

# Kerry County Council

## Climate Change Risk Assessment



**KPMG**  
Sustainable  
Futures

LACAP  
Final Report  
13<sup>th</sup> March 2023





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# Executive Summary





# Executive Summary

## Context and Scope of this Report

Climate change poses a critical challenge for Kerry County Council. It will result in a wide range of impacts across County Kerry from damaging infrastructure such as roads and bridges, to adverse impacts on biodiversity and restrictions on water supply.

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

Ireland's Climate Action and Low Carbon Development (Amendment) Act, 2021 highlights the role of Local Authorities 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 national climate policy objectives to the local level.

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

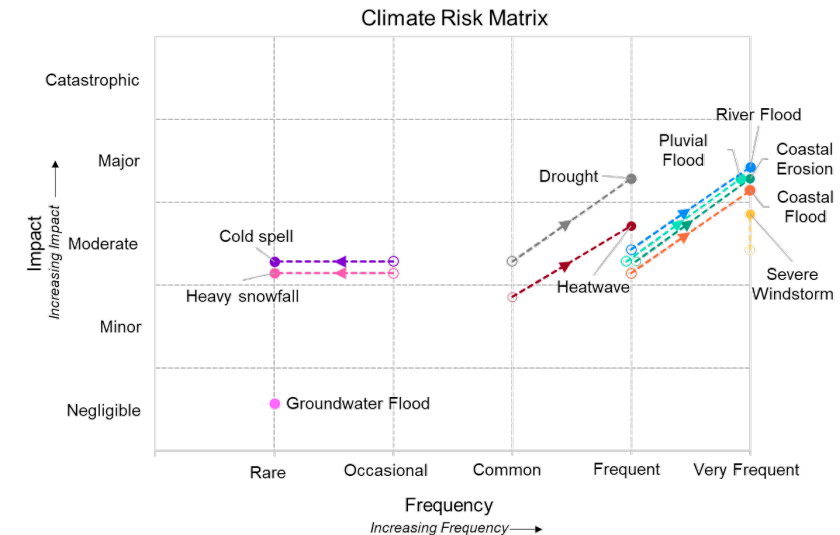
## Key Results and Findings

As illustrated in the climate risk matrix on the right, projections indicate that the frequency and intensity of some hazards (e.g., coastal erosion, coastal, river and pluvial flooding, heatwaves and drought) will increase while others will remain the same (e.g., severe windstorms and groundwater flooding). Some hazards are expected to decrease in frequency, such as cold spells and heavy snowfalls.

- Recent experiences of **cold spells and heavy snowfall** events (e.g., Storm Emma, 2018) demonstrated the wide range of impacts for County Kerry. These included, amongst others, disruption to road networks (e.g., Conor Pass and Ballaghisheen Pass), freeze thaw damage to critical infrastructure, damage and disruption of electricity supply and increase risk of flooding as a result of snow melt. 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.
- River and pluvial flooding** currently occur on a frequent basis in County Kerry and have resulted in damages to buildings and infrastructure, disruption of transport networks and bridge failure. Projected increases in the frequency of extreme precipitation events will result in increased river and pluvial flood risk for County Kerry.
- Recent experiences of **coastal erosion and coastal flooding** in 2020 and 2022 resulted in damage to heritage sites, transport infrastructure, water treatment and wastewater infrastructure. Projections indicate that sea levels will continue to rise exacerbating the risks associated with coastal erosion and flooding.
- County Kerry experienced **heatwave and drought conditions** in 2018 and 2022. These events resulted in damage to road surfaces, increased demand placed on water resources and recreational areas, detrimental impacts on freshwater quality and fish populations and an increase in the frequency of uncontrolled fire. Projected increases in the frequency of heatwaves and drought conditions will mean that events currently experienced on an infrequent basis will become more frequent. As the population ages, there will also be an increase in the number of vulnerable people exposed to heat-related risks.

- Severe windstorms** are currently experienced on a very frequent basis in County Kerry and result in wide-ranging impacts, including disruption to energy supply and communications infrastructure, and damages to buildings and infrastructure. Projections indicate no significant change to the frequency of severe windstorms.
- Groundwater flooding** is currently considered a rare event in County Kerry and has resulted in damages to road infrastructure. Projections indicate no change in the frequency of groundwater flooding for County Kerry.

To increase resilience, Kerry 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 County Kerry. 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



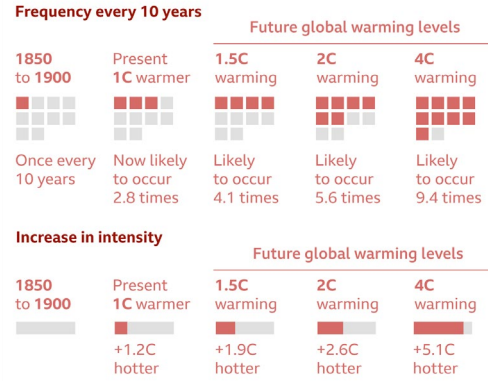


# Global Response to the Challenge of Climate Change

## 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.

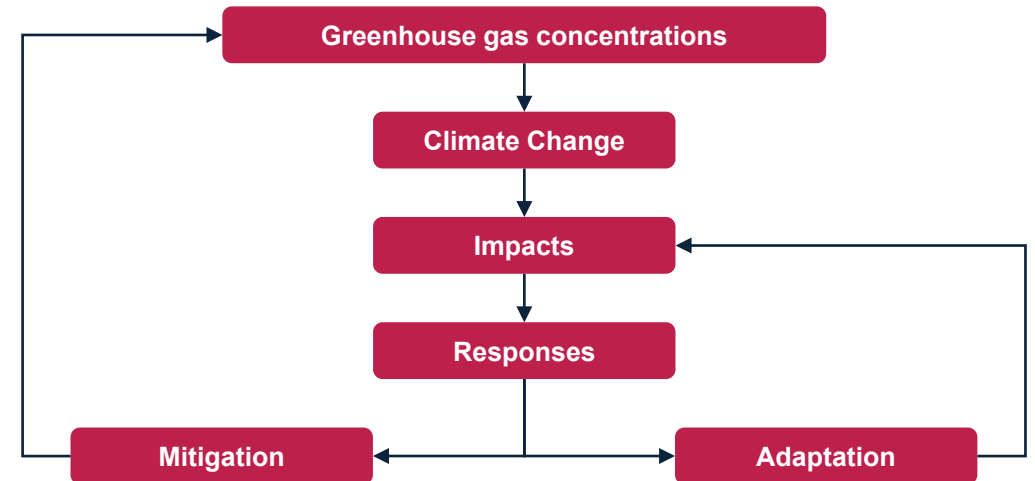
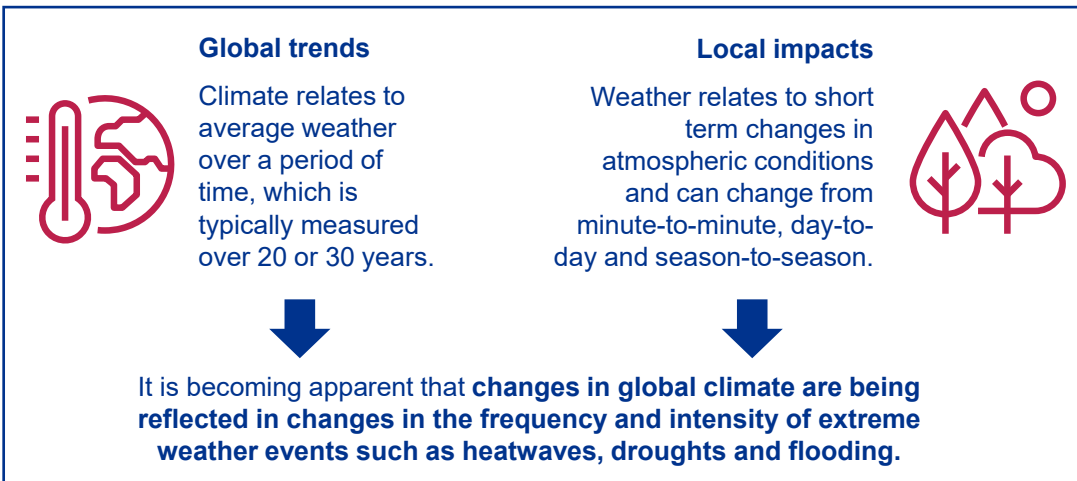
Since 1990, the Intergovernmental Panel on Climate Change (IPCC) have published a series of assessment reports which provide a synthesis of the most up-to-date science and evidence of climate change. The most recent assessment report shows that the global average temperature has increased by 1.1°C when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

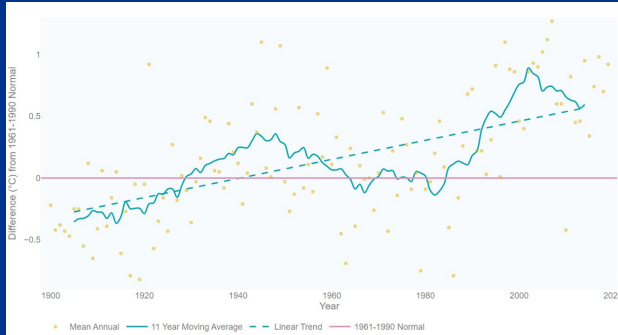
**Mitigation:** Making the impacts of climate change less severe by preventing or reducing the emission of greenhouse gases (GHGs) into the atmosphere. Mitigation is achieved either by reducing the sources of these gases (e.g. by increasing the share of renewable energies, or establishing a cleaner mobility 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 over the period 2009 to 2018 when compared to the average for the period 1981 to 2010.

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## Projected Impacts of Climate Change on Ireland

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



- By 2050, average annual temperatures are expected to increase by up to 1.6°C under a high emissions scenario.
- The frequency and intensity of heatwave events are projected to increase.



- By 2050, Levels of summer precipitation are expected to decrease by up to 17% under a high emissions scenario.
- During winter and autumn months, there is expected to be an increase of up to 19% in the occurrence of heavy precipitation events.



- By 2050, Projections indicate a small reduction in overall wind speed (10m) by up to -3.3% under a high emissions scenario.
- Projections of severe windstorms show a high degree of uncertainty with some projections indicating an increase in very severe windstorms. However, more work is required to increase confidence in these projections.



- Global sea level is expected to continue to and by up to 1m by 2100.
- Projections indicate that the Irish Sea could warm by a further 1.9 °C before the end of the 21st Century

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



# National and Local Response

## Paris Agreement, 2015

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

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

## European Climate Law, 2021

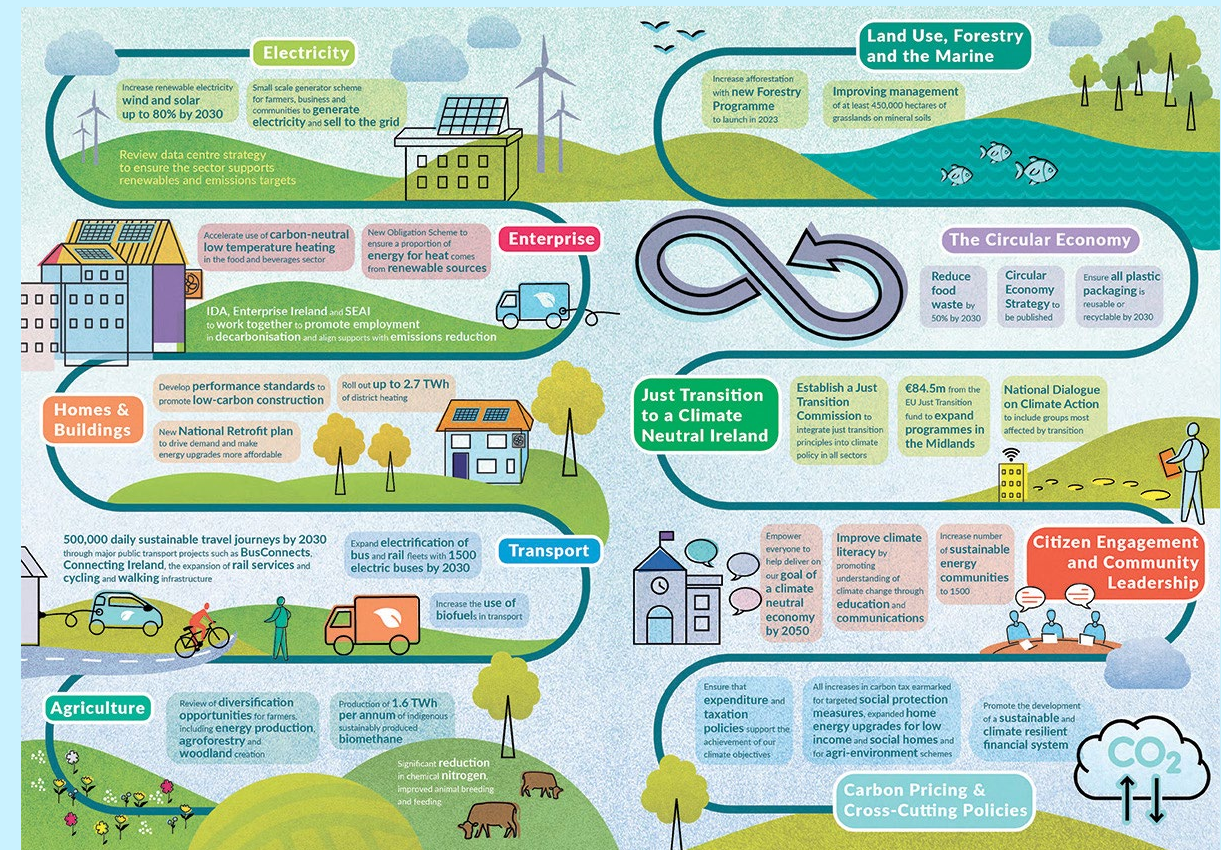
The EU adopted a legislative proposal for the European Climate Law in June 2021 to frame the climate neutrality objective by 2050 across the EU with an intermediate target of **reducing net greenhouse gas emissions by at least 55% by 2030**. The European Commission (EC) is clear in the commitment required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

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

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

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

## Climate Action Plan 2021- Infographic





# Project Overview



## Legislative context

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

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

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



## Preparing local authorities' climate action plans

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

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

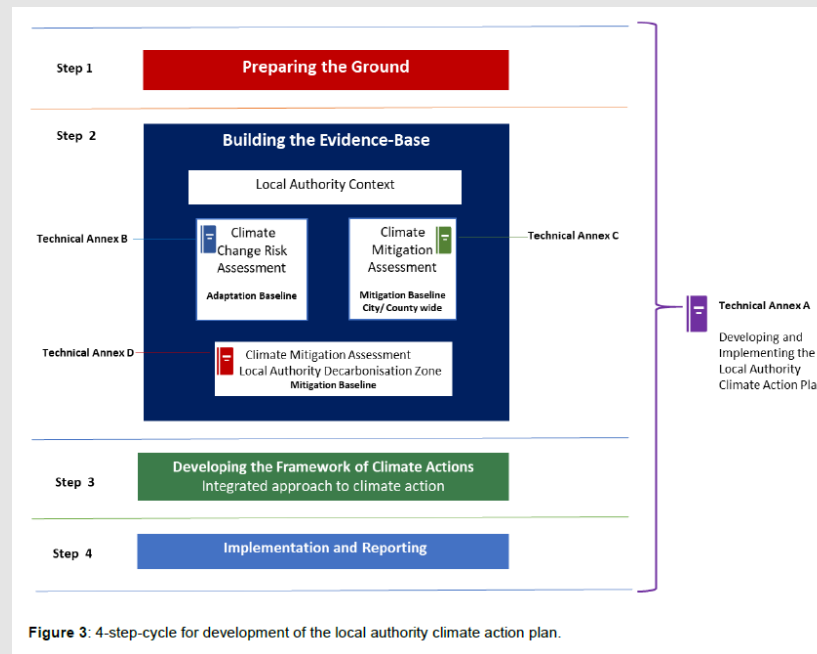


Figure 3: 4-step-cycle for development of the local authority climate action plan.

