range of impacts across the County including disruption of transport routes, damage to buildings, and environmental impacts. The most notable impacts of Pluvial flooding are direct damages to buildings and infrastructures and mobilisation of pollutants.

| Hazard & Frequency | Exposure | Impact Description | Rating |
|---|------------------------------|---|------------|
|  <p>Pluvial flood</p> <p>Common</p> | Assets | <ul style="list-style-type: none"> Pluvial flooding has resulted in the temporary inundation of assets. Heavy rain in January 2018 led to significant flooding in the Woodlands Estate and Ballytivnan, inundating the Mowlam Nursing Home and several residences. | Moderate |
| | Health and Well being | <ul style="list-style-type: none"> Pluvial flooding results in transport disruption and damage to road surfaces. Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public. Heavy rainfall can disrupt provision of healthcare services. Storm Barra in 2021 caused cancellation of Covid-19 vaccination services in Sligo Town. | Moderate |
| | Environment | <ul style="list-style-type: none"> Pluvial flooding has resulted in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems. Pluvial flooding can cause landslides and damage to local habitats. For example, extreme rainfall in August 2008 resulted in a significant landslide at Geevagh that inundated a sports field, covering it with up to 1 metre of peat and debris. | Moderate |
| | Social | <ul style="list-style-type: none"> Road closures can result in significant social isolation for communities. | Minor |
| | Cultural Heritage | <ul style="list-style-type: none"> Pluvial flooding puts built heritage at risk of inundation, soakage and leakage. | Negligible |
| | Financial | <ul style="list-style-type: none"> The financial implications of emergency response (e.g. pumping and emergency co-ordination, clean-up and repair) can be significant. Increased budget pressure to adapt to impact of climate change, e.g. flood protection measures and upgrading of existing drainage systems. | Minor |
| | Reputational | <ul style="list-style-type: none"> Pluvial flooding issues are localised but can result in short term impacts on public opinion. | Minor |
|  <p>River flood</p> <p>Frequent</p> | Assets | <ul style="list-style-type: none"> River flooding has resulted in the temporary inundation of buildings. River flooding results in transport disruption and road closures. Fluvial flooding between Dromod and Longford caused disruption to rail services between Sligo and Dublin in 2020. The road between Sligo, Ballintogher and Dromahair called 'The Long Stretch' is known to flood frequently. River flooding and fast flowing rivers can cause damage to bridges through hydrodynamic scour. | Moderate |
| | Health and Well being | <ul style="list-style-type: none"> Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public. Fluvial floods can carry debris which can lead to injury of residents and pedestrians. | Minor |
| | Environment | <ul style="list-style-type: none"> River flooding can result in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems. | Minor |
| | Social | <ul style="list-style-type: none"> Road closures can result in significant social isolation for communities. Inhibited development of communities as a result of frequent river flooding. | Minor |
| | Cultural Heritage | <ul style="list-style-type: none"> A number of the county's cultural heritage and archaeological sites are situated near river systems and are particularly exposed to river flooding. | Minor |
| | Financial | <ul style="list-style-type: none"> 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. | Minor |
| | Reputational | <ul style="list-style-type: none"> For areas that are subject to inundation, there is the potential for short term localised impact on public opinion. | Minor |

3.2.3 Impact Assessment (Service Delivery)

Summary of Service Level Impacts

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

On the basis of reported information and in consultation with Sligo County Council, an assessment of the impacts of identified climate change hazards and impacts on the delivery of services by Sligo 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 Sligo 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.

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

| Hazard | Internal LA Governance & Administration | Roads, Transportation & Critical Infrastructure Services | Built Environment & Asset Management Services | Community Development Services / Economic & Tourism Development Services | Arts, Culture & Heritage Services | Water Supply Services* | Environment Services (Protection & Enhancement) | Emergency Services & Response |
|------------------|---|--|---|--|-----------------------------------|------------------------|---|-------------------------------|
| Heatwave | Minor | Moderate | Minor | Moderate | Minor | Moderate | Moderate | Moderate |
| Drought | None | None | None | Minor | Minor | Moderate | Minor | Minor |
| Cold spell | Minor | Moderate | Moderate | Moderate | Minor | Moderate | Moderate | Moderate |
| Heavy snowfall | Moderate | Moderate | Moderate | Moderate | Minor | Minor | Moderate | Moderate |
| Severe windstorm | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate | Moderate |
| Coastal Flood | Moderate | Moderate | Minor | Moderate | Moderate | Moderate | Moderate | Moderate |
| Coastal Erosion | None | Minor | None | Minor | Minor | None | Minor | Minor |
| Pluvial Flood | Minor | Moderate | Minor | Minor | Minor | Minor | Moderate | Minor |
| River Flood | Minor | Moderate | Moderate | Moderate | Minor | Minor | Minor | Moderate |

*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 Sligo 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 |
|--|--|--|
| Internal LA Governance & Administration | <ul style="list-style-type: none"> Decreased staff productivity and increased staff and customer discomfort. | None |
| Roads, Transportation & Critical Infrastructure Services | <ul style="list-style-type: none"> Increased costs associated with repair of road surfaces across the county. Increased health and safety risk for outdoor staff members across the county. | None |
| Built Environment & Asset Management Services | <ul style="list-style-type: none"> Increased requirement for cooling in council offices/buildings . | None |
| Community Development Services/ Economic & Tourism Development Services | <ul style="list-style-type: none"> Increased requirement for waste collection and traffic management at key recreational sites. | <ul style="list-style-type: none"> Reduced grass growth causing increased supplementary feed requirement for cattle reducing farm incomes and the wider industry. |
| Arts, Culture & Heritage Services | <ul style="list-style-type: none"> Increased requirements for monitoring and maintenance of cultural heritage sites. Increased staff and customer discomfort. | <ul style="list-style-type: none"> Localised degradation of cultural heritage sites due to drying out. Increased requirements for monitoring and maintenance of cultural heritage sites. |
| Water Supply Services | <ul style="list-style-type: none"> Increased demand for water to cool infrastructure, communities, and livestock. Implementation of water conservation measures (e.g., hosepipe bans). | <ul style="list-style-type: none"> Increased requirement to support provision of water to communities suffering loss of water supply (e.g., Tankering). |
| Environment Services (Protection & Enhancement) | <ul style="list-style-type: none"> Reduced water flows impacting on water quality in local areas with increased requirement for monitoring and remediation. Decreased ecosystem health across the county with potential for loss of priority habitats resulting in increased requirement for monitoring and remediation. | <ul style="list-style-type: none"> Reduced water flows impacting on water quality in local areas with increased requirement for monitoring and remediation. Reduced water flows impacting on biodiversity with potential for loss of priority species and habitats necessitating increased monitoring and remediation. |
| Emergency Services & Response | <ul style="list-style-type: none"> Increase in number of wildfire call-outs across the county. Increase in number of call out to bathing areas throughout the county. | <ul style="list-style-type: none"> Increase in number of localised uncontrolled fire call-outs. |
| Crosscutting | <ul style="list-style-type: none"> Health and Safety of Staff | |

Service Level Impacts (Cold Spell & Heavy Snowfall)

Cold spells and heavy snowfall have significant impacts across County Sligo with direct and indirect consequences for the delivery of services by Sligo 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.

