Kilkenny County Council
Comhairle Chontae Chill Chainnigh

CARO

An Roinn Comhshaoil,
Aeráide agus Cumarsáide
Department of the Environment,
Climate and Communications

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A TETRA TECH COMPANY

TIER 1 CLIMATE CHANGE RISK ASSESSMENT

Kilkenny County Council

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KILKENNY COUNTY COUNCIL

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1 EXECUTIVE SUMMARY

On behalf of Kilkenny County Council (KCC), RPS has prepared a Tier 1 Qualitative Local Authority Climate Change Risk Assessment (CCRA) to support the development of the Local Authority Climate Action Plan (LACAP) 2024-2029. In accordance with the methodology provided in Annex B of the LACAP guidelines, this report provides an assessment of the current and future climate risks and impacts on the operations and delivery of services by KCC. The assessment of these risks will raise awareness of the consequences of climate change, help to prioritise risks, help to monitor and track changes in climate risks, and support a social and organisational licence to act on adaptation. This CCRA will inform the adaptation section of the new Kilkenny County Council Climate Action Plan which will constitute part of the National Adaptation Framework.

The review undertaken for this CCRA included the consideration of existing regional and national level data relating to climate events, followed by a multi-party workshop with key service area stakeholders within Kilkenny County Council. The workshop facilitated review of historic climate events, hazards, impacts, exposures, and vulnerabilities affecting the local authority services and function. This CCRA also builds on the previous risk assessment carried out as part of the Climate Adaptation Strategy[1] (CAS) in 2019. The climate data and impacts on council services mentioned in this CAS are brought in line with the Annex B guidelines and incorporated into this CCRA.

This process resulted in the development of a climate hazard profile for County Kilkenny. Following an assessment of the nature and frequency of climate hazards, a qualitative assessment of the overall impact based on the level of disruption to the delivery of local authority services and functions was assessed for both current and future climate events. Based on the qualitative risk assessment, as presented in this report, the most significant current climate risks in County Kilkenny were identified as:

- **River Flooding;**
- **Extreme Precipitation;**
- **Drought.**

Increasing impacts are envisaged for future climate events across most climate hazards, however future projections indicate that flooding is likely to remain as the most significant.

As a Tier 1 assessment, this CCRA can be used to inform general strategies to mitigate current and future impacts, providing a broad understanding of climate change risk. To further support the effective implementation and management of adaptation action in the future, there is a need to carry out semi-quantitative (Tier 2) to quantitative (Tier 3) approaches to risk assessment, with each step providing greater level of information on which to base adaptation decisions.