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



## Scope of this report

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

03

# Climate Change Risk Assessment (CCRA)





# 3.1 Introduction, Scope and Methodology

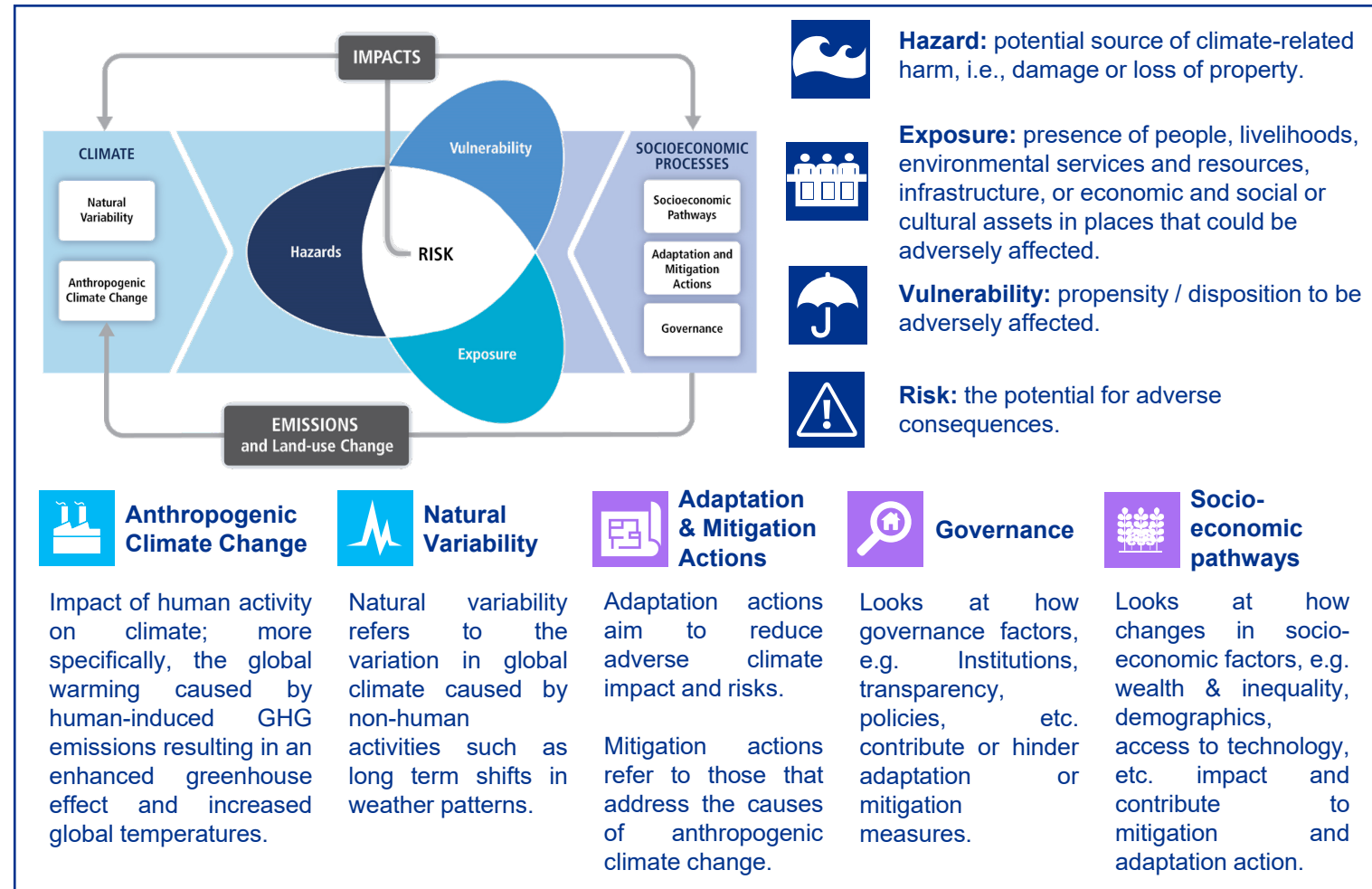
# Understanding of Climate Change Risk Assessment

## Purpose of Climate Change Risk Assessment

As detailed in the introduction to this report, the response to climate change entails both mitigation and adaptation actions. The aim of adaptation is to reduce the risks posed by climate change to County Kerry's environment, society and economy and increase resilience. In order to know how County Kerry needs to adapt to observed and projected changes in climate, KPMG conducted a Climate Change Risk Assessment (CCRA).

## 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, we have adopted the risk assessment framework of the Intergovernmental Panel on Climate Change (IPCC). This framework identifies three key components of climate risk: hazard, exposure and vulnerability. Details of the framework are explained to the right.



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



# Methodology of 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 Kerry County Council.

A qualitative risk assessment provides the evidence base to identify potential climate risks for the administrative area of Kerry County Council and for the delivery of services by Kerry 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 (Physical, Social and Environmental)
- Impact Assessment (Service Delivery)
- Overall Impact on Kerry County Council (e.g., Asset Damage, Health and Wellbeing, Environment, Social, Financial, Reputation, Cultural Heritage and Cultural Premises).

## Step 2. Future Climate Risks and Impacts

- Assess Future Changes in Climate Hazards Frequency and Intensity
- Assess Future Change in Exposure and Vulnerability
- Uncertainty Assessment
- Assess Emerging Hazards and Potential Future Climate Risks
- Overall Impact on Kerry County Council



# 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 impacting Kerry 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 Local Authority.

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

### Overall Impact on Kerry County Council

The overall impact of the identified climate hazards on Assets, Health and Wellbeing, Environment, Reputation, Cultural Heritage and Cultural Premises and Social and Financial impacts has been assessed and 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 faced by the Local Authority. 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 future 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 and risks and the rationale behind this 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 Kerry have been identified and considered as part of the CCRA.

Section 3.3.2

## 2.4

### Overall Impact on Kerry County Council

Accounting for projected changes in hazard, exposure and vulnerability, the overall future impacts on Asset, Health and Wellbeing, Environment, Reputation, Cultural Heritage and Cultural Premises and Social and Financial impacts is assessed and a summary of potential future climate impacts have been provided through a future climate risk matrix.

Section 3.3.3

## 2.5

### Uncertainty Assessment

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

Section 3.3.4



# Data and Information Sources

As detailed below, a wide range of qualitative and quantitative and information was employed to inform the development of the CCRA for Kerry County Council. The Kerry 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 while the National Planning Framework, Kerry County Council Development Plan 2022-2028 and the Regional Spatial and Economic Strategy for the Southern Region were employed to assess future development patterns. In addition, two stakeholder workshops were held to garner further insights from Kerry County Council.

Report Section	Sources
Introduction and scope	<ul style="list-style-type: none"> <li>Local Authority Climate Action Plan Guidelines, Technical Annex</li> </ul>
Step 1: Current Climate Risks and Impacts	<ul style="list-style-type: none"> <li>Climate Status Report 2020 (<a href="#">Cámaro García and Dwyer, 2021</a>)</li> <li>Environmental Protection Agency (EPA)</li> <li>European Environment Agency (EEA)</li> <li>Floodinfo.ie (Office of Public Works)</li> <li>Intarch.co.uk – Internet Archaeology</li> <li>Kerry County Council Climate Adaption Strategy 2019 -2024</li> <li>Kerry County Council website and internal documents</li> <li>Kerry County Council internal documents</li> <li>Kerry County Council Property Claims</li> <li>Maharees Conservation</li> <li>Met Éireann</li> <li>Teagasc</li> <li>Water.ie</li> <li>Agriland</li> <li>Dredging Today</li> <li>Farmers Journal</li> <li>Radio Kerry</li> <li>Newstalk</li> <li>RTE News</li> <li>Irish Examiner</li> <li>Irish Independent</li> <li>The Irish Mirror</li> <li>The Irish Times</li> <li>The Journal</li> <li>The Sun</li> <li>BreakingNews.ie</li> <li>Tralee Today</li> <li>Killarney Today</li> <li>Joe.ie</li> <li>Irish News Archive</li> </ul>
Step 2: Future Climate Risks and Impacts	<ul style="list-style-type: none"> <li>Kerry County Development Plan 2022-2028</li> <li>High-resolution Climate Projections for Ireland – A Multi-model Ensemble Approach (<a href="#">Nolan and Flanagan, 2020</a>) accessed via Climate Ireland</li> <li>Regional Spatial &amp; Economic Strategy for the Southern Regional Assembly</li> <li>Transport Infrastructure Ireland</li> </ul>

# 3.2

# Current Climate Risks and Impacts



# 3.2.1 Profile of Climate Hazards (incl. Frequency)

# Characteristics of County Kerry

Kerry County Council is a member of the Atlantic Seaboard South Climate Action Regional Office (CARO) which coordinates climate action undertaken by the Local Authorities of County Kerry, Clare, Limerick and Cork and Cork City. According to the Census 2022, the Kerry County Council serves 155,258 people. The county is known for its varied landscape, including its rich pastureland, rugged coastlines and mountains.

## Physical & Environmental Characteristics

Kerry is approximately 4,807km<sup>2</sup> in area, making it the fifth largest county in Ireland. It is bordered by counties Limerick to the north-east and Cork to the south and south-east. Kerry is also located within the Atlantic Economic Corridor region and on the Wild Atlantic Way tourism route, both significant drivers of economic growth and investment.

County Kerry has an extensive coastline of over 1000km which is a major tourist and environmental asset. As part of the Wild Atlantic Way tourist route, Kerry has many coastal Discovery Points and 2 Signature points (Blasket Sound and Bray Head). The county has 13 Blue Flag Beaches, 2 Blue Flag Marinas as well as 5 Green Coast awarded beaches. The county also has several islands, including the Blasket Islands, Valentia Island and the Skelligs.

Kerry has 6,446km length of rivers, 9% of the total river length in Ireland. The county is mainly drained by the catchments of the Rivers Feale, Lee and Maine/Brown Flesk, Laune, and Flesk which generally flow westwards and discharge into the Atlantic Sea.

Kerry is home to Ireland's highest mountain peak, Carrauntoohil, which stands at 1,038.6 metres. Another important natural site is Killarney National Park, a 10,236 hectare park, which includes mountains, lakes, waterfalls and woodlands.

## Socio-economic Characteristics

According to the 2022 Census, County Kerry has a population of 155,258 people which represented a 7,551 increase since the previous census (2016: 147,707). The county has experienced relatively steady population growth over recent years and has an almost equal gender breakdown. Kerry's Gaeltacht consists of two areas, Corca Dhuibhne and Uíbh Ráthach. These have a combined population of 8,756 which represents 9% of Ireland's total Gaeltacht population.

County Kerry comprises of 5 municipal districts: Kenmare, Killarney, Tralee, Listowel and Castleisland-Corca Dhuibhne. The county has a strong internal economic core which includes the hub towns of Tralee, Killarney and by extension Killorglin. These form the Kerry Hub & Knowledge Triangle, identified in the Regional Spatial & Economic Strategy (RSES) as an economic driver for the region. The most populous towns in the 2016 census were Tralee (23,691), followed by Killarney (14,504) and Listowel (4,820).

In terms of transport infrastructure, the county has three National Primary Roads (N21, N22 and N23) and six National Secondary Roads (N67, N69, N70, N71, N72 and N86). The county's road network of 4,453 km consists of 535 km of Regional Roads and 3,918 km of Local Roads. The

county also has an airport and is served by the Dublin-Mallow-Tralee railway routes.

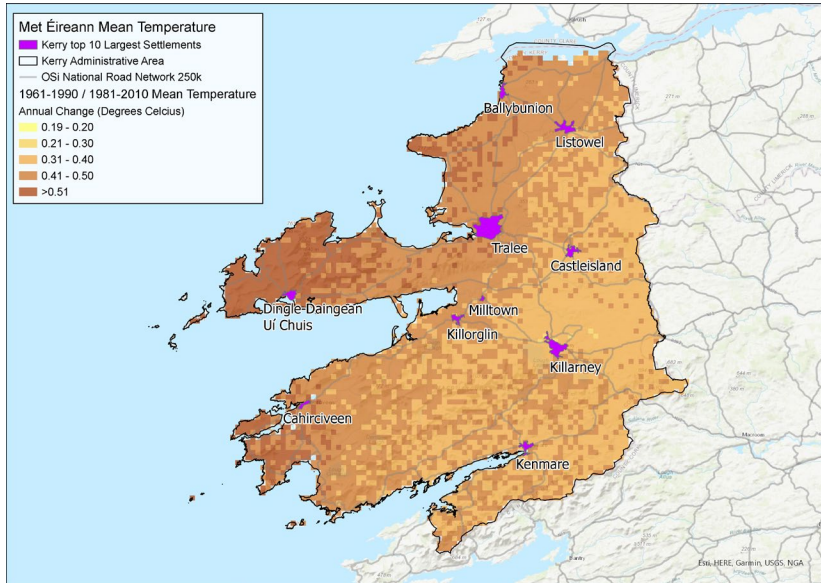
A predominantly rural county, over 55% of people in the county live in rural areas. Agriculture is the main land use in Kerry with approximately 226,000 hectares of farmed land in the County.

According to the 2016 Census, the county's main industries of employment include Professional Services (23%), Commerce and Trade (20%), Manufacturing (11%) and Agriculture, Forestry and Fishing (8%). Other Industries including Public Administration, Building & Construction, Transport and Communications.

Tourism is a major driver of Kerry's economy. The county attracts some 1.5 million tourists annually and the industry accounts for almost 1 in 5 jobs. As a sign of the industry's innovative potential, in 2021 the European Commission selected Dingle town as the Irish representative of the Smart Rural 21 project. Similarly, in 2021 the Council developed a Smart Beaches pilot project at Inch Beach, which aimed to address the issue of parking on the popular beach.