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

| | Cold Spell | Heavy Snowfall |
|---|---|---|
| Internal LA Governance & Administration | <ul style="list-style-type: none"> Localised disruption and closure of business services. Health and safety risks for public and staff. | <ul style="list-style-type: none"> Closure of business services across the county. Health and safety risks for public and staff. |
| Roads, Transportation & Critical Infrastructure Services | <ul style="list-style-type: none"> Increased costs associated with gritting and salting roads across the county. Increased road repair and maintenance costs. Reduced capacity for drainage resulting in standing water due to post cold spell events. Damage to stormwater infrastructure with increased requirement for maintenance and repair across the county. Damage to wastewater infrastructure with increased requirement for maintenance and repair. | <ul style="list-style-type: none"> Transport disruption and road closures. Increased costs associated with gritting and salting roads and footpaths around the county. |
| Built Environment & Asset Management Services | <ul style="list-style-type: none"> Increased energy costs for buildings county wide. Increased health and safety risks for public and staff county wide. | <ul style="list-style-type: none"> Increased energy costs for buildings county wide. Increased health and safety risks for public and staff county wide. |
| Community Development Services / Economic & Tourism Development Services | <ul style="list-style-type: none"> Increased energy costs in community buildings across the county. Increased health and safety risks for public and staff working in community buildings. Increased instances of community isolation county wide. | <ul style="list-style-type: none"> Increased health and safety risks for public and staff. Closure of services throughout local communities. Increased instances of community isolation across the county. |
| Arts, Culture & Heritage Services | <ul style="list-style-type: none"> Increased energy costs for cultural heritage sites. Increased health and safety risks for public and staff at community heritage sites. | <ul style="list-style-type: none"> Increased health and safety risks for public and staff. Closure of sites. |
| Water Supply Services | <ul style="list-style-type: none"> County wide water supply issues due damaged water supply infrastructure (e.g., burst pipes). Increased maintenance and repair costs of water service infrastructure across the county. Overland flows of pollutants due to post freezing events, causing contamination of water supplies necessitating increased monitoring and remediation. | <ul style="list-style-type: none"> Localised water supply issues due damaged water supply infrastructure (e.g., burst pipes). Increased maintenance and repair costs of water service infrastructure. |
| Environment Services (Protection & Enhancement) | <ul style="list-style-type: none"> Overland flows of pollutants due to post freezing flood events resulting in decreased water quality necessitating increased requirement on council for monitoring. Prolonged cold spells impacting species and habitats not protected from the frigid temperatures requiring increased monitoring and remediation. | <ul style="list-style-type: none"> Overland flows of pollutants due to post freezing flood events resulting in decreased water quality necessitating increased requirement on council for monitoring. Heavy Snowfall impacts species not protected from the frigid temperatures, with increased monitoring and remediation. |
| Emergency Services & Response | <ul style="list-style-type: none"> Increased pressure on emergency response units across the county. Increase in response times due to treacherous road conditions around the county. | <ul style="list-style-type: none"> Increased pressure on emergency response units across the county. Increase in response times due to heavy snowfall on roads around the county. |
| Crosscutting | <ul style="list-style-type: none"> Redeployment of staff | |

Service Level Impacts (Severe Windstorm)

Severe windstorms can result in the closure and/or disruption of Sligo 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.

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

| | Severe Windstorm |
|---|---|
| Internal LA Governance & Administration | <ul style="list-style-type: none"> Widespread closure of business services. Health and safety risks for public and staff. |
| Roads, Transportation & Critical Infrastructure Services | <ul style="list-style-type: none"> County wide transport disruption and road closures affecting the wider community and local authority operations. Increased clean-up and repair costs after an event. Increased drain maintenance costs for wastewater infrastructure. Disruption of critical infrastructure services (e.g. electricity) impacting on wastewater treatment. |
| Built Environment & Asset Management Services | <ul style="list-style-type: none"> Closure of buildings and disruption of services as a result of direct damage to buildings and disruption of power and communications. |
| Community Development Services / Economic & Tourism Development Services | <ul style="list-style-type: none"> Disruption to delivery of community services across the county. Increased power outages and damages to infrastructure result in an impact on local economy. Increased clean-up and repair costs after an event. |
| Arts, Culture & Heritage Services | <ul style="list-style-type: none"> Closure of sites and cancellation of events. Increased maintenance and repair costs due to storm damage to cultural heritage sites. |
| Water Supply Services | <ul style="list-style-type: none"> Water supply issues due to damaged water supply infrastructure. |
| Environment Services (Protection & Enhancement) | <ul style="list-style-type: none"> High winds result in damage to habitats. Increased cost to protect habitats from wind damage. |
| Emergency Services & Response | <ul style="list-style-type: none"> Increased pressure on emergency service units across the county. |
| Crosscutting | <ul style="list-style-type: none"> Staff redeployment. |



Service Level Impacts (Coastal Flood & Erosion)

Coastal flooding and erosion result in a range of impacts for service provision by Sligo County Council. Impacts of coastal flooding are associated with clean-up and repair costs, damage to assets and infrastructure and damage to environmentally sensitive areas. The primary impacts of coastal erosion are associated with transport disruption and road closures, damages to community assets and infrastructure, and damages to coastal habitats.

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

| | Coastal Flood | Coastal Erosion |
|---|--|---|
| Internal LA Governance & Administration | <ul style="list-style-type: none"> Temporary inundation of buildings in exposed area resulting in closure of services. | None |
| Roads, Transportation & Critical Infrastructure Services | <ul style="list-style-type: none"> Transport disruption and road closures. Increased clean-up and repair costs. Damage to stormwater systems with increased requirement for maintenance and repair. Damage to wastewater infrastructure with increased requirement for maintenance and repair. | <ul style="list-style-type: none"> Erosion of key transport routes (rail, road) situated in coastal areas. |
| Built Environment & Asset Management Services | <ul style="list-style-type: none"> Inundation of building stock. | None |
| Community Development Services / Economic & Tourism Development Services | <ul style="list-style-type: none"> Damage to community infrastructure such as parks and refuse collection points. Closure of community infrastructure and services. Increased repair and maintenance costs. Inhibited development of communities at risk of coastal flooding. | <ul style="list-style-type: none"> Damage to community infrastructure such as parks and recreational areas. |
| Arts, Culture & Heritage Services | <ul style="list-style-type: none"> Damage to heritage sites exposed to coastal flooding. Increased Health and safety risks. Increased maintenance and repair costs. | <ul style="list-style-type: none"> Damage to heritage sites exposed to coastal flooding. |
| Water Supply Services | <ul style="list-style-type: none"> Damage to critical water supply infrastructure with increased requirement for maintenance and repair. | None |
| Environment Services (Protection & Enhancement) | <ul style="list-style-type: none"> Impact on the bathing water quality necessitating increased monitoring and remediation. Damage to coastal habitats resulting in a decrease of ecosystem health at a localised level and an increased requirement for monitoring and remediation. | <ul style="list-style-type: none"> Damage to coastal habitats resulting in a decrease of ecosystem health and an increased requirement for monitoring and remediation. |
| Emergency Services & Response | <ul style="list-style-type: none"> Increased pressure on emergency response units across the county. | <ul style="list-style-type: none"> Increased pressure on emergency response units. |
| Crosscutting | <ul style="list-style-type: none"> Staff redeployment. | |