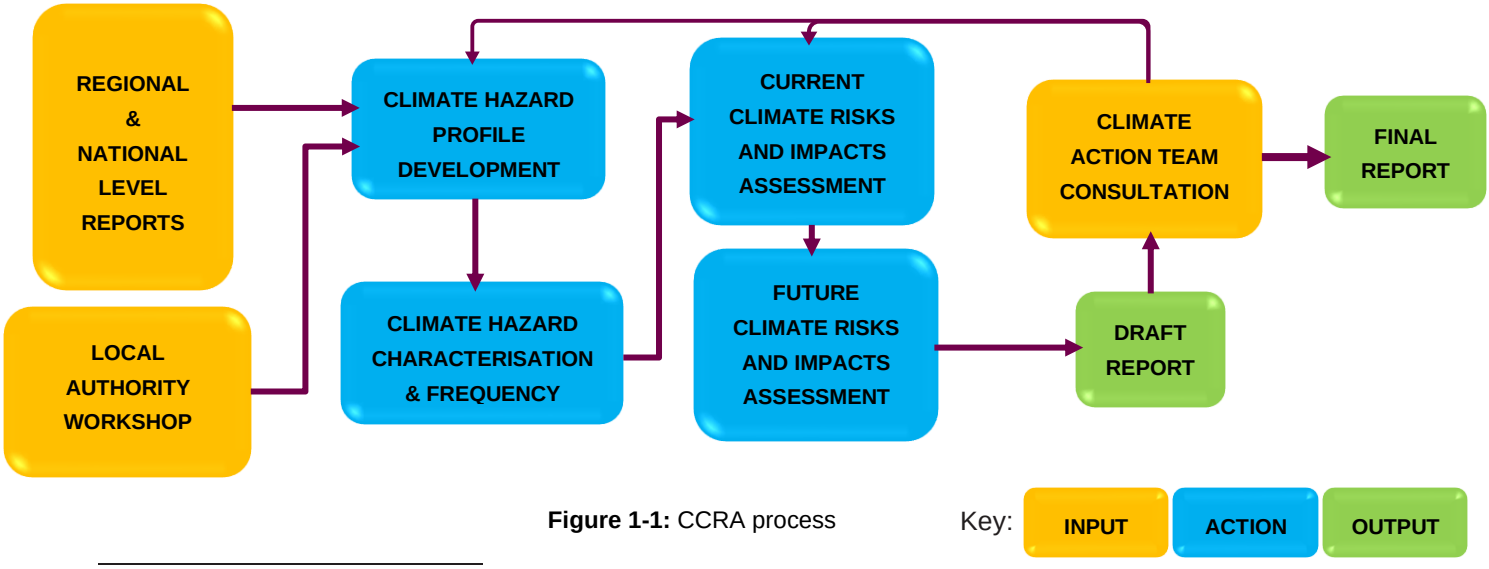
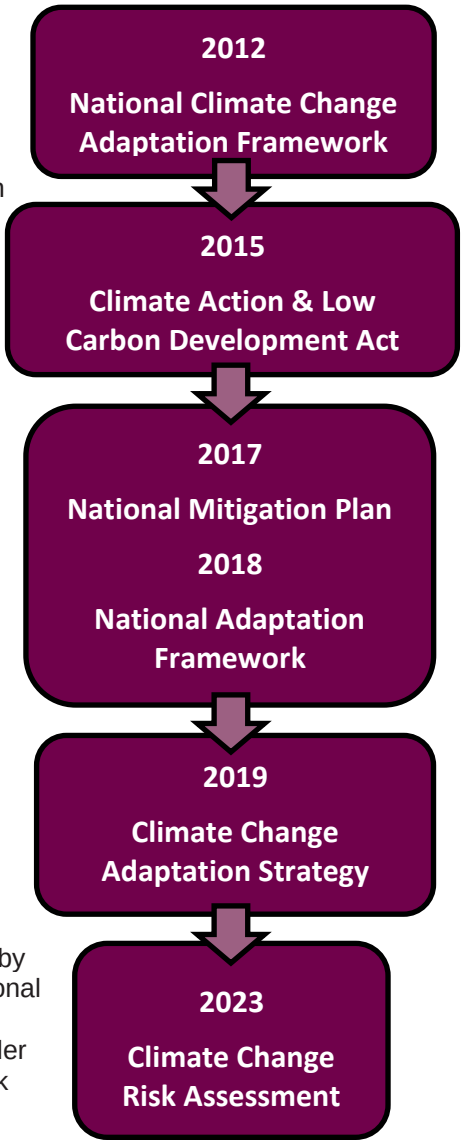


Figure 1-1: CCRA process

[1] KCC. Kilkenny County Council Climate Adaptation Strategy 2019-2024. 2019

2 CONTEXT



The National Climate Change Adaptation Framework (NCCAF) developed in 2012 provided a strategic policy focus to ensure adaptation measures were taken across different sectors and levels of government to reduce Ireland's vulnerability to the negative impacts of climate change. The aim of the NCCAF was to ensure that an effective role was played by all stakeholders in putting in place an active and enduring adaptation policy regime. The governance structure provided for climate change adaptation to be addressed at national and local level, consistent with the approach being taken at EU level in the White Paper on Adaptation

The first phase focused on identifying national vulnerability to climate change, based on potential impacts relative to current adaptive capacity. Reliable information on the range of socio-economic vulnerabilities, the costs and benefits, and the options available and appropriate to Ireland, were key elements to inform effective adaptation planning. A key component was to provide the evidence base necessary to inform development of the national agenda.

The second phase involved the development and implementation of sectoral and local adaptation action plans to form part of the comprehensive national response to the impacts of climate change. Sectoral plans are prepared by the relevant Department or Agency and are adopted by the relevant Minister. Draft sectoral plans should be reviewed at least every 5 years.

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

Ireland's first statutory National Adaptation Framework (NAF) was published by Minister Denis Naughten TD on 19 January 2018. The NAF sets out the national strategy to reduce the vulnerability of the country to the negative effects of