The county's Household Median Gross Income in 2016 was €37,339 and in 2021 the council provided 1,685 Housing Assistance Payments.

# Observed Changes in Kerry's Climate



In line with global trends, the climate of Ireland and Kerry is changing, temperatures are increasing and patterns of precipitation are changing. These changes are projected to continue and intensify with a wide range of impacts for Kerry and Kerry County Council. A summary of key climate and weather-related changes already observed for County Kerry are detailed below.

## Highlights of Observed Climate Change for Ireland and Kerry

### Sea Level Rise



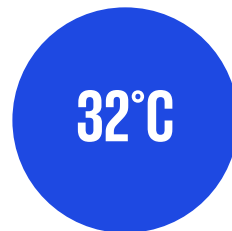
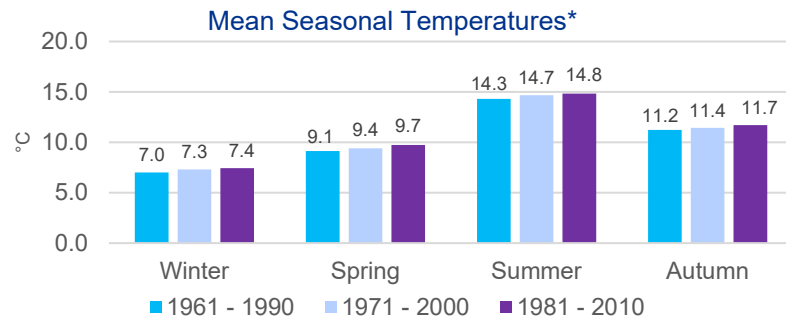
Sea Levels in the south of Ireland are rising at an approximate rate of 2-3mm per year\*\*

### Rainfall

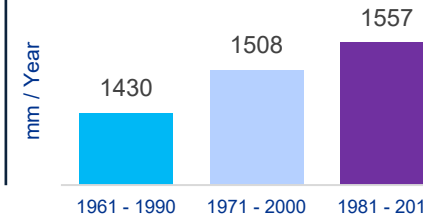
Average annual rainfall at Valentia Increased by 8.9% for the most recent period (1981-2010) compared to the 1961-1990 baseline of the station.\*

# 0.5°C

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



Highest temperature on record recorded on July 18<sup>th</sup> 2006 at Dooks



5 of the top 10 wettest years on record since 1941 have occurred since the year 2000\*

\*Source: Met Éireann Long term weather station : Valentia  
 \*\*Source: EPA ; Climate Status Report for Ireland 2020 (2021)  
 \*\*\*Source: Met Éireann weather stations: Listowel (Bunaghara), Listowel (Gurtocloghane)



The longest running heatwave in Kerry was recorded at the Listowel Weather station during the summer of 2021, lasting a total of 10 days with maximum temperatures over 25°C\*\*\*



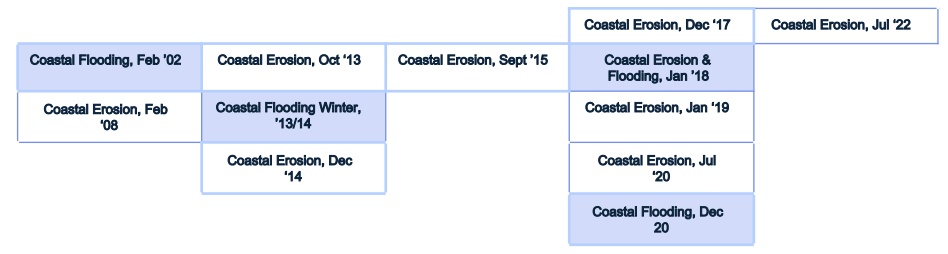
# Climate Hazard Profile

In addition to observed changes in Kerry's climate, we have identified significant climate and weather-related events to have impacted County Kerry over the period 1973-2023. To do this, we have further developed the existing climate hazard profile developed through the existing Kerry County Council Adaptation Strategy (2019) and expanded the analysis to cover the period 2018-2023.

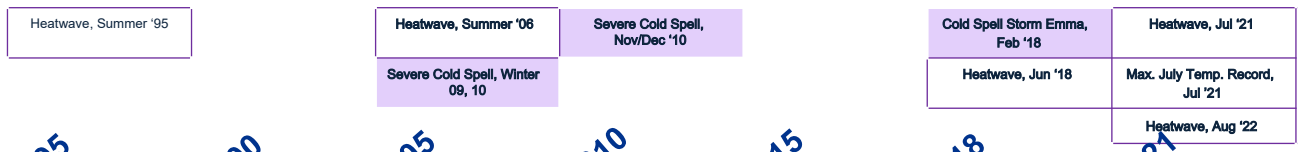
## Snow & Ice



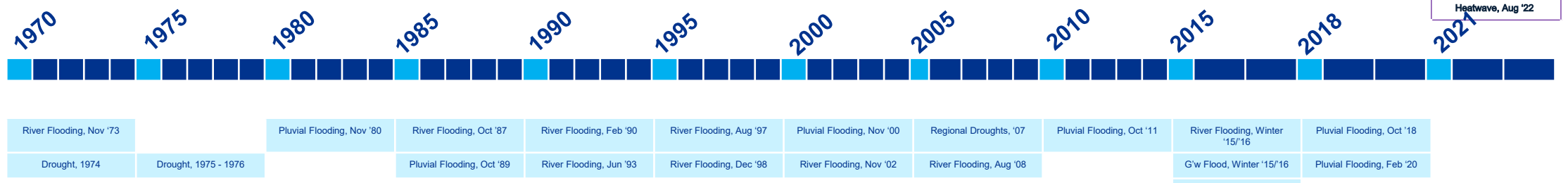
## Coastal



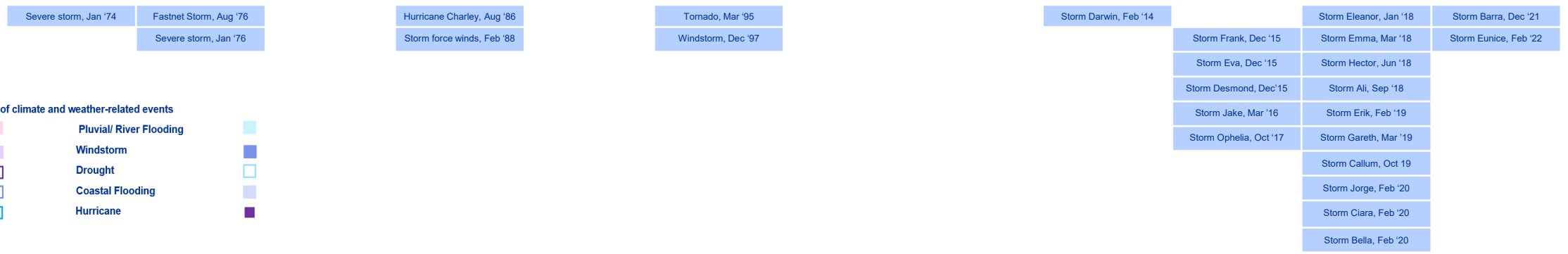
## Heat & Cold



## Wet & Dry



## Wind



Key to colour coding of climate and weather-related events

- Snowfall
- Cold Spell
- Heatwave
- Coastal Erosion
- Lightning Storm
- Pluvial/ River Flooding
- Windstorm
- Drought
- Coastal Flooding
- Hurricane

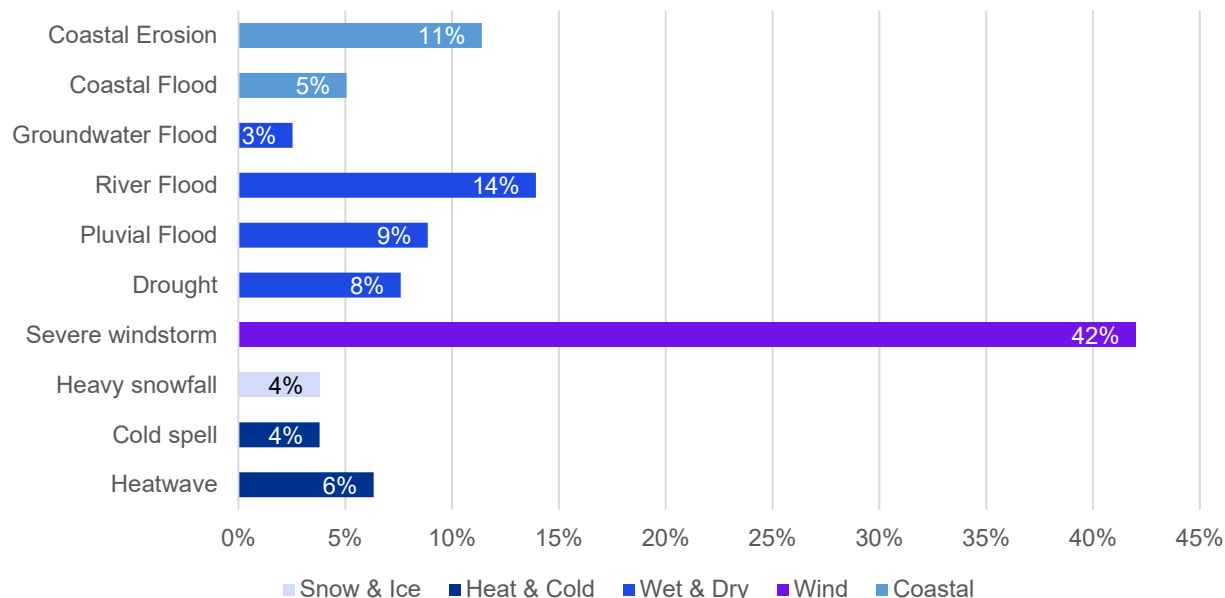
# Frequency of Climate Hazards

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

Based on the climate hazard baseline, severe windstorm events have impacted upon County Kerry most frequently over the period 1973-2022. Flooding (river, coastal, pluvial, and groundwater), coastal erosion, heatwaves, heavy snowfall, cold spells and droughts have also impacted Kerry County, but less frequently.

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

**Frequency of Identified Events According to Category (1973 - 2022)**



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

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

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

Hazard Type	Current Frequency
Heatwave	Common
Drought	Common
Cold spell	Occasional
Heavy snowfall	Occasional
Severe windstorm	Very Frequent
Pluvial Flood	Frequent
River Flood	Frequent
Coastal Flood	Frequent
Coastal Erosion	Frequent
Groundwater Flood	Rare

# 3.2.2 Exposure, Vulnerability and Impacts

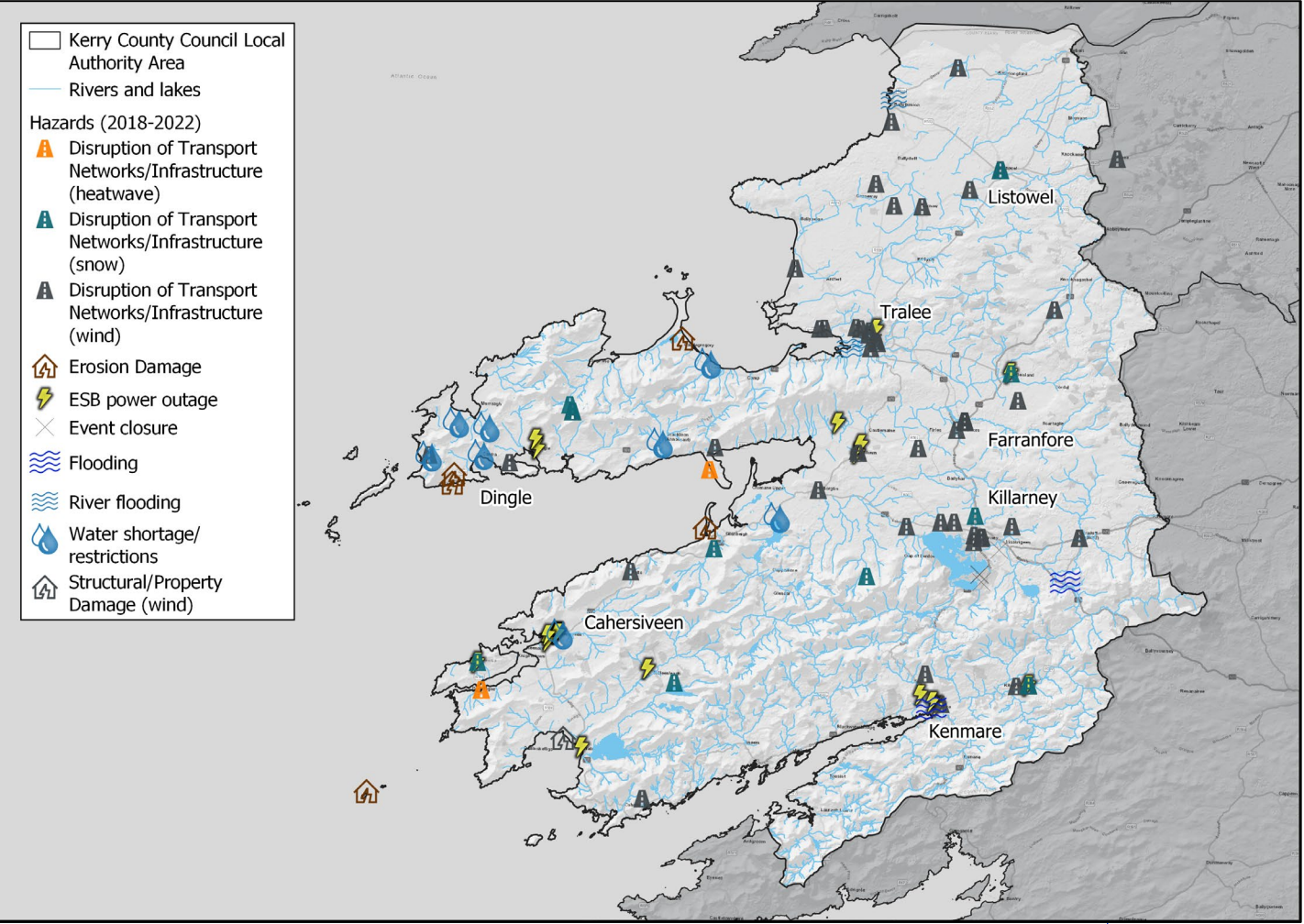


# Characterising Exposure, Vulnerability and Impacts of Climate Hazards

Employing and integrating information derived from previous events (sources of information are detailed on page 17), we have characterised the exposures, vulnerabilities and impacts of the hazard events experienced in County Kerry. Below and to the right we provide an example of exposures and impacts of hazard events already experienced.