Service Level Impacts (Pluvial & River Flood)

Pluvial and river flooding have resulted in a wide range of impacts for Sligo 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 |
|---|---|---|
| Internal LA Governance & Administration | <ul style="list-style-type: none"> Localised disruption and closure of local authority services. | <ul style="list-style-type: none"> Localised disruption and closure of local authority services. |
| Roads, Transportation & Critical Infrastructure Services | <ul style="list-style-type: none"> Transport disruption and road closures. Increased clean-up and repair costs after an event. Reduced capacity for drainage resulting in standing water. Damage to stormwater infrastructure. Damage to wastewater treatment plants. | <ul style="list-style-type: none"> Transport disruption and road closures. Increased clean-up and repair costs after an event. Reduced capacity for drainage resulting in standing water. Damage to stormwater infrastructure. |
| Built Environment & Asset Management Services | <ul style="list-style-type: none"> Damage to buildings and disruption of service at the localised level. Increased maintenance and repair costs. Increased requirement for flood defence measures. | <ul style="list-style-type: none"> Damage to buildings and disruption of service. Increased maintenance and repair costs. Increased requirement for flood defence measures. |
| Community Development Services / Economic & Tourism Development Services | <ul style="list-style-type: none"> Closure of community infrastructure and services at a localised level. Increased repair and maintenance costs. Inhibited development of communities at a localised level. Damage to buildings and travel disruptions impact on local economies. | <ul style="list-style-type: none"> Closure of community infrastructure and services. Increased repair and maintenance costs. Inhibited development of communities. Damage to buildings and travel disruptions impact on local economies. |
| Arts, Culture & Heritage Services | <ul style="list-style-type: none"> Damage to heritage sites due to pluvial flooding. Increased maintenance and repair costs. | <ul style="list-style-type: none"> Damage to heritage sites due to river flooding. Increased maintenance and repair costs. |
| Water Supply Services | <ul style="list-style-type: none"> Water supply issues at a localised level requiring supplemental water provision (e.g., tankering). Increased water treatment costs due to contamination by overland pollutant flows. | <ul style="list-style-type: none"> Water supply issues at a localised level requiring supplemental water provision (e.g., tankering). Increased water treatment costs due to contamination by overland pollutant flows. |
| Environment Services (Protection & Enhancement) | <ul style="list-style-type: none"> 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. Severe damage across the county to environmentally sensitive areas requiring monitoring and/or restoration work. | <ul style="list-style-type: none"> Deterioration of water quality due to overland flow of pollutants resulting in water supply issues and an increased requirement for monitoring and remediation. Isolated and limited damage to environmentally sensitive areas requiring monitoring and/or restoration work. |
| Emergency Services & Response | <ul style="list-style-type: none"> Localised increase in pressure on emergency response. | <ul style="list-style-type: none"> Widespread increase in pressure on emergency response. |
| Crosscutting | <ul style="list-style-type: none"> Staff redeployment. | |

3.2.4 Current Climate Risk Matrix

Current Climate Risk Matrix

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

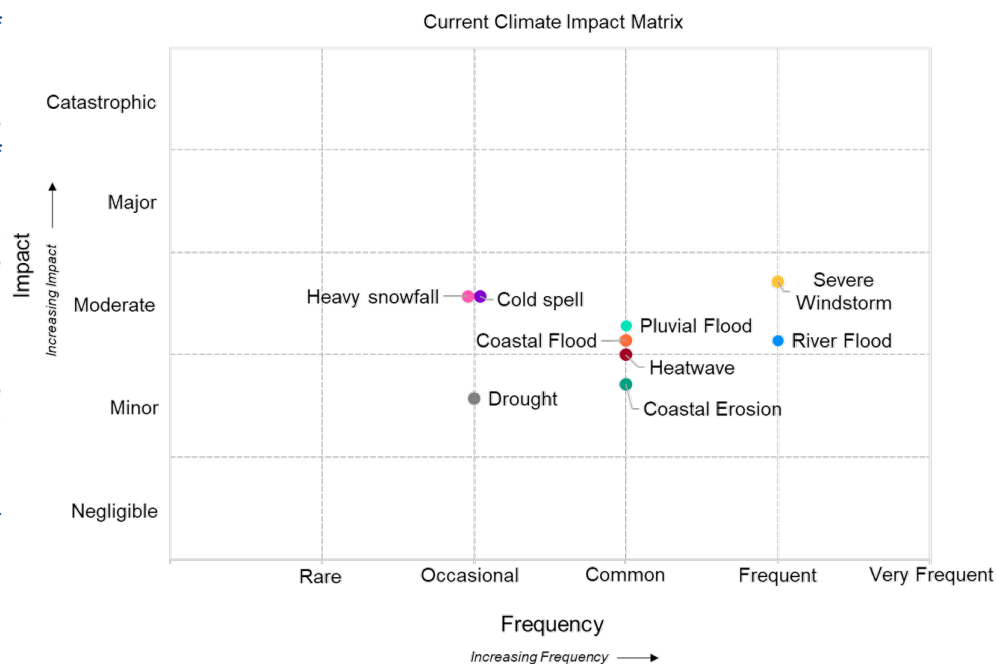
The assessment identified **severe windstorm** and **river flooding** as posing the highest level of risk for County Sligo with impacts of severe windstorm being primarily associated with disruption and damage to energy, communication and transport networks. Impacts associated with river flooding are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

Pluvial and coastal flooding have been identified as posing a relatively high risk for County Sligo with impacts including damage to assets and infrastructure, disruption of transport networks and potential for isolation of communities and vulnerable populations.

Heatwaves occur on a common basis across County Sligo; 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. **Coastal erosion** along the Sligo coastline is ongoing, and has localised impacts for assets, infrastructure and cultural heritage sites located in coastal areas.

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



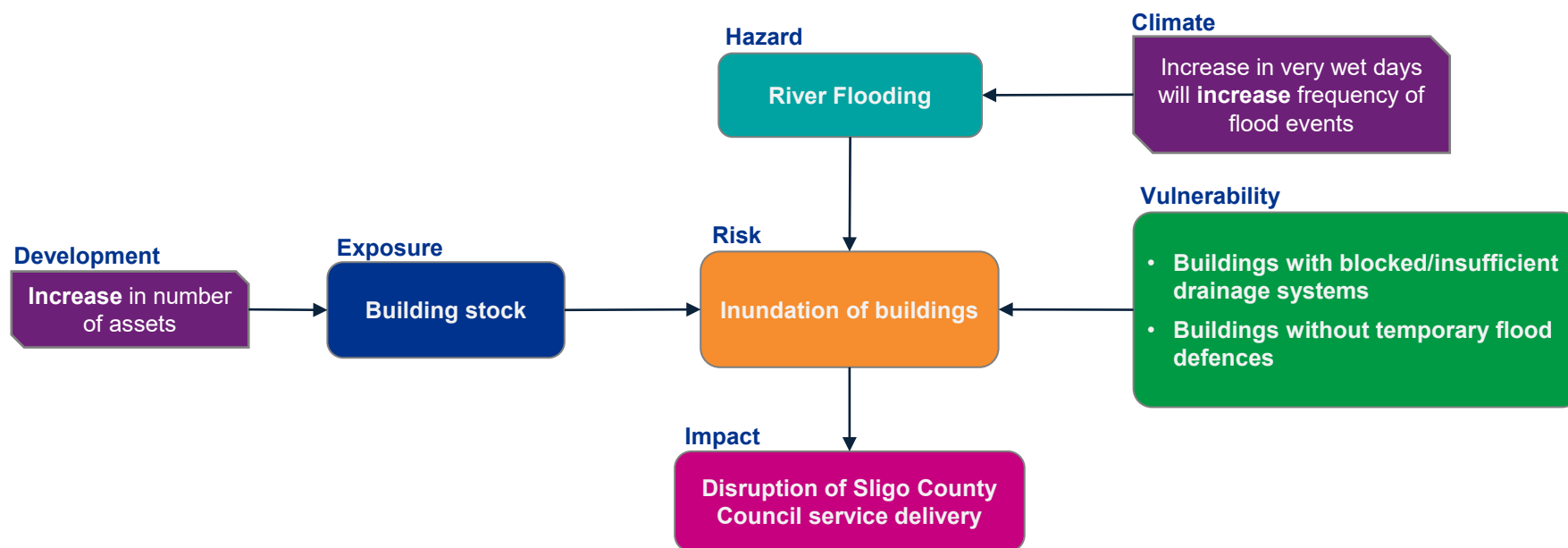
The risk matrix above shows the current risk for the identified hazards within County Sligo.

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 Sligo 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 Sligo 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.

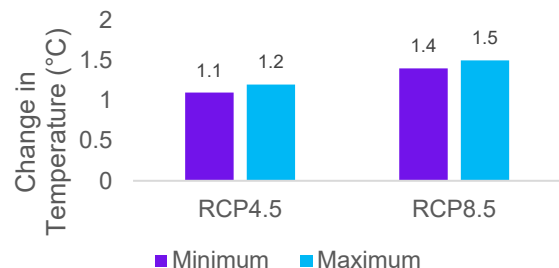


3.3.1 Future Changes in Climate Hazards

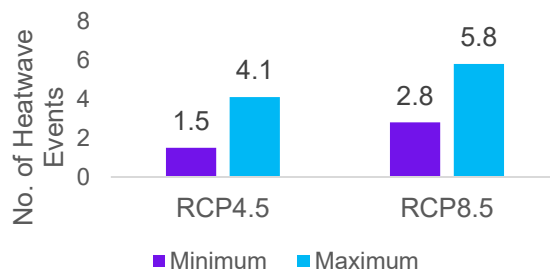
Climate Projections for County Sligo in 2050 (1/2)

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

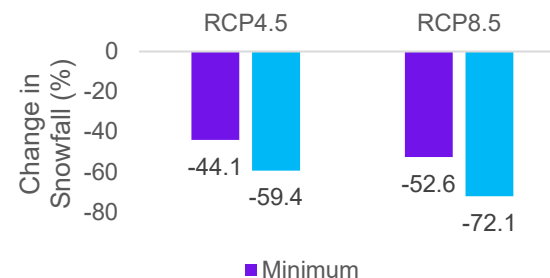
| Hazard | Projected Change | Future Frequency |
|---|---|--|
|  Heatwaves | <ul style="list-style-type: none"> Projections indicate an overall increase in average temperature (bottom left) of between 1.1 and 1.5°C for County Sligo relative to the 1981-2000 period. Under a high emission scenario, projections indicate that heatwaves will become more frequent (bottom middle) by mid-century. Summer rainfall is expected to reduce 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. | Frequent  |
|  Droughts | | Common  |
|  Cold Spell | <ul style="list-style-type: none"> As a consequence of the increasing temperatures, a decrease in the number of frost days and ice days in the 2041-2060 future period when compared with the baseline period of 1981 to 2000, is projected for both the RCP4.5 and RCP8.5 scenario. | Rare  |
|  Heavy Snowfall | <ul style="list-style-type: none"> The annual snowfall in the region is projected to decrease substantially by the middle of the century for the RCP4.5 and RCP8.5 scenarios (bottom right). | Rare  |
|  Severe Windstorms | <ul style="list-style-type: none"> Projections of storms are subject to a high level of uncertainty. 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. | Frequent  |



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

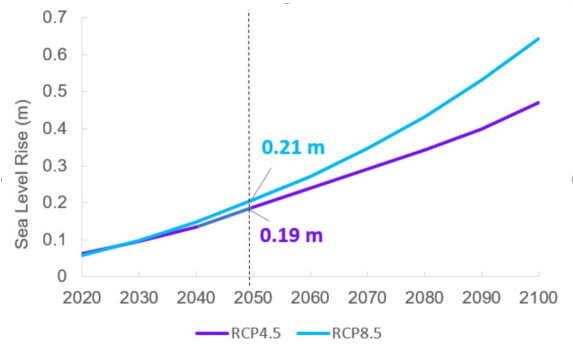


The projected minimum and maximum **reduction in snowfall (> 30 mm)** for the area of County Sligo for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario (Source: Nolan and Flanagan, 2020)

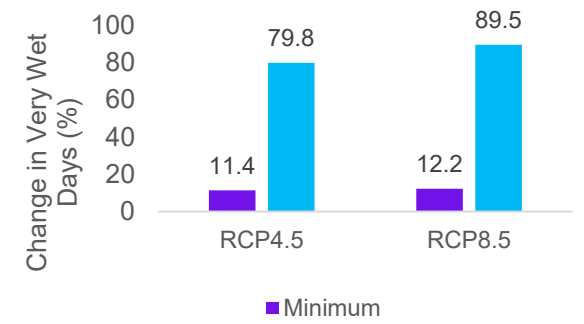
Climate Projections for County Sligo in 2050 (2/2)