- **Storm Eunice in February 2022** caused power outages for over 25,000 homes in Kerry including homes in Kilgarvan and surrounding areas.
- **Storm Barra in December 2021** caused power outages for 10,000 customers including households, business and farms across Kerry.
- A large portion of the 2,500 year old Dunbeg Fort on the Dingle Peninsula fell into the seas as a result of **Storm Eleanor in January 2018**.
- **Storm Eleanor in January 2018** caused flooding on the N86 Tralee/Dingle Road leaving it impassable at Blennerville.
- The N71 at the Suspension Bridge in Kenmare closed as a result of a high tide caused by **Storm Ciara in February 2020**.
- The Conor Pass and the Ballaghisheen Pass near Cahersiveen were left impassable as a result of **Heavy Snowfall in January 2021**.
- Valentia Weather Station recorded 23 days of **Drought between 21/06/18 and 13/07/18**.
- **Heavy rainfall in July 2020** led to the closure of the Ring of Kerry road near Sneem and at Inny Bridge between Cahersiveen and Waterville as well as the flooding of a number of business premises in the town centre of Kenmare.
- **Storm Deirdre in December 2018** led to power outages in Kerry along with the cancellation of flights to and from Kerry airport.

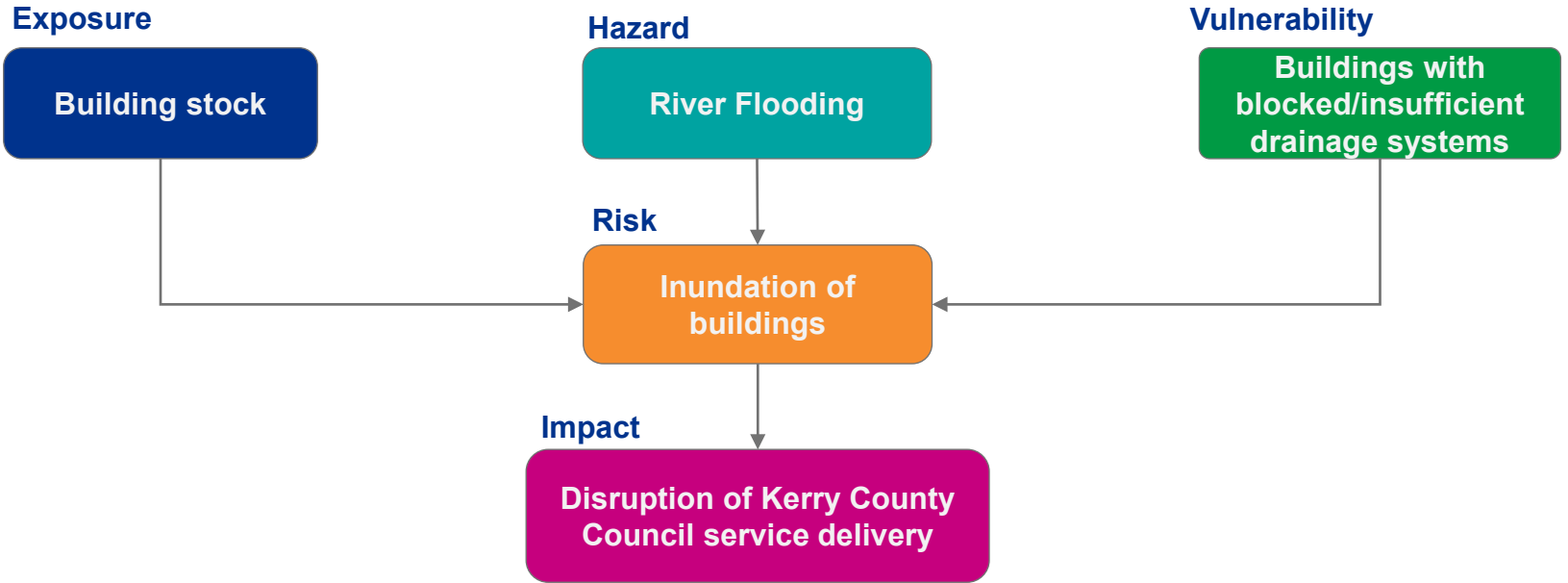
The map below illustrates the range of impacts reported for County Kerry for the period 2018-2022 through publicly available data sources. It is important to note that this map only illustrates reported impacts (that included details of impact location) and does not represent a comprehensive assessment of climate impacts.



# Climate Risk and Impacts

For County Kerry 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 components of risk for river flooding which would pose an inundation risk for Kerry County Council’s buildings. Those buildings with insufficient drainage and with no temporary flood defences would be considered more vulnerable to this hazard. Consequently, if Kerry County Council buildings were to be flooded, one of the possible impacts would be the disruption of Kerry County Council’s ability to deliver its services. This process was undertaken for each hazard and a range of exposures were identified along with their associated vulnerabilities.

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



# 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"> <li>Hot and uncomfortable working/living conditions</li> <li>Increased demand on recreational areas</li> <li>Damage to road surface and hazardous driving conditions</li> <li>Disruption of public transport networks</li> <li>Decreased grass growth and increased supplementary feed requirements for livestock</li> <li>Heat stress for animals and livestock</li> <li>Increased demand on available water resources, leading to increased pressure to share resources</li> <li>Detrimental impacts on freshwater quality</li> <li>Disruption of recreational activities</li> <li>Increase in the frequency of uncontrolled fire</li> <li>Increased strain on natural biodiversity</li> </ul>	<ul style="list-style-type: none"> <li>Housing, buildings, care home/leisure centres/recreational facilities, outdoor workers (elderly, with limited access to water, shade and sunscreen)</li> <li>Bathing areas and parks (within close proximity to urban areas)</li> <li>Local roads (surface-dressed roads, located in areas of high solar radiation)</li> <li>National railway network (communities with limited transports network)</li> <li>Pasture (farms in areas of low precipitation, farms with limited watering infrastructure, situated in areas of high solar radiation)</li> <li>Reservoirs/lakes (lakes with already depleted water resource, sites with deteriorated water quality/eutrophic status)</li> <li>European/Irish designated sites (SPAs, SACs, Ramsar sites, NHAs)</li> <li>Areas of growing vegetation</li> <li>Recreational areas (situated in areas of high solar radiation)</li> </ul>
Drought	<ul style="list-style-type: none"> <li>Decreased grass growth and increased supplementary feed requirements for livestock</li> <li>Increased demand on available water resources, leading to increasing pressure to share resources</li> <li>Reduced river flow</li> <li>Damage to built heritage</li> <li>Disruption to water supply</li> <li>Road damage</li> </ul>	<ul style="list-style-type: none"> <li>Pasture (in areas of low precipitation)</li> <li>Reservoirs/lakes/groundwater supplies (already depleted/under stress)</li> <li>Biodiversity (water bodies, areas with diverse wildlife populations)</li> <li>Homes/businesses/local govt office/agricultural sites (with structure or fabric more vulnerable to temperature extremes, in more exposed locations)</li> <li>Private households, buildings incl. LA offices</li> <li>Road damage (located on peat substrate)</li> </ul>



# 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)
<p><b>Cold Spell</b></p>	<ul style="list-style-type: none"> <li>• Extreme cold results in increased requirement for heating and associated economic costs</li> <li>• Cold conditions result in increased damage to vehicles</li> <li>• Disruption in road networks, including increases in costs associated with gritting, fuel and overtime</li> <li>• Energy consumption for heating purposes rises significantly during extreme cold</li> <li>• Disruption to public transport networks</li> <li>• Cold conditions leading to damage of road surfaces (i.e., freeze thaw)</li> <li>• Increase in the frequency of trips and falls</li> <li>• Reduction in agricultural production and difficulties in accessing land</li> <li>• Freeze thaw damage to critical infrastructure</li> <li>• Impacts on water resources</li> <li>• Increases in cold-related mortality and morbidity</li> <li>• Delay of infrastructure/development projects</li> <li>• Increased strain on natural biodiversity</li> <li>• Damage and disruption of electricity supply</li> <li>• Damage to built heritage</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings (poorly insulated, with elderly residents, properties in isolated locations)</li> <li>• Public/private transport vehicles (exposed vehicles, relying on personal vehicle for employment)</li> <li>• Transport network (at higher elevations)</li> <li>• Public/staff (untreated road surfaces, higher elevations)</li> <li>• Road network (at high elevations and located in areas of low solar radiation)</li> <li>• Public/staff (areas of low solar radiation, elderly populations)</li> <li>• Crops, livestock (cold-sensitive crops)</li> <li>• Land (marginal farms without access to suitable tractor machinery)</li> <li>• Water infrastructure/pipes (buildings with older/damaged pipes or water tanks)</li> <li>• People at high risk of exposure to cold (vulnerable communities: elderly, disadvantaged - those at risk of energy poverty; members of homeless community)</li> <li>• Development projects (ongoing construction with materials loose on site)</li> <li>• European/Irish designated sites (SPAs, SACs, Ramsar sites, NHAs)</li> <li>• Homes/businesses/local govt office/agricultural sites (situated at higher elevations)</li> </ul>
<p><b>Heavy Snowfall</b></p>	<ul style="list-style-type: none"> <li>• Damage to buildings</li> <li>• Disruption of transport network and isolation of communities</li> <li>• Heavy snowfall and freezing conditions impacting on farms and livestock</li> <li>• Snow melt resulting in increased risk of flooding</li> <li>• Runoff from snow melt impacting on environmentally sensitive areas</li> <li>• Disruption to energy/electricity supply</li> <li>• Disruption to waste collection</li> <li>• Difficulty accessing facilities to undertake repair work</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings (vacant/flat roof properties, higher elevation, elderly residents), offices (incl. LA) (single story/flat roof, higher elevation, impervious surfaces)</li> <li>• Transport networks (in terrain with a higher propensity of snow drifts, isolated roads)</li> <li>• Agricultural sites (farms at higher elevations, marginal farms)</li> <li>• Areas prone to flooding (areas prone to pooling of water, inadequate drainage)</li> <li>• Natural resources/sensitive materials/water supply (env. sensitive areas – terrestrial and aquatic e.g. Ramsar sites)</li> <li>• Energy (energy infrastructure in need of maintenance, older infrastructure)</li> <li>• Waste collection routes (terrain with a higher propensity of snow drifts, exposed locations)</li> <li>• Water treatment facilities (routes in exposed locations)</li> </ul>

# 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)
<p><b>Severe Windstorm</b></p>	<ul style="list-style-type: none"> <li>• Direct wind damage to buildings and infrastructure</li> <li>• Wind damage to habitats and sensitive species</li> <li>• Wind damage to trees resulting in tree fall</li> <li>• Disruption of wind energy generation</li> <li>• Disruption of energy supply across the county</li> <li>• Disruption of communications infrastructure</li> <li>• Disruption of transport networks</li> <li>• Closure of parks and public buildings</li> <li>• Disruption to waste collection</li> <li>• Impact on harbours and marinas</li> <li>• Disruption to water treatment</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, development sites (buildings w. rooftop equip., vulnerable populations, high-rise structures)</li> <li>• Habitats and sensitive species (situated in upland or exposed areas, more exposed to wind)</li> <li>• Trees (species under stress)</li> <li>• Wind turbines (turbines with lower shut-down thresholds for high winds)</li> <li>• Power supply (infrastructure in exposed locations, vulnerable populations, isolated communities)</li> <li>• Overhead communication lines (situated in upland and exposed sites)</li> <li>• Road and rail network</li> <li>• Parks and public buildings</li> <li>• Waste collection routes</li> <li>• Harbours and marinas</li> <li>• Water treatment facilities (gravity fed water treatment facilities)</li> </ul>
<p><b>Coastal Erosion</b></p>	<ul style="list-style-type: none"> <li>• Disruption and loss of transport infrastructure</li> <li>• Erosion of agricultural areas</li> <li>• Damage to recreational amenities</li> <li>• Damage to coastal habitats</li> <li>• Damage to heritage sites</li> </ul>	<ul style="list-style-type: none"> <li>• Coastal roads (low lying coastal areas, serving isolated communities)</li> <li>• Public/staff (situated in coastal areas)</li> <li>• Agricultural areas (low lying coastal areas)</li> <li>• Recreational amenities (situated in coastal areas)</li> <li>• Coastal habitat (sites exposed to existing coastal erosion)</li> <li>• Heritage sites (situated in coastal areas)</li> </ul>

# 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)
<b>Coastal Flood</b>	<ul style="list-style-type: none"> <li>• Temporary inundation of buildings</li> <li>• Deterioration of transport infrastructure</li> <li>• Closure/submergence of transport routes and impact on commuting, accessibility and travellers</li> <li>• Flooding and erosion of agricultural areas</li> <li>• Treacherous conditions at coast and on land</li> <li>• Damage to recreational amenities and facilities provided by the council</li> <li>• Damage to coastal habitats</li> <li>• Accessibility of Islands communities</li> <li>• Damage to water treatment and wastewater infrastructure</li> <li>• Potential coastal bridge failure</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings (located in low lying coastal areas)</li> <li>• Coastal roads (roads, bridges and infrastructure not designed to withstand corrosive salt-water)</li> <li>• Coastal roads (insufficient drainage, low lying coastal areas)</li> <li>• Agricultural areas (farms on a marginal income, low lying coastal areas)</li> <li>• Coastal areas (low-lying amenity areas exposed to storms)</li> <li>• Footpaths, parks and recreational amenities (situated in coastal areas)</li> <li>• Coastal habitat (sites exposed to coastal storms)</li> <li>• Island transport infrastructure (habitable island areas without safe harbours)</li> <li>• Wastewater treatment plants (water restrictions, boil water notices, bathing water notices)</li> <li>• Bridges (older structures in fast flowing estuary)</li> </ul>
<b>Groundwater Flood</b>	<ul style="list-style-type: none"> <li>• Inundation and damage to road infrastructure</li> <li>• Inundation of farmland</li> <li>• Impact on groundwater quality</li> </ul>	<ul style="list-style-type: none"> <li>• National road (limited drainage capacity)</li> <li>• Farmland situated in areas of ground water flood risk (marginalised farmers, insufficient drainage)</li> <li>• Groundwater resources</li> </ul>



# 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)
<b>Pluvial Flood</b>	<ul style="list-style-type: none"> <li>• Direct rain and surface water damage to buildings and infrastructure</li> <li>• Damage to amenities and recreational areas</li> <li>• Pluvial debris</li> <li>• Disruption to transport networks/infrastructure</li> <li>• Surface water (run-off) pollutants</li> <li>• Impact on business and local economy</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, local authority offices, heritage sites (blocked drainage systems, high levels of impervious surfaces, etc)</li> <li>• Recreational amenities (low-lying parks and other amenities, locate near water bodies such as lakes and rivers)</li> <li>• People (areas where there is a lot of un-reinforced waste management systems containing potential debris )</li> <li>• Stormwater infrastructure (riversides and parks with reduced - especially ones located near sources of debris)</li> <li>• Road/railways (low-lying roads with no alternative access routes and which allows for the pooling of water)</li> <li>• Wastewater treatment infrastructure, natural resources/sensitive materials (environmentally sensitive areas)</li> <li>• Employers, employees, customers, students (business in low-lying areas, lacking remote work/study options, etc.)</li> </ul>
<b>River Flood</b>	<ul style="list-style-type: none"> <li>• Flood damage to buildings and infrastructure.</li> <li>• Damage to amenities and recreational areas.</li> <li>• Fluvial debris</li> <li>• Disruption of transport networks/infrastructure.</li> <li>• Surface water (run-off) pollutants</li> <li>• Impact on business and local economy</li> <li>• Damage/degradation to automobiles and public transport</li> <li>• Potential bridge failure</li> <li>• Farmland erosion</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, local authority offices, heritage sites (blocked drainage, vulnerable residents)</li> <li>• Recreational amenities (low-lying parks, located near water bodies, parks and amenities in need of investment)</li> <li>• Public/ staff (river banks and parks which lack man-made/natural drainage- especially ones located near sources of debris)</li> <li>• Road/railways (low lying roads/railways, located near water bodies, limited drainage)</li> <li>• Natural resources/sensitive materials</li> <li>• Employers, employees, customers, students (located in at-risk areas)</li> <li>• Council fleets, public transport, private vehicles (underground/low-lying carparks)</li> <li>• Bridges (older bridges, bridges in need of investment and maintenance)</li> <li>• Farmland situated on riverbanks (economically marginalised farmers, areas of soil bank erosion, etc)</li> </ul>

# 3.2.3

## Impacts of Current Climate Risks (Service Delivery)

# Summary of Service Level Impacts

Key to colour coding of impact ratings

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

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

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

# Service Level Impacts (Heatwaves & Drought)

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

The impact of heatwaves on the services areas provided by Kerry County Council was identified as minor for Business Services, Building Stock, Community Infrastructure, Cultural Heritage, Water Quality and Community Development. Heatwaves were identified as having a moderate impact on Roads, footpaths, bridges, construction and maintenance, Water Supply, Biodiversity and Emergency response with appreciable declines in service provisions across the county.

Drought was identified as putting the provision of Business Services, Roads, footpaths, bridges, construction and maintenance, Community Infrastructure, Water Supply, Community Development and Emergency Responses under Moderate pressure with impacts felt across the county. The impact of drought on Cultural Heritage, Water Quality and Biodiversity, was identified as minor, with impacts occurring at a localised level.

	Heatwaves	Drought
<b>Business Services</b>	<ul style="list-style-type: none"> <li>Decreased staff productivity and increased staff and customer discomfort.</li> </ul>	<ul style="list-style-type: none"> <li>Increased pressure on businesses to operate with limited water resources</li> </ul>
<b>Roads, footpaths, bridges, construction and maintenance</b>	<ul style="list-style-type: none"> <li>Increased costs associated with repair of localised road surfaces.</li> <li>Increased health and safety risk for outdoor staff across the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increased cost for repair of roads and footpaths across the county.</li> <li>Increased health and safety risk due to hazardous driving conditions.</li> </ul>
<b>Building Stock</b>	<ul style="list-style-type: none"> <li>Increased requirement for cooling in council offices/buildings.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Community Infrastructure</b>	<ul style="list-style-type: none"> <li>Increased requirement for waste collection and traffic management at key recreational sites.</li> </ul>	<ul style="list-style-type: none"> <li>Increased pressure on key recreational sites to operate with limited water resources.</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Increased requirements for monitoring and maintenance of cultural heritage sites.</li> </ul>	<ul style="list-style-type: none"> <li>Localised degradation of cultural heritage sites due to drying out.</li> <li>Increased requirements for monitoring and maintenance of cultural heritage sites.</li> </ul>
<b>Stormwater / Sewerage</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Wastewater</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Supply</b>	<ul style="list-style-type: none"> <li>Increased requirement for waste collection and traffic management at recreational sites.</li> </ul>	<ul style="list-style-type: none"> <li>Increased requirement to support provision of water to communities suffering loss of water supply across the county (e.g., Tankering).</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>Increased requirements for monitoring water quality.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced water flows impacting on water quality across the county with increased requirement for monitoring and remediation.</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>Decreased ecosystem health across the county with potential for loss of priority habitats resulting in increased requirement for monitoring and remediation.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced water flows impacting on biodiversity with potential for loss of priority species and habitats necessitating increased monitoring and remediation.</li> </ul>
<b>Community Development</b>	<ul style="list-style-type: none"> <li>Increased requirement for management at congested sites.</li> </ul>	<ul style="list-style-type: none"> <li>Reduced grass growth necessitating increased supplementary feed requirement for livestock reducing farm incomes and the wider industry.</li> </ul>
<b>Emergency Response</b>	<ul style="list-style-type: none"> <li>Increase in number of wildfire call-outs across the county.</li> <li>Increase in number of call-outs to bathing areas throughout the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increase in number of uncontrolled fire call-outs across the county.</li> <li>Increased requirement for water tinkering.</li> </ul>





# Service Level Impacts (Cold Spell & Heavy Snowfall)

The impact of Cold Spells on the service areas provided by Kerry County Council was identified as moderate resulting in an appreciable decline in the provision of Roads, Building Stock, Community Infrastructure, Business Services, Stormwater/ Sewerage, Wastewater, Water Supply, Biodiversity, Community Development, and Emergency Response services. The impact of Cold Spells on the provision of services associated with Cultural heritage and Water Quality was identified as localised and minor. In addition, the impact of Heavy Snowfall on the service areas provided by Kerry County Council was identified as moderate for Business Services, Building Stock, Road services, Community Infrastructure, Community Development, and Emergency Response. Heavy Snowfall was also identified to have a localised and minor impact on services associated with Cultural Heritage, Stormwater/Sewerage, Wastewater, Water Supply, Water Quality and Biodiversity.

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

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



# Service Level Impacts (Severe Windstorm & Groundwater Flood)

Severe Windstorms were identified as having a moderate impact on the provision of Business Services, Roads, Building Stock, Community Infrastructure, Cultural Heritage, Wastewater, Water Supply, Biodiversity, Community Development, and Emergency Response services provided by Kerry County Council, with severe pressure on services across the county. The impact of severe windstorms on Water Quality services was identified as minor and at a localised level.

Groundwater flooding was identified as having a minor and localised impact on Water Quality, Biodiversity, Community Development and Emergency Responses. Groundwater flooding was identified as having an appearance of threat but no actual impact on the following service areas: Business Services, Roads, Building Stock, Community Infrastructure, Cultural Heritage, Stormwater/Sewerage, Wastewater and Water Supply.

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

	Severe Windstorm	Groundwater Flood
<b>Business Services</b>	<ul style="list-style-type: none"> <li>Closure of business services across the county.</li> <li>Health and safety risks for public and staff.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Roads, footpaths, bridges, construction and maintenance</b>	<ul style="list-style-type: none"> <li>Countywide transport disruption and road closures affecting the wider community and local authority operations.</li> <li>Increased clean-up and repair costs after an event.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Building Stock</b>	<ul style="list-style-type: none"> <li>Closure of buildings and disruption of services as a result of direct damage to buildings and disruption of power across the county.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Community Infrastructure</b>	<ul style="list-style-type: none"> <li>Disruption to delivery of community services across the county.</li> <li>Increased clean-up and repair costs after an event.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Increased maintenance and repair costs due to storm damage to cultural heritage sites.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Stormwater / Sewerage</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Wastewater</b>	<ul style="list-style-type: none"> <li>Increased maintenance due to treefall and leaf/debris disrupting wastewater systems.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Supply</b>	<ul style="list-style-type: none"> <li>Increased pressure on water supply services due to disruption of electricity supply at water treatment plants.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>Disruption to water quality monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Deterioration of water quality due to overland flow of pollutants resulting in water supply issues and environmental degradation and an increased requirement for monitoring and remediation.</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>High winds result in damage to habitats at a county wide level.</li> <li>Increased cost to protect habitats from wind damage.</li> </ul>	<ul style="list-style-type: none"> <li>Isolated and limited damage to environmentally sensitive areas requiring monitoring and/or restoration work.</li> </ul>
<b>Community Development</b>	<ul style="list-style-type: none"> <li>Increased power outages and damages to infrastructure result in an impact on the countywide economy.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibited development of communities at a localised level.</li> </ul>
<b>Emergency Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency services across the county.</li> <li>Increase in response times due to fallen trees and debris on roads around the county.</li> </ul>	<ul style="list-style-type: none"> <li>Increased pressure on emergency services in local areas.</li> </ul>



# Service Level Impacts (Pluvial & River Flood)

Pluvial flooding was identified as having a minor and localised impact on the provision of services related to Business Services, Building Stock, Community Infrastructure, Stormwater/ Sewerage, Wastewater, Water Supply, Water Quality and Emergency Response by Kerry County Council. The impact of pluvial flooding on the provision of Roads, Cultural Heritage, Biodiversity and Community Development services was identified as moderate, with an appreciable decline in the provision of services across the county.

In addition, the impact of river flooding on the provision of service areas provided by Kerry County was identified as moderate for Roads, Cultural Heritage, Community Development, and Emergency Response, with services under severe pressure due to floods. River flooding was identified as having a minor and localised impact on the provision of services related to Business Services, Building Stock, Community Infrastructure, Water Supply, Water Quality, and Biodiversity.

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

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



# Service Level Impacts (Coastal Flood & Erosion)

Coastal Floods were identified as having a negligible impact on the provisions of services related Business Services and Water Quality. Coastal flooding was considered to have a minor and localised impact on services related to Community Infrastructure, Stormwater/Sewerage, Wastewater, Water Supply, Biodiversity, Community Development and Emergency Response. The impact of Coastal flooding on Roads and Cultural Heritage was identified as moderate, with an appreciable decline in the provision of services across the county. In addition, the impact of Coastal Erosion on the provision of services was identified as minor and localised for services related to Roads, Community Infrastructure, Community Development and Emergency Response. The impact of Coastal erosion on the provision of Cultural Heritage and Biodiversity services was identified as moderate, with an appreciable decline in the provision of services across the county. Coastal Erosion was identified as having a negligible impact on the provision of services related to Business Services, Building Stock, Stormwater/Sewerage, Wastewater, Water Supply, and Water Quality.

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

	Coastal Flood	Coastal Erosion
<b>Business Services</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Roads, footpaths, bridges, construction and maintenance</b>	<ul style="list-style-type: none"> <li>Transport disruptions and road closures across the county.</li> <li>Increased clean-up and repair costs countywide.</li> </ul>	<ul style="list-style-type: none"> <li>Transport disruption and road closures at a localised level.</li> <li>Increased clean-up and repair costs at a localised level.</li> </ul>
<b>Building Stock</b>	<ul style="list-style-type: none"> <li>Potential for closure of buildings and disruption of services as a result of damage to buildings.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Community infrastructure</b>	<ul style="list-style-type: none"> <li>Disruption to the delivery of services in local communities</li> </ul>	<ul style="list-style-type: none"> <li>Damage to community infrastructure such as parks and refuse collection points.</li> <li>Increased repair and maintenance costs</li> </ul>
<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Increased maintenance and repair costs due to flood damage to cultural heritage sites.</li> </ul>	<ul style="list-style-type: none"> <li>Damage to heritage sites exposed to coastal erosion .</li> <li>Increased health and safety risks for public and staff.</li> <li>Increased maintenance and repair costs.</li> </ul>
<b>Stormwater / Sewerage</b>	<ul style="list-style-type: none"> <li>Damage to stormwater infrastructure at a localised level.</li> <li>Increased maintenance and repair costs.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Wastewater</b>	<ul style="list-style-type: none"> <li>Damage to wastewater infrastructure with increased requirement for maintenance and repair at a localised level.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Supply</b>	<ul style="list-style-type: none"> <li>Increased maintenance and repair costs of water service infrastructure at a localised level.</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	<ul style="list-style-type: none"> <li>None</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>Costal flooding resulting in damage to habitats at a localised level.</li> <li>Increased cost to protect habitats from flood damage</li> <li>Isolated and limited damage to environmentally sensitive areas requiring monitoring and/or restoration work</li> </ul>	<ul style="list-style-type: none"> <li>Damage to coastal habitats resulting in a decrease of ecosystem health across the county and an increased requirement for monitoring and remediation</li> </ul>
<b>Community Development</b>	<ul style="list-style-type: none"> <li>Inhibited development of local communities.</li> <li>Damage to buildings and travel disruptions impacting on local economies.</li> </ul>	<ul style="list-style-type: none"> <li>Inhibited development of communities as a result of coastal erosion at a localised level.</li> <li>Building damage and travel disruptions impact on local economies.</li> </ul>
<b>Emergency Response</b>	<ul style="list-style-type: none"> <li>Increased pressure on emergency services at a localised level.</li> </ul>	<ul style="list-style-type: none"> <li>Increased pressure on emergency response units at a community level.</li> </ul>



# 3.2.4 Overall Impacts of Current Climate Risks

# Impacts of Current Climate Risks on the Local Authority

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Following on from characterising the frequency of the hazard, exposure, vulnerability, and the associated level of impact to the local authority, the overall impact on key risk areas for Kerry County Council was assessed according to the criteria provided through Technical Annex B: Climate Change Risk Assessment (catastrophic, major, moderate, minor and negligible) (see appendix 2). Below we provide a summary of impacts across the ten climate hazards identified. The following pages provide the information that informed this assessment.

Hazard	Current Frequency	Assets	Health and Wellbeing	Environment	Social	Cultural Heritage	Financial	Reputational	Overall Impact Score
Heatwave	Common	Moderate	Negligible	Minor	Minor	Negligible	Minor	Minor	1.9
Drought	Common	Minor	Minor	Minor	Moderate	Minor	Moderate	Minor	2.3
Cold Spell	Occasional	Moderate	Moderate	Negligible	Moderate	Negligible	Moderate	Minor	2.3
Heavy Snowfall	Occasional	Minor	Moderate	Minor	Moderate	Negligible	Minor	Minor	2.1
Severe Windstorm	Very Frequent	Moderate	Minor	Minor	Minor	Moderate	Moderate	Minor	2.4
Coastal Flood	Frequent	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	2.1
Coastal Erosion	Frequent	Minor	Negligible	Moderate	Minor	Moderate	Minor	Moderate	2.3
Pluvial Flood	Frequent	Moderate	Minor	Minor	Minor	Negligible	Moderate	Moderate	2.3
River Flood	Frequent	Moderate	Minor	Minor	Moderate	Negligible	Moderate	Moderate	2.4
Groundwater Flood	Rare	None	None	Minor	Negligible	None	Negligible	None	0.6

*Overall impact score is calculated as an average of the impact categories. More detail is provided in the accompanying spreadsheet.*





# Impacts of Current Climate Risks– Heatwaves & Drought

County Kerry has been exposed to heatwave events (defined as 5 consecutive days with temperatures >25 deg. C) over the period 1985-2022 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 Kerry has experienced drought conditions over the period as exemplified by the drought events in 2006 and July 2018.