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

| Hazard | Projected Change | Future Frequency |
|--|--|---|
|  Coastal Flood | <ul style="list-style-type: none"> Rising sea levels projections under a high emissions scenario indicate an increase of up to 0.21 m by 2050 which will increase the frequency of coastal inundation (bottom left). | Frequent  |
|  Coastal Erosion | <ul style="list-style-type: none"> A rising sea level is strongly linked with coastal erosion and an increase in erosion rates and extent. | Frequent  |
|  Pluvial Flood | <ul style="list-style-type: none"> Projections indicate an increase in the frequency of heavy rainfall days (days with precipitation >30mm) for County Sligo with some areas projected to see increase of up to 90% (bottom right). This will likely result in an increased frequency of associated fluvial and pluvial flooding. | Frequent  |
|  River Flood | | Very Frequent  |



Projected **change in sea level** for a medium (RCP4.5) and high (RCP8.5) emissions scenario offshore of (Grid Reference: 55,-10) County Sligo (Source: IPCC AR6 Sea-Level Rise Projections)



Projected **increase in very wet days (> 30 mm)** for County Sligo 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 Sligo 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 Sligo 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

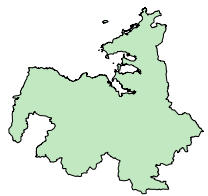


- Extra 550,000 homes
- 'Housing for All' promotes a 'town centre first' approach

Cross-Sectoral National Priorities:

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

How is County Sligo projected to change?



- Population to increase from 65,500 in 2016 to **71-72,500 in 2028** (NPF)
- Sligo Town **population targeted to increase by 8,000** between 2016 and 2028. (RSES)
- **c.2,764** new housing units required by 2028 (DHLGH HNDA Toolkit)
- Sligo's total road network of **2,831 km**, consists of 153 km national roads, 236 km regional roads and 2,442 km local roads (TII)

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."

Planning for adaptation

Coastal and Flood Defence Schemes:
The Office of Public Works-Council projects for 2021 include an approved €124,000 funding for Rosses Point (i.e. to install 34m of rock revetment to protect the public path) and €72,000 Strandhill Bay (i.e. a Coastal Erosion & Flood Risk Management Study).

Key national road infrastructure projects include focus for council:

- N4 Collooney to Castlebaldwin
- N16 Sligo to County Boundary
- N16 Lugatober Road Development
- N17 Knock to Collooney [AEC]
- N4-N15 Sligo Urban Improvement Scheme



Notable renewable energy initiatives include:

- 10 X Sustainable Energy Community (SEC) (e.g. Curry SEC and Aurovo Cooperative)
- Wind Farms (e.g. Carrane Hill and Lackan)
- Sligo SEC Proposal – to develop a Satellite Gas Network in Sligo Town. The project would provide 'enabling infrastructure' for locally-sourced low carbon renewable gas (i.e. Anaerobic Digestion and Hydrogen).



Planning for mitigation



Case Study in Urban Planning: Sligo Town Regeneration Project

- **€47 million** has been allocated to Sligo Town under 'Call 2' of the Urban Regeneration and Development Fund (URDF).
- The funding will go towards a new cultural and learning hub called 'City Campus'. This will include a library to be developed by Sligo County Council and IT Sligo.
- Public Realm projects will see €19.16 million spent on re-designing streets and spaces. The aim is to make these spaces more attractive and pedestrian friendly and to encourage visitors to the town.

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

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.

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

Future Impacts

Taking into account the changes in exposure and vulnerability, the future change in impacts for each of the nine 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 | Minor | Moderate | Minor | Moderate | Moderate | Major | Minor | Moderate | Minor | Moderate | Minor | Moderate | Negligible | Minor |
| Drought | Negligible | Minor | Negligible | Minor | Moderate | Major | Minor | Moderate | Minor | Moderate | Negligible | Minor | Negligible | Minor |
| Cold Spell | Moderate | Moderate | Moderate | Moderate | Minor | Minor | Moderate | Moderate | Minor | Minor | Moderate | Moderate | Minor | Minor |
| Heavy Snowfall | Moderate | Moderate | Moderate | Moderate | Minor | Minor | Moderate | Moderate | Minor | Minor | Moderate | Moderate | Minor | Minor |
| Severe Windstorm | Major | Major | Moderate | Moderate | Minor | Minor | Moderate | Moderate | Minor | Minor | Moderate | Moderate | Minor | Minor |
| Coastal Flood | Moderate | Major | Minor | Moderate | Minor | Moderate | Minor | Moderate | Minor | Moderate | Minor | Moderate | Minor | Moderate |
| Coastal Erosion | Minor | Moderate | Negligible | Minor | Moderate | Major | Negligible | Minor | Negligible | Minor | Minor | Moderate | Minor | Moderate |
| Pluvial Flood | Moderate | Major | Moderate | Major | Moderate | Major | Minor | Moderate | Negligible | Minor | Minor | Moderate | Minor | Moderate |
| River Flood | Moderate | Major | Minor | Moderate | Minor | Moderate | Minor | Moderate | Minor | Moderate | Minor | Moderate | Minor | Moderate |

3.3.3 Future Climate Risk Matrix

Future Climate Risk Matrix

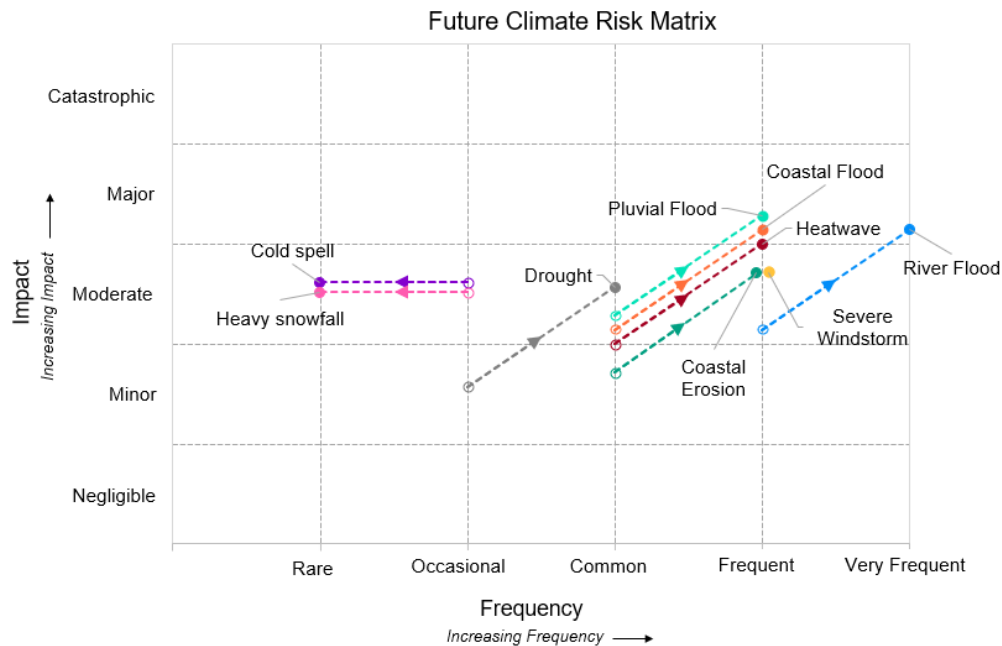
Projected changes in levels of hazard, exposure, and vulnerability for County Sligo combine to form an assessment of future climate risk. The future climate risk matrix on the right shows projected change in risk with the hollow marker showing the current risk and the solid marker the future risk. The dotted line shows the change between the current and future risk.