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
 <p>Heatwave Common</p>	Assets	<ul style="list-style-type: none"> <li>High temperatures have resulted in localised damage to road surfaces (tar and chip) across the County. High temperatures in summer 2022 led a recently constructed road in North Kerry to require gritting.</li> </ul>	Moderate
	Health and Well being	<ul style="list-style-type: none"> <li>High temperatures have resulted in disruption to travel networks. In August 2022 high rail temperatures led to delayed trains running between Kerry and Dublin.</li> <li>High indoor temperatures have resulted in uncomfortable working conditions for staff and public with potential for impacts on for heat sensitive equipment (e.g. Council laboratories). This has resulted in the increased requirement for active/mechanical cooling and has impacted productivity. The 2018 heatwave forced the Skellig chocolate factory to cease production for three days.</li> <li>Increased sea surface temperatures can result in higher frequencies of jellyfish on coasts.</li> </ul>	Negligible
	Environment	<ul style="list-style-type: none"> <li>Heatwaves provide suitable conditions for the ignition of uncontrolled fires. Gorse fires in Killarney National Park are a regular occurrence with a large scale fire occurring in April 2021, lasting 4 days and destroying hen harrier nesting sites.</li> <li>High water temperatures associated with heatwave events have had significant impacts on freshwater and marine environments. High temperatures in July 2018, June 2021 and July 2022 led to algal blooms in Lough Leane in Killarney.</li> </ul>	Minor
	Social	<ul style="list-style-type: none"> <li>Heatwaves have resulted in congestion at key recreational areas with facilities (e.g., litter collection and parking) overwhelmed.</li> </ul>	Minor
	Cultural Heritage	<ul style="list-style-type: none"> <li>Extreme temperatures are recognised as contributing to the increased weathering of cultural heritage sites.</li> </ul>	Negligible
	Financial	<ul style="list-style-type: none"> <li>The financial implications of heatwaves are primarily associated with road maintenance and repair.</li> </ul>	Minor
	Reputational	<ul style="list-style-type: none"> <li>Heatwaves have had a negligible reputational impact for Kerry County Council.</li> </ul>	Minor
 <p>Drought Common</p>	Assets	<ul style="list-style-type: none"> <li>Drought conditions (e.g. Summer 2018) resulted in the imposition of restrictions on water supply on a national and county basis with implications for building operation. In August 2022, water supplies were restricted overnight in areas between Killarney and Killorglin, including Miltown.</li> </ul>	Minor
	Health and Well being	<ul style="list-style-type: none"> <li>Water restrictions, particularly in combination with extreme heat, have the potential to result in dehydration, particularly for vulnerable populations and outdoor workers.</li> </ul>	Minor
	Environment	<ul style="list-style-type: none"> <li>High temperatures and dry conditions, often compounded by high levels of ignition activity, can result in uncontrolled fires. Gorse fires in Killarney National Park are a regular occurrence with a large scale fire occurring in April 2021, lasting 4 days and destroying hen harrier nesting sites.</li> </ul>	Minor
	Social	<ul style="list-style-type: none"> <li>Water restrictions can lead to inconvenience for local businesses and residents. High temperatures in summer 2020 led to multiple Kerry water schemes being in drought or near drought conditions, leading to hosepipe bans.</li> </ul>	Moderate
	Cultural Heritage	<ul style="list-style-type: none"> <li>Drought conditions results in damage to cultural heritage sites due to weathering and drying out of substrate.</li> </ul>	Minor
	Financial	<ul style="list-style-type: none"> <li>The financial implications of drought are limited and restricted to responding to wildfire and supporting the provision of water (e.g., tankering).</li> </ul>	Moderate
Reputational	<ul style="list-style-type: none"> <li>The reputational impacts of drought conditions are limited and localised.</li> </ul>	Minor	





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

County Kerry has experienced significant extreme cold/cold spell and heavy snowfall events over the period 1985-2022 with significant events reported for 2018 (the ‘Beast from the East’) and January 2019. These events have wide ranging impacts across the County including disruption of transport routes, damage to buildings, and isolation of communities.

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
 <p><b>Cold spell</b> Occasional</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Cold spells have resulted in road closure, transport disruption and increased maintenance and repair costs across the county.</li> <li>Freeze thaw action has resulted in damage to critical infrastructure (e.g., water infrastructure) and building stock.</li> <li>Extreme cold conditions in combination with snowfall have resulted in the widespread closure of business (incl. LA business services).</li> </ul>	Moderate
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Extreme cold has resulted in treacherous conditions and increased incidence of slips and falls.</li> <li>Exposure to extreme cold has had detrimental impacts for outdoor workers and vulnerable populations.</li> </ul>	Moderate
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Cold spells have led to decreased water availability and have detrimental impacts for biodiversity and habitats, resulting in a decrease of ecosystem health.</li> </ul>	Negligible
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures have resulted in social isolation for remote communities.</li> <li>Elderly and vulnerable populations are required to stay in place resulting in isolation.</li> </ul>	Moderate
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Freeze thaw has been identified as having detrimental impacted on the structural integrity of cultural heritage sites, as was observed during the low temperatures of the 2010 ‘Big Freeze’.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and assets, and can be significant.</li> </ul>	Moderate
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Isolation of communities and council response (e.g., gritting) across the county receives media attention but with limited reputational impact for County Kerry.</li> </ul>	Minor

 <p><b>Heavy snowfall</b> Occasional</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Heavy snowfall has resulted in transport disruption. Conor Pass and Ballaghisheen Pass were impassable due to snow in January 2021 and February 2022.</li> <li>Accumulations of snowfall on roofs results in damage to buildings.</li> <li>Heavy snowfall can lead to power outages.</li> </ul>	Minor
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Extreme cold events have resulted in hazardous conditions and increased incidence of slips and falls amongst public and staff.</li> </ul>	Moderate
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Flooding post-heavy snowfall event results in overland flow of pollutants to habitats and ecosystems with detrimental effects.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for remote communities.</li> </ul>	Moderate
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Accumulations of heavy snowfall can result in damage to cultural heritage sites.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of cold spells are primarily associated with maintenance and repair costs for local and regional roads, buildings and assets.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Isolation of communities and council response (e.g., gritting) across the county receives media attention but with limited reputational impact for the county.</li> </ul>	Minor




# Impacts of Current Climate Risks - Windstorms

County Kerry has been frequently exposed to wind storms over the period 1985-2022, notable examples being Storms Eleanor, Barra and Franklin. Impacts have been experienced across the county and relate to disruption of transport, electricity and communication networks. Severe windstorms also result in a range of environmental impacts.

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact Description	Rating
 <p><b>Severe windstorm</b> <b>Very Frequent</b></p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Windstorms have caused direct damage to building stock and other assets. Storm Barra in December 2021 led to damage to the Golf Hotel in Ballybunion.</li> <li>Windstorm damage to power and communication transmission infrastructure (e.g., tree fall on overhead lines) has resulted in disruption of communications and energy supply. Storm Eunice in February 2022 caused power outages for over 25,000 homes in Kerry including in Kilgarvan, the Iveragh Peninsula, and in Miltown. Storm Barra in December 2021 caused power outages for 10,000 customers including households, business and farms across Kerry.</li> <li>Windstorms have caused disruption to transport networks. Storm Deirdre in December 2018 led to the cancellation of flights to and from Kerry airport, as did Storm Lorenzo in October 2019. Treefall arising from Storm Eunice in February 2022 led to blockages on the N21 and the Killorglin to Killarney Road. Other significant treefall-related blockages were recorded throughout the county in September 2018, November 2018, December 2019, January 2020, February 2020, December 2021, and February 2022.</li> </ul>	<b>Moderate</b>
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Windstorms posed a health and safety risk with potential for injury, and associated closures due to this risk. Storm Brendan in January 2020 and Storm Eunice in February 2022 led to Killarney National Park being closed due to the risk of treefall.</li> </ul>	<b>Minor</b>
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Windstorms have resulted in loss of trees and this is particularly the case for vulnerable tree species.</li> <li>Windstorms prevent council staff from safely taking accurate water samples from lakes, hindering monitoring of water quality.</li> </ul>	<b>Minor</b>
	<b>Social</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>	<b>Minor</b>
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Severe wind storms can cause structural damage to cultural heritage sites. A 10 metre section of a large drystone rampart at Dún Beag Fort, fell into the sea during storm Eleanor, and the entrance passage into the Bronze Age fort and a drystone souterrain also collapsed during the storm.</li> </ul>	<b>Moderate</b>
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial impacts of severe wind storm are associated with clean-up and repair cost.</li> </ul>	<b>Moderate</b>
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>Reputational damage as a result of wind storms is limited and associated with short term media reporting on council preparedness and response.</li> </ul>	<b>Minor</b>

# Impacts of Current Climate Risks - Coastal Flooding and Erosion

County Kerry is exposed to coastal storms resulting in inundation of coastal communities. A number of areas are subject to frequent and recurring flooding and situated on estuaries. The Kerry coastline comprises of 684 km, much of which is considered soft (Heritage Council, 1999).

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate
- Minor
- Negligible



**Coastal flood**  
**Frequent**

Hazard & Frequency	Exposure	Impact Description	Rating
Coastal flood Frequent	<b>Assets</b>	<ul style="list-style-type: none"> <li>Coastal flooding can result in direct damage to building stock. Flooding in Tralee during 2018 required repairs to the town's sea wall, and prompted risk management studies to be carried out in Ballyheigue, Brandon Point and Castlemaine Harbour.</li> <li>Coastal flooding can result in damage to road surfaces and footpaths.</li> <li>Coastal flooding can result in disruption to transport networks. Storm Ciara in 2020 caused the N71 suspension bridge in Kenmare to be closed due to high tide flooding. A tidal surge from Storm Diana in 2018 led to Strand Street in Dingle being temporarily impassable.</li> </ul>	Moderate
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Coastal flooding poses risks to health and well being of the public and staff working in exposed areas.</li> </ul>	Minor
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Coastal flooding has detrimental impacts on coastal ecosystems, causing an overall reduction in ecosystem health.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Closure of transport routes due to coastal flooding results in significant social isolation for isolated communities.</li> <li>Coastal flooding results in damage to amenities located in coastal areas.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Coastal flooding can cause structural damage to cultural heritage sites not designed to withstand frequent inundation or exposure to corrosive salt water.</li> </ul>	Minor
	<b>Financial</b>	<ul style="list-style-type: none"> <li>Financial implications associated with coastal flooding relate to increased costs associated with emergency response (e.g. pumping and emergency co-ordination), clean-up and repair.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>For those areas subject to frequent inundations, there is a the potential for reputational damage to the Council on a localised and medium term basis .</li> </ul>	Minor



**Coastal erosion**  
**Frequent**

Coastal erosion Frequent	<b>Assets</b>	<ul style="list-style-type: none"> <li>Assets and communities are currently at risk from coastal erosion. In 2015, during tidal surge, part of road collapsed near Rossbeigh beach which leads to 16 houses. The beach has lost 10-15 million tonnes of sand to coastal erosion in past ten years.</li> </ul>	Minor
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Coastal erosion results in the loss of land, impacting the health and wellbeing of the community affected.</li> <li>Damage to recreational amenities poses a health and safety risk to the members of the public.</li> </ul>	Negligible
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Coastal erosion results in damage to coastal habitats. Dune system between Fenit back strand and Fenit Island has been affected due to increasing coastal erosion.</li> </ul>	Moderate
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures as a result of coastal erosion can result in significant social isolation for communities.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Coastal erosion due to storms have an impact on sites and monuments in coastal areas. In January 2018, Dunbeg Fort on the Dingle Peninsula had to be closed due to damage sustained over Storm Eleanor as a large portion of the fort has fallen into the sea due to the storm.</li> </ul>	Moderate
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of coastal erosion are primarily related to the development and maintenance of coastal defence works.</li> </ul>	Minor
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>For areas that are subject to frequent erosion, there is potential for reputational damage to County Kerry.</li> </ul>	Moderate



# Impacts of Current Climate Risks - Pluvial and Fluvial Flooding

For County Kerry in the period 1985-2022, pluvial and fluvial flooding have occurred on a common basis. Areas of exposure to fluvial flooding are limited geographically but with the potential for frequent exposure.

*Key to colour coding of impact ratings*

- Catastrophic
- Major
- Moderate
- Minor
- Negligible


Hazard & Frequency	Exposure	Impact Description	Rating
 <p><b>Pluvial flood</b> Frequent</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>Pluvial flooding has resulted in the temporary inundation of assets. Rainfall in July 2020 caused the flooding of businesses in Kenmare town centre. Heavy rainfall in February 2021 caused the inundation of the Glenflesk GAA club.</li> <li>Pluvial flooding results in damage to road surfaces and disruption to transport networks. Storm Eleanor in 2018 led to flooding which rendered the N86 impassable at Blennerville. Flooding in July 2020 caused the N70 on the scenic Ring of Kerry route to be impassable between Sneen and Caherdaniel.</li> </ul>	Moderate
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public.</li> </ul>	Minor
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Pluvial flooding has resulted in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems.</li> <li>Pluvial flooding can cause landslides and damage to local habitats.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for communities.</li> </ul>	Minor
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>Pluvial flooding puts built heritage with stone cavities at risk of water ingress. Rainwater ingress can also cause algae and other microorganisms to grow.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of emergency response (e.g. pumping and emergency co-ordination, clean-up and repair) can be significant.</li> <li>Increased budget pressure to adapt to impact of climate change, e.g. flood protection measures and upgrading of existing drainage systems.</li> </ul>	Moderate
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>For areas that are subject to frequent inundation, there is potential for reputational damage to the council.</li> </ul>	Moderate
 <p><b>River flood</b> Frequent</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>River flooding has resulted in the temporary inundation of buildings. Flooding from the Clydagh river led to the inundation of Cahir school in Kilgarvan in February 2021.</li> <li>River flooding results in transport disruption and road closures. Flooding at the Listry bridge in the same month forced diversions via the N22.</li> <li>River flooding and fast flowing rivers can cause damage to bridges through hydrodynamic scour.</li> </ul>	Moderate
	<b>Health and Well being</b>	<ul style="list-style-type: none"> <li>Heavy precipitation and floodwater leads to dangerous driving conditions for both council staff and public.</li> <li>Fluvial floods can carry debris which can lead to injury of residents and pedestrians.</li> </ul>	Minor
	<b>Environment</b>	<ul style="list-style-type: none"> <li>River flooding can result in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems..</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for communities.</li> <li>Inhibited development of communities as a result of frequent river flooding.</li> </ul>	Moderate
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>A number of the county's cultural heritage and archaeological sites are situated near river systems and are particularly exposed to river flooding.</li> </ul>	Negligible
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of fluvial flooding are associated with increased costs of preparedness (e.g., sandbags and demountable defences) emergency response (e.g. pumping and emergency co-ordination), clean-up and repair.</li> </ul>	Moderate
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>For areas that are subject to frequent inundation, there is the potential for reputational damage to the council.</li> </ul>	Moderate

# Impacts of Current Climate Risks – Groundwater Flooding

For the period 1985-2022, groundwater flooding has occurred on a rare basis with limited impact.