The **risk** of existing hazards such as **river and pluvial flooding, coastal flooding and erosion, and heatwaves** is projected to **increase** in the future as a result of projected increases in the frequency of hazard events and also due to an increase in the areas, assets and populations exposed to these hazards.

Droughts although already experienced in County Sligo, are expected to occur more frequently due to climate change and with a greater impact on County Sligo in the future. The risk is exacerbated by not only projected changes in the frequency occurrence of drought but also as a result of projected increases in population and the proportion of population considered vulnerable (those aged 65 years and over). Droughts can therefore be considered as **emerging risk** for the region.

Although the frequency and impact of **severe windstorms** is thought to be **unchanged in the future**, these events will remain a risk for County Sligo.

The impact of **heavy snowfall and cold spells** on County Sligo remains constant, however, due to projected decreases in hazard frequency, the overall risk of these hazards is projected to reduce in the future.



The risk matrix above shows the future changes in risk for the identified hazards within County Sligo. 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

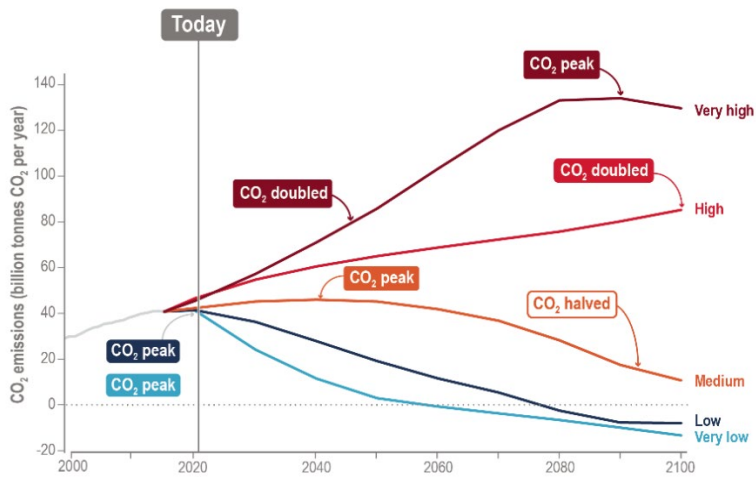
Uncertainty

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.

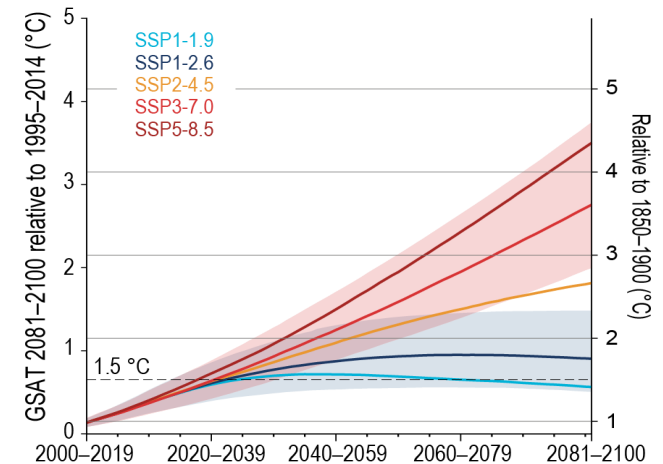
Different social and economic developments can lead to substantially different future emissions of carbon dioxide and other greenhouse gases (bottom left) resulting in uncertainty in what the future global climate will be. As an example of the possible future ranges in mean global surface temperature (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 Sligo will develop into the future. Although, in the near-term there is relatively good understanding as a result of strategies, such as the Sligo County Development Plan 2017-2023, 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 CO₂ 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

The CCRA detailed within this report provides an assessment of County Sligo’s climate change risks and has been produced to support Sligo County Council’s efforts to prepare its LACAP. The CCRA has been developed 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 and 2021, resulted in damages to residential properties, closure of businesses (Mowlam Nursing Home, 2018), disruption to public services and closure of transport networks. Projected increases in the frequency of extreme precipitation events will result in increased surface water and riverine flood risk for Sligo.
- 
 • **Coastal erosion** and **coastal flooding** already pose a significant risk for County Sligo and have resulted in disruption of transport networks and damage to coastal habitats (E.g. Strandhill). Rising sea levels will increase the rate of coastal erosion and frequency of coastal inundation, resulting in an increased coastal erosion and flood risk for County Sligo.
- 
 • **Severe windstorms** are currently experienced on a frequent basis in Sligo and result in wide-ranging impacts, including disruption to energy supply and transport networks. Projections indicate no significant change to this frequency.
- 
 • **Heatwaves** and **droughts** have contributed to the imposition of restrictions on water supply, damage to road surfaces (e.g., N15 in 2018) and have placed an 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.
- 
 • Recent experiences of **cold spells** and **heavy snowfall** events in 2018 and 2022, demonstrated the wide range of impacts for County Sligo. These included, amongst others, disruption to public transport networks (e.g. rail and Bus Eireann bus services) and road closures. 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.

To increase resilience, Sligo 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/m² and 6.0 W/m² after 2100 (the corresponding ECPs assuming constant concentrations after 2150)

RCP8.5 One high pathway for which radiative forcing reaches >8.5 W/m² 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 |
|--|--|
| Business Services | Corporate and customer facing services. |
| Roads, footpaths, bridges, construction and maintenance | Road and active travel, bridges, piers and harbours. |
| Building Stock | Local Authority buildings and social housing stock. |
| Community infrastructure | Recreation (incl. libraries and parks), tourism and economic development infrastructure. |
| Cultural Heritage | Arts and heritage protection. |
| Stormwater / Sewerage | Stormwater and sewerage infrastructure. |
| Wastewater | Foul and surface water sewers, water treatment plants and wastewater pumping stations. |
| Water Supply | Public water supply network (with Irish Water), public water treatment plant and pumping stations (with Irish Water) . |
| Water Quality | Water quality (rivers, lakes and marine). |
| Biodiversity | Biodiversity and habitat protection. |
| Community Development | Community development and co-ordination. |
| Emergency Response | 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) |
|--|---|--|--|--|---|
| Asset Damage | 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 |
| Health and Wellbeing | 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 |
| Environment | 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 |
| Social | 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 |
| Financial (for single extreme event or annual average impact) | 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 |
| Reputation | 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 |
| Cultural Heritage | 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 |

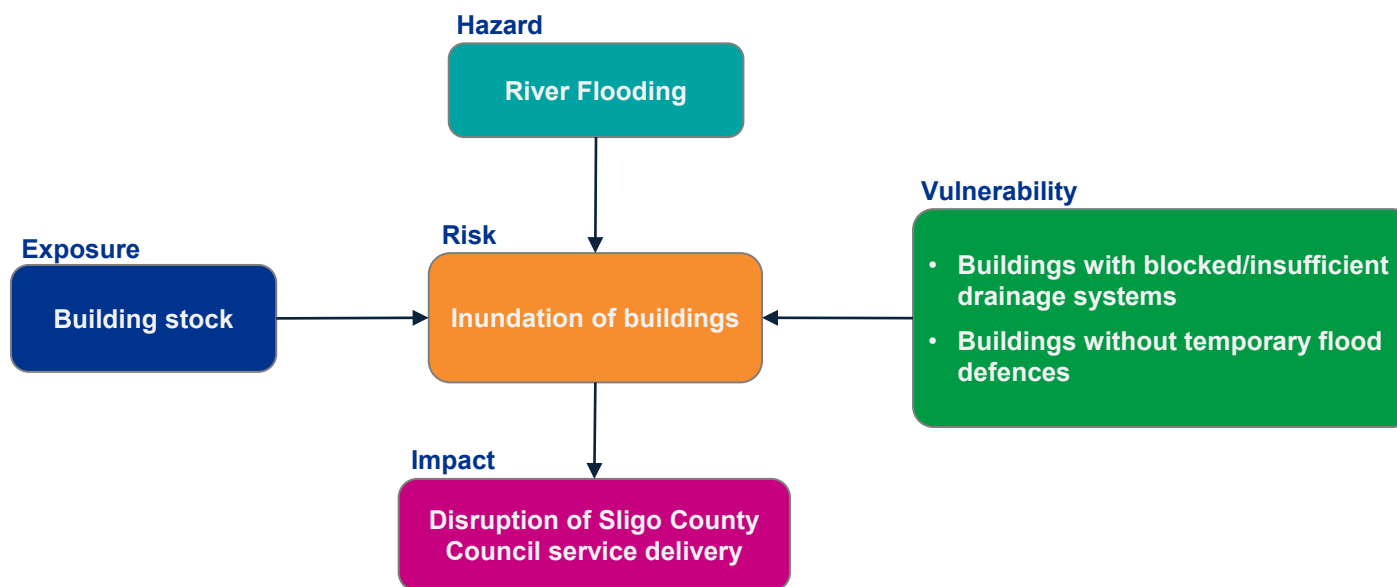
4.3

Appendix 3

Characterising Exposure, Vulnerability and Impacts of Climate Hazards

For County Sligo 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 Sligo County Council buildings. The buildings with insufficient drainage and with no temporary flood defences would be considered more vulnerable to this hazard. Consequently, if Sligo County Council buildings were to be flooded, one of the possible impacts would be the disruption of Sligo 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.

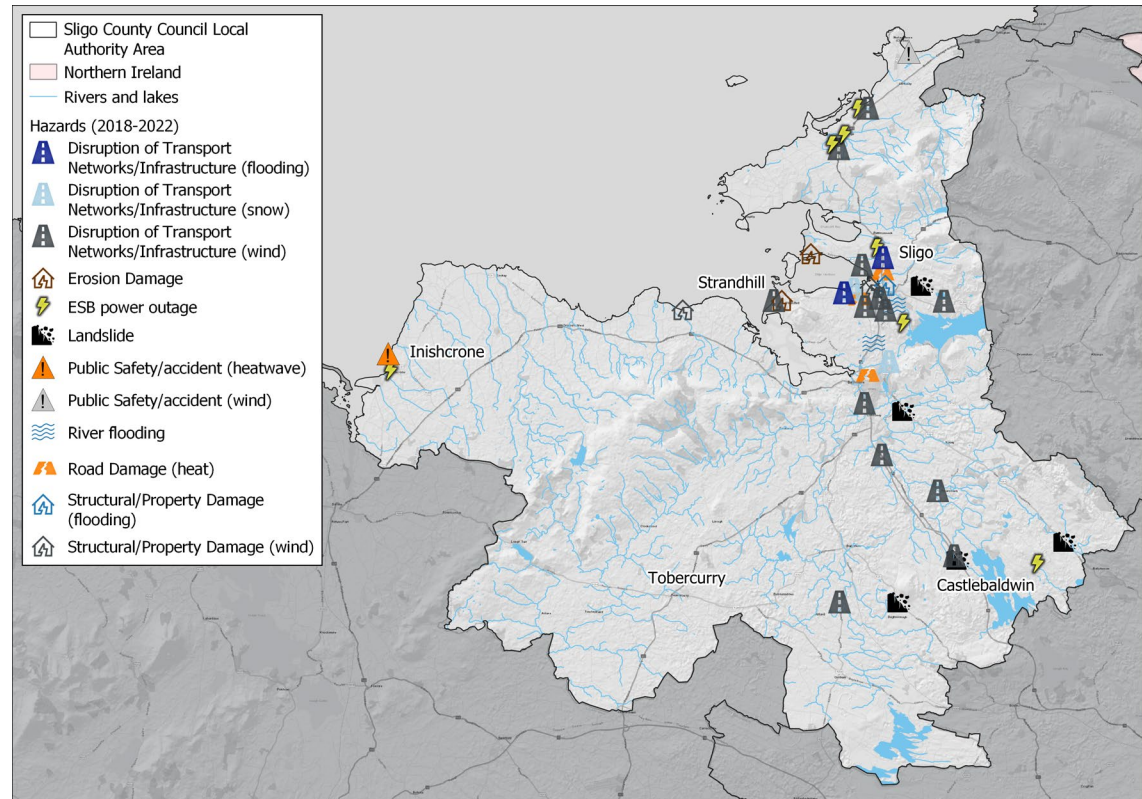
The following pages summarise the exposures, vulnerabilities and impacts for the hazards that exist within the Sligo County region.



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 County Sligo. Below and to the right we provide an example of exposures and impacts of hazard events experienced between 2018 and 2022.

- Treefall associated with **Storm Barra** in 2021 caused blockages on the N15, R286 and R29, as well as the Drum Road, Harbour Road in Moneygold, Carncash Road in Rathcormac, and on the Collooney to Coolaney road.
- **Tidal flooding** associated with Storm Eunice in February 2022 rendered public roads in the Gibraltar area impassable to traffic.
- **Coastal erosion** in January 2022 threatened recreational amenities and homes at Rosses Point and Strandhill, with up to 5ft of land being lost in a week.
- **Fluvial flooding** between Dromod and Longford caused disruption to rail services between Sligo and Dublin in 2020. The road between Sligo, Ballintogher and Dromahir called **'The Long Stretch'** is known to flood frequently.
- Increased sea surface temperatures can result in **higher frequencies of jellyfish** on coasts. In July 2021 a number of sightings of the potentially hazardous lion's mane jellyfish were recorded at Enniscrone Beach.