*Key to colour coding of impact ratings*

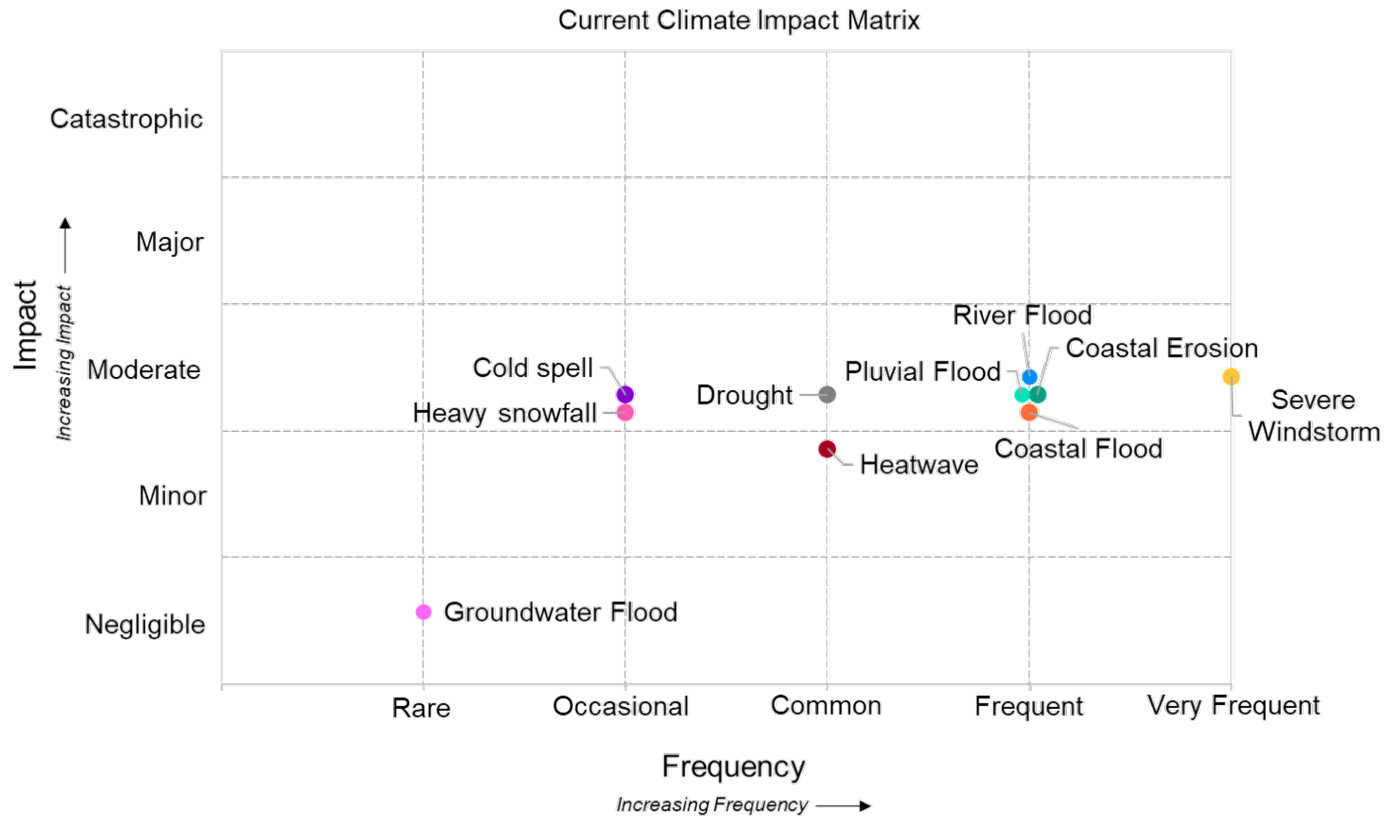
- Catastrophic
- Major
- Moderate
- Minor
- Negligible

Hazard & Frequency	Exposure	Impact description	Rating
 <p><b>Groundwater Flood</b>  Rare</p>	<b>Assets</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	None
	<b>Health and Wellbeing</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	None
	<b>Environment</b>	<ul style="list-style-type: none"> <li>Flooding can result in the overland flow of pollutants (nutrients, sediment and pesticides) with impacts on terrestrial and freshwater ecosystems.</li> </ul>	Minor
	<b>Social</b>	<ul style="list-style-type: none"> <li>Road closures can result in significant social isolation for communities.</li> </ul>	Negligible
	<b>Cultural Heritage</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	None
	<b>Financial</b>	<ul style="list-style-type: none"> <li>The financial implications of emergency response (e.g. pumping and emergency co-ordination, clean-up and repair) can be significant.</li> </ul>	Negligible
	<b>Reputational</b>	<ul style="list-style-type: none"> <li>None</li> </ul>	None



# Current Climate Impact Matrix

Based on frequency of hazard occurrence and level of impact, we have developed a current climate impact matrix for Kerry County Council. Our assessment identified heatwaves, drought, severe windstorms, cold spells, heavy snowfall, pluvial and river flooding hazards as having occurred within the county. Severe windstorms were assessed as being the hazard occurring most often and with a moderate impact on County Kerry.



# 3.3 Future Climate Risks and Impacts

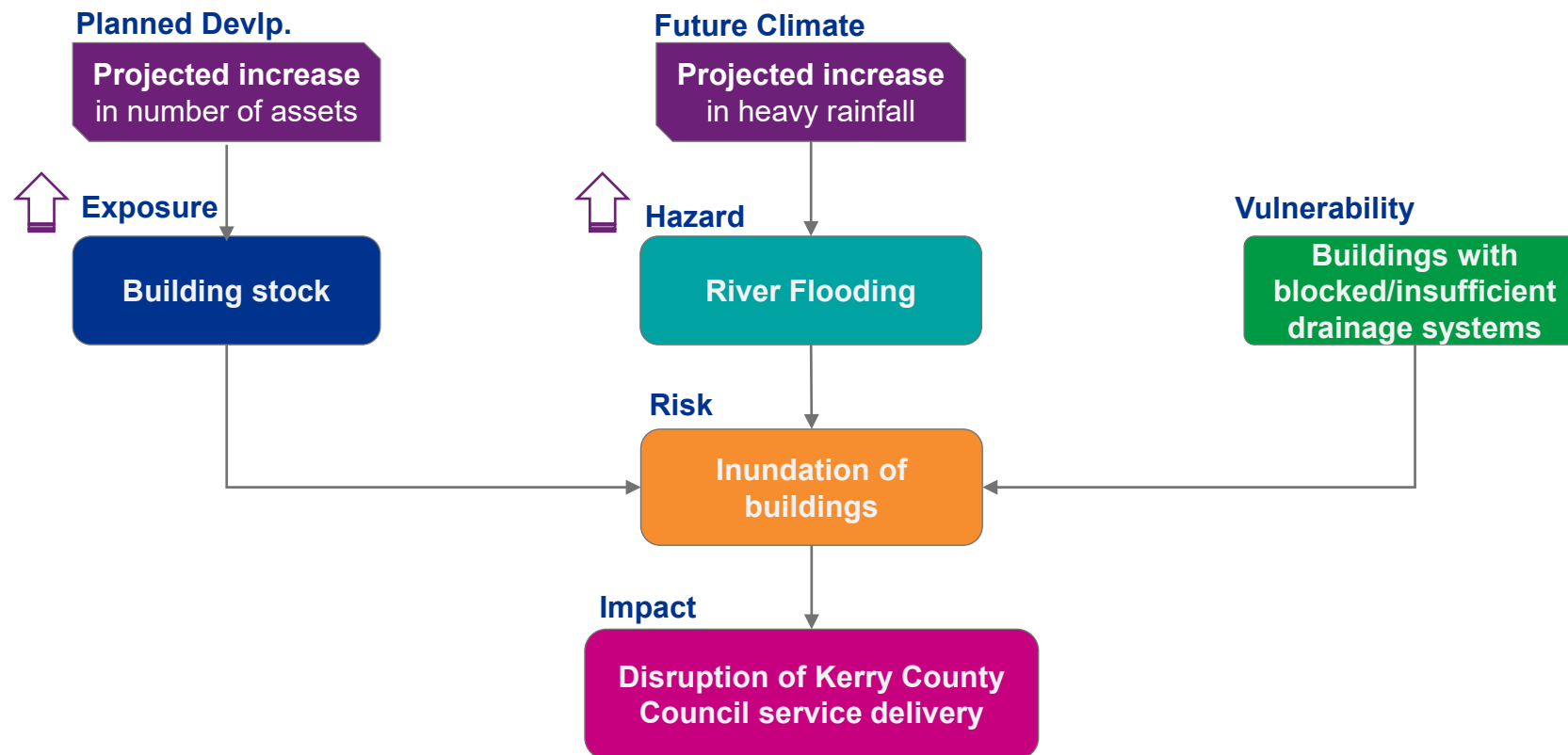
# 3.3.1

# Future Changes in Climate Hazards

# Future Climate Risk and Impact











Climate risks may increase or decrease in the future due to a change in the frequency and/or 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 increase in the population of the county resulting in new buildings being constructed, increasing the number of assets potentially exposed to river flooding. Therefore, due to changes in both the hazard and exposure, the risk of inundation of Kerry County Council buildings will increase in the future.

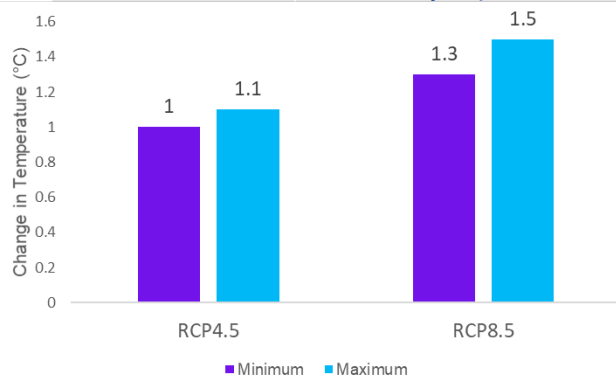
In the following sections, we provide an assessment of potential future changes in the climate of County Kerry by 2050 and its effects on the frequency of hazard occurrence. An assessment of the future changes in the population and development in the region by 2050 that could affect exposure and vulnerability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



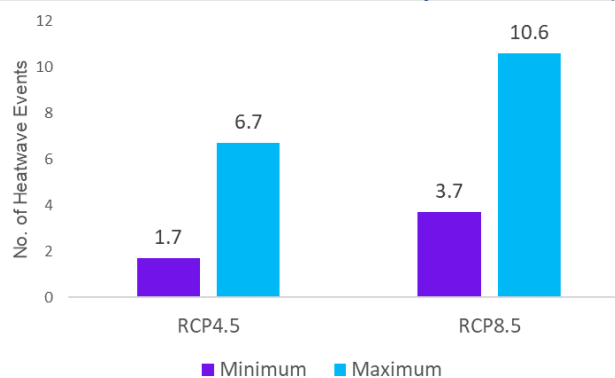
# Climate Projections for County Kerry in 2050 (1/2)

Having identified and assessed the range of climate hazards already experienced by Kerry County Council, projected changes in the frequency and intensity of climate hazards was assessed to understand how existing climate impacts and risks faced by Kerry County Council may change in the future.

Hazard		Projected Change	Future Frequency
	<b>Heatwaves</b>	<ul style="list-style-type: none"> <li>Projections indicate <b>an overall increase in average temperature</b> (bottom left) of between 1.0 and 1.5°C for County Kerry relative to the 1981-2000 period.</li> <li>Under a high emission scenario, projections indicate that <b>heatwaves will become more frequent</b> (bottom middle) by mid-century.</li> </ul>	Frequent 
	<b>Droughts</b>	<ul style="list-style-type: none"> <li><b>Summer rainfall is expected to reduce</b> by between 2 and 18% in the future when compared with the baseline period of 1981 to 2000, in both the RCP4.5 and RCP8.5 scenario contributing to potential drought conditions.</li> </ul>	Frequent 
	<b>Cold Spell</b>	<ul style="list-style-type: none"> <li>As a consequence of the increasing temperatures, <b>a decrease in the number of frost days and ice days</b> 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.</li> </ul>	Rare 
	<b>Heavy Snowfall</b>	<ul style="list-style-type: none"> <li>The annual <b>snowfall</b> in the region is projected to decrease substantially by the middle of the century for the RCP4.5 and RCP8.5 scenarios (bottom right).</li> </ul>	Rare 
	<b>Severe Windstorms</b>	<ul style="list-style-type: none"> <li><b>Projections of storms are subject to a high level of uncertainty.</b> By mid century, projections indicate that average wind speed will remain similar to those currently experienced but an increase in more intense storms which are currently rare events is projected.</li> </ul>	Very Frequent 



The projected minimum and maximum **increase in the mean annual temperature** for the area of County Kerry 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 Kerry 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 **change in snowfall** for the area of County Kerry 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)

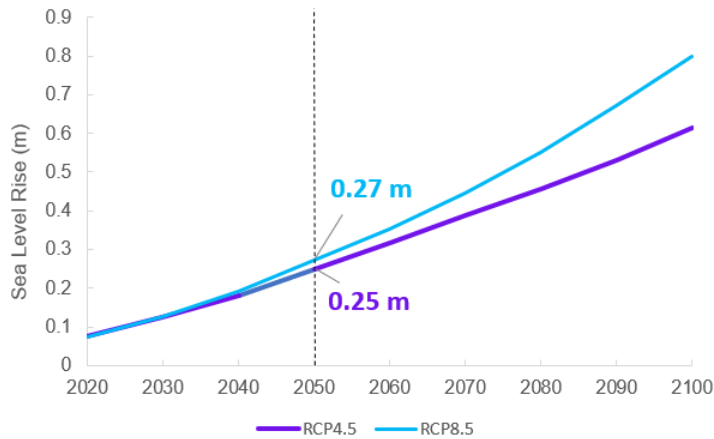




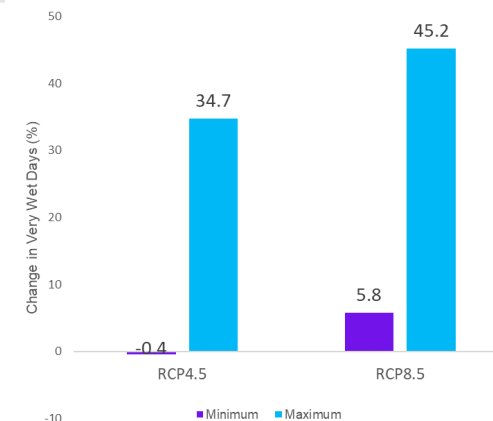
# Climate Projections for County Kerry in 2050 (2/2)

Having identified and assessed the range of climate hazards already experienced by Kerry County Council, projected changes in the frequency and intensity of climate hazards was assessed to understand how existing climate impacts and risks faced by Kerry County Council may change in the future.