Impacts of climate hazards (1/5)

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) |
|-----------------|--|---|
| Heatwave | <ul style="list-style-type: none"> Hot and uncomfortable working/living conditions Increased demand on recreational areas Damage to road surface and hazardous driving conditions Disruption of public transport networks Heat stress for animals and livestock Increased frequency of swimming area closures due to presence of Lion's Mane and the Portuguese Man o' War jellyfish. Increased demand on available water resources, leading to increasing pressure to share resources Detrimental impacts on freshwater quality and fish populations Increase in the frequency of uncontrolled fire Disruption of recreational activities Increased strain on biodiversity | <ul style="list-style-type: none"> Housing, buildings (including LA offices), care home/leisure centres/recreational facilities, outdoor workers (elderly, with limited access to water, shade and sunscreen) Beaches, parks (with easy access to urban areas) Local roads (surface-dressed roads, located in areas of high solar radiation) National railway network (communities with limited transport network) Livestock (marginal farm incomes) Beaches/swimming areas (highly utilised beaches) Reservoirs/lakes (sites with deteriorated water quality/eutrophic status) Emergency response services (areas of growing vegetation) Recreational areas (areas with diverse wildlife populations) European/Irish designated sites (SPAs, SACs, Ramsar sites, NHAs) (areas with diverse wildlife populations) |
| Drought | <ul style="list-style-type: none"> Decreased grass growth and increased supplementary feed requirements for cattle Increased demand on available water resources, leading to increasing pressure to share resources Increased degradation rates Reduced river flow Limits the ability of the ground to absorb water, leading to increased risk of flash flooding when rainfall occurs | <ul style="list-style-type: none"> Pasture (farmers at risk of marginal farm incomes) Reservoirs/lakes/groundwater supplies (lakes already depleted/under stress) Cultural heritage Biodiversity (areas with diverse wildlife populations) |

Impacts of climate hazards (2/5)

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

Impacts of climate hazards (3/5)

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) |
|-------------------------|---|---|
| Severe Windstorm | <ul style="list-style-type: none"> • Direct wind damage to buildings and infrastructure. • Disruption of communications infrastructure • Wind damage to trees resulting in tree fall • Wind damage to habitats and sensitive species • Treacherous conditions at coast and on land • Disruption of wind energy generation • Disruption to energy supply • Disruption of transport networks • Disruption to waste collection • Disruption to water quality monitoring • Closure of parks and public buildings | <ul style="list-style-type: none"> • Buildings, development sites (buildings w. rooftop equip., vulnerable populations, high-rise structures) • Overhead communication lines (situated in upland and exposed sites) • Trees (forestry situated in upland and /or exposed areas) • Habitats and sensitive species (habitats and tree species already under stress) • Coastal and uplands areas (areas in exposed locations) • Wind turbines (turbines with lower shut-down thresholds for high winds) • Distribution network (energy infrastructure situated in exposed locations or in close proximity to tress) • Road and rail network (in exposed locations) • Waste collection routes (routes in exposed locations) • Waterbodies (exposed water bodies) • Parks/public buildings (populations requiring essential council services, exposed, locations) |
| Coastal Flood | <ul style="list-style-type: none"> • Temporary inundation of buildings • Deterioration of transport infrastructure • Closure/submergence of transport routes and impact on commuting, accessibility and travellers. • Flooding of agricultural areas. • Damage to recreational amenities and facilities provided by the council. • Damage to coastal habitat • Accessibility of Islands communities • Damage to critical water supply infrastructure • Damage to wastewater infrastructure. | <ul style="list-style-type: none"> • Housing buildings, heritage sites (located in low lying coastal areas) • Coastal road and rail infrastructure (roads and rail situated in low-lying coastal areas) • Agricultural areas (farms on marginal income) • Footpaths, parks and recreational amenities (amenities not served by suitable drainage which are in proximity to bodies of water and sensitive to storms) • Coastal habitat (sites exposed to coastal storms) • Island transport infrastructure (habitable island areas without safe harbours) • Water infrastructure/pipes • Wastewater treatment plants (water restrictions, boil water notices and bathing water notices) |

Impacts of climate hazards (4/5)

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) |
|------------------------|---|---|
| Coastal Erosion | <ul style="list-style-type: none"> • Disruption and loss of transport infrastructure • Erosion of agricultural areas • Damage to and loss of recreational amenities • Damage to and loss of coastal habitat • Damage to heritage sites | <ul style="list-style-type: none"> • Coastal roads and rail infrastructure (roads used for commuting purposes and by isolated communities and students) • Public/staff (road and rail situated in coastal areas) • Agricultural areas (farms on marginal income) • Recreational amenities (amenities not served by suitable coastal protection measures and sensitive to erosion) • Coastal habitat (sites exposed to existing coastal erosion) • Heritage sites (sites exposed to existing coastal erosion) |
| Pluvial Flood | <ul style="list-style-type: none"> • Direct rain and surface water damage to buildings and infrastructure • Damage to amenities and recreational areas. • Pluvial debris • Disruption of public transport networks • Disruption of transport networks/infrastructure • Surface water (run-off) pollutants • Impact on business and local economy | <ul style="list-style-type: none"> • Buildings, local authority offices, heritage sites (blocked drainage systems, high levels of impervious surfaces, etc) • Recreational amenities (low-lying parks and other amenities, locate near water bodies such as lakes and rivers) • People (beaches, riversides and parks with reduced - especially ones located near sources of debris) • Stormwater infrastructure (areas where there is a lot of un-reinforced waste management systems containing potential debris (natural/man-made)) • Road/railways (low-lying roads and railways with no alternative access routes and which allows for the pooling of water) • Public/staff (transport infrastructure with limited surrounding drainage and signage made of sensitive materials) • Natural resources/sensitive materials (enviro. sensitive areas, heavily fertilised agric. land close to water bodies), wastewater treatment infrastructure • Employers, employees, customers, students (business in low-lying areas, lacking remote work/study options, etc.) |

Impacts of climate hazards (5/5)

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) |
|---------------------------|--|---|
| <p>River Flood</p> | <ul style="list-style-type: none"> • Flood damage to buildings and infrastructure • Damage to amenities and recreational areas • Fluvial debris • Disruption of transport networks/infrastructure • Surface water (run-off) pollutants • Impact on business and local economy • Damage/degradation to automobiles and public transport. • Potential bridge failure • Inundation of farmland | <ul style="list-style-type: none"> • Buildings, local authority offices, heritage sites (blocked drainage, loc. on floodplains, vulnerable residents) • Recreational amenities (low-lying parks, located near water bodies, parks and amenities in need of investment) • Stormwater infrastructure, people (river backs and parks which lack man-made/natural drainage- especially ones located near sources of debris) • Road/railways (low lying roads/railways, located near water bodies, limited drainage) • Natural resources/sensitive materials (env. sensitive areas, networks with polluting vehicles, near waterbodies) • Employers, employees, customers, students (located in at-risk areas, lack of access to early warning systems). • Council fleets, public transport, private vehicles (underground/low-lying carparks, fleets sensitive to submergence) • Bridges (older bridges, bridges in need of investment and maintenance) • Farmland situated on riverbanks (farmlands situated in close proximity to rivers and on flood plain) |



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 endeavor 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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