Hazard	Projected Change	Future Frequency
 Coastal Flooding	<ul style="list-style-type: none"> <li>Projected sea level rise under a high emissions scenario indicate an increase of up to 0.27 m by 2050 which will <b>increase the frequency of coastal inundation</b> (bottom left).</li> </ul>	Very Frequent 
 Coastal Erosion	<ul style="list-style-type: none"> <li>A rising sea level is strongly linked with coastal erosion and <b>an increase in erosion rates and extent</b>.</li> </ul>	Very Frequent 
 Pluvial Flooding	<ul style="list-style-type: none"> <li>Projections indicate an <b>increase in the frequency of heavy rainfall days</b> (days with precipitation &gt;30mm) for County Kerry with some areas projected to see increases of up to 45% (bottom right). This will likely result in an increased frequency of associated fluvial and pluvial flooding.</li> </ul>	Very Frequent 
 River Flooding		Very Frequent 
 Groundwater Flooding	<ul style="list-style-type: none"> <li>Projections of changes in groundwater flooding are currently not available, therefore there is <b>uncertainty in the change</b> in groundwater flooding frequency that can be expected.</li> </ul>	Rare 



The projected **increase in sea level** for a medium (RCP4.5) and high (RCP8.5) emissions scenario offshore of (Grid Reference: 53,-10) County Kerry (Source: IPCC AR6 Sea-Level Rise Projections)

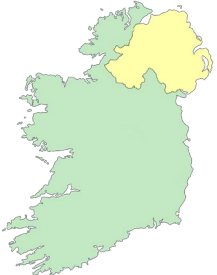


The projected **increase in very wet days** (days with > 30 mm precipitation) for the area of County Kerry for the period 2041-2060 compared to 1981-2000 for a medium (RCP4.5) and high (RCP8.5) emissions scenario (Source: Nolan and Flanagan, 2020)

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

# Projected Changes in Exposure and Vulnerability

In the future, County Kerry will also experience change in terms of its population and socio-economic development. This will potentially affect the exposure and vulnerability of people and assets within the region. National, regional and local strategies that outline expected and possible sociodemographic and infrastructure developments within County Kerry 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

- Sources:
- National Planning Framework
  - Kerry Development Plan
  - SEAI
  - Projects Ireland 2040 Prospects 2022
  - DHLGH HNDL Toolkit
  - Gov.ie (URDF)
  - FloodInfo
  - Radio Kerry

## How is County Kerry projected to change?



- Population to increase from 147,707 in 2016 to **166,265 in 2028** (CDP)
- Kerry Metropolitan Area **population to increase by 10.5%** between 2022 and 2028 (CDP)
- **7,000 new houses** required by 2028 (CDP)

**RPO 9:** "[e]nsure investment and delivery of comprehensive infrastructure packages to meet growth targets that prioritise the delivery of compact growth and sustainable mobility".

**RPO 35:** "[d]eliver at least 30% of all new homes that are targeted in settlements other than the cities and suburbs within their existing built-up footprints."

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## Planning for adaptation

### Flood Defence Schemes:

The Office of Public Works-Council projects include Kenmare Flood Relief Scheme and the Tralee Flood Relief Scheme (a five stage scheme due for completion by 2030).

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

- N22 Farranfore to Killarney
- N69 Listowel Bypass



### Notable renewable energy projects include:

- Approx. 26 X Sustainable Energy Community (SEC) (e.g. Ballybunion SEC and ECCO South Kerry Community Energy Initiative)
- Onshore wind farms (e.g. Grousemount and Silverbirch proposed wind farms)
- Solar farm at North Kerry near Ballylongford (e.g. planning permission sought for a 346 acres solar farm)



## Planning for mitigation



## Case Study in Urban Planning: Tralee Project

- Kerry County Council has been successful in securing funds under the Urban Regeneration Development Fund (URDF). The URDF part-funds project aimed at enhancing urban areas to make them more attractive places to live, work, visit and invest.
- The proposal for "Positioning Tralee as a Regional Economic Driver & Destination" had an allocated funding of almost €16m in 2021.
- The funding aimed to continue the work on Rock, Russell and Bridge Streets, strengthen links to major retail areas, development of Tralee's Market Quarter, and develop multi-purpose community spaces.

# Future Exposure and Vulnerability (1/2)

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

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

# Future Exposure and Vulnerability (2/2)

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

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



# Future Impacts

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

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

# 3.3.3

# Overall Future Impact on Kerry County Council

# Climate Risks Matrix

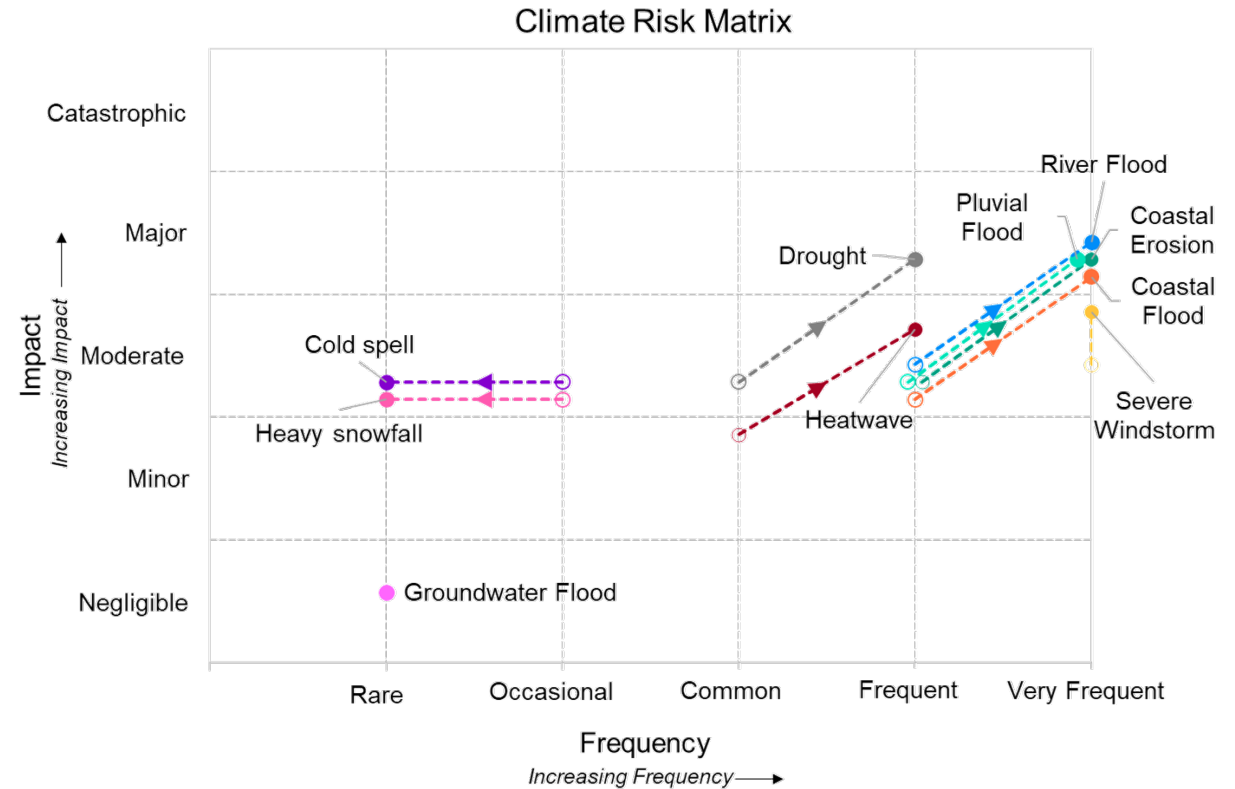
Projected future changes in the hazard, exposure, and vulnerability combine to form an assessment of future risks across County Kerry. The risk matrix on the right shows the future change in risk with the hollow marker showing the current risk and the solid marker the future risk. The dotted line shows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

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

**Heatwaves and droughts** although already experienced in County Kerry, are expected to occur more frequently due to climate change and with a greater impact on County Kerry in the future. These hazards can therefore be considered as **emerging risks** for the region.

Although the frequency of **severe windstorms** is projected to be **unchanged in the future**, the impact will increase slightly due to projected increases in exposure and vulnerability. As a result these events will remain a significant risk for County Kerry. The risk of **groundwater flooding** is also unchanged in the future, however, there is uncertainty associated with how climate change will impact the occurrence of this hazard.

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



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

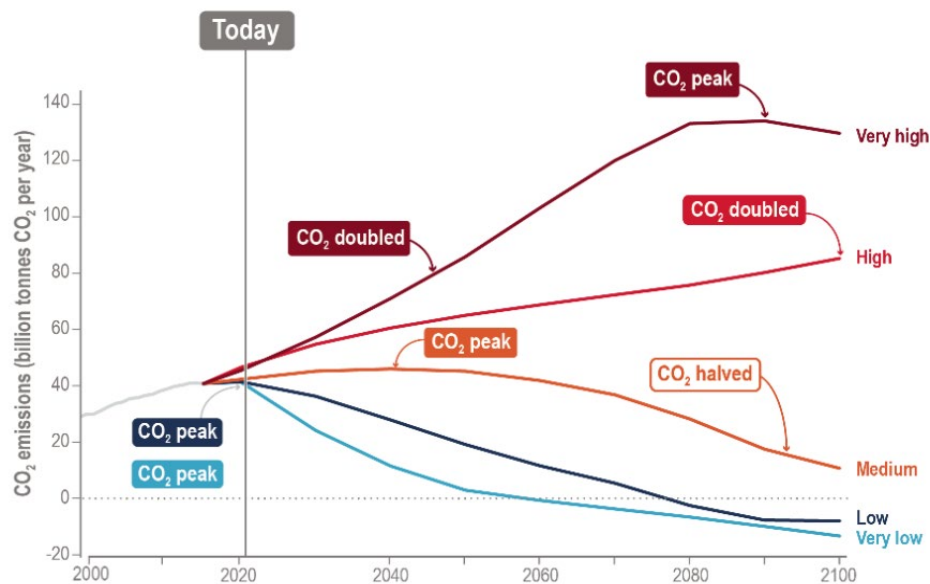
# Uncertainty

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.

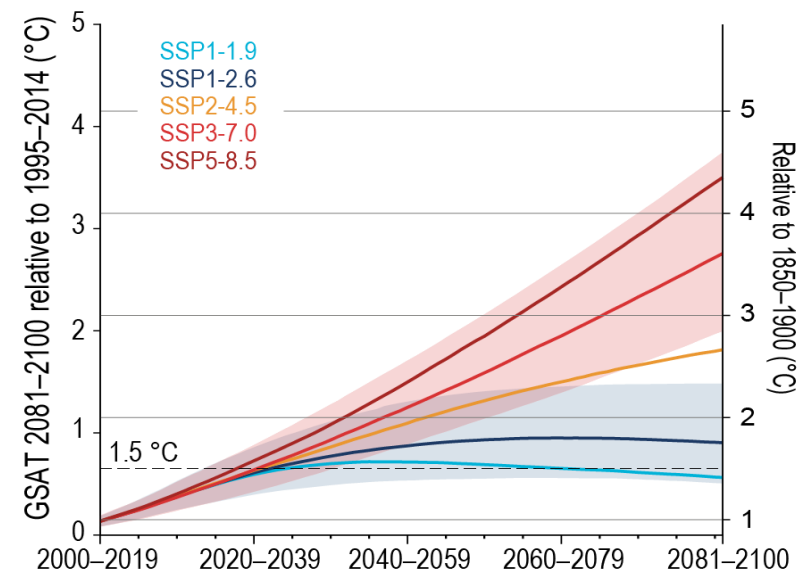
Different social and economic developments can lead to substantially different future emissions of carbon dioxide and other greenhouse gases (bottom left) resulting in uncertainty in what the future global climate will be. As an example of the possible future ranges in mean global surface temperature (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 Kerry will develop into the future. Although, in the near-term there is relatively good understanding as a result of strategies, such as the Kerry County Development Plan 2022-2028, developments up to 2050 are less certain. A 'worst case scenario' approach has been taken here also, with the potential future impact being increased according to the indicative near-term trend and the assumption that adaptation actions are not implemented.



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









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



# 3.4 Summary

# Summary

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

- 
  - Recent experiences of **cold spells and heavy snowfall** events in 2018 demonstrated the wide range of impacts for County Kerry. These included, amongst others, disruption to road networks (Conor Pass and Ballaghisheen Pass), freeze thaw damage to critical infrastructure, damage and disruption of electricity supply and snow melting resulting in increase risk of flooding. 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.
- 
  - Recent experiences of **river and pluvial flooding** events in 2020, resulted in damages to buildings, and infrastructure, disruption of transport networks, and potential bridge failure. Projected increases in the frequency of extreme precipitation events will result in increased surface water and riverine flood risk for County Kerry.
- 
  - Recent experiences of **coastal erosion and coastal flooding** events in 2020 and 2022, resulted in damage to heritage sites, deterioration of transport infrastructure, damage to water treatment and wastewater infrastructure..
- 
  - County Kerry experienced both a **heatwave and drought** in 2018 and 2022, with heatwaves also recorded in 2021. These events resulted in damage to road surfaces, increased demand placed on water resources and recreational areas, detrimental impacts on freshwater quality and fish populations and increase in the frequency of uncontrolled fire. Projected increases in the frequency of heatwaves and drought conditions will mean that events currently experienced on an infrequent basis will become more frequent. As the population ages, there will also be an increase in the number of vulnerable people exposed to heat-related risks.
- 
  - **Severe windstorms** are currently experienced on a very frequent basis in County Kerry and result in wide-ranging impacts, including disruption to energy supply, communications infrastructure and damages to buildings and infrastructure. Projections indicate no significant change to this frequency.
- 
  - **Groundwater flooding** are currently experienced on a rare basis in County Kerry and result in inundation and damage to road infrastructure. Projections indicate no change to this frequency.

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

04

# Appendices





# 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

# Appendix 1 - Glossary

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

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

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

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

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

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

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

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

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

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

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



# Appendix 2 – Service Area Descriptions

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

# Appendix 3 – 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
SACs	Special Area of Conservation
SPAs	Special Protection Areas
URDF	Urban Regeneration Development Fund
WTP	Water Treatment Plant

# Appendix 4 – 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

# Appendix 5 – Characterisation of the magnitude of impact across various risk areas

## (Source: Technical Annex B: Climate Change Risk Assessment)

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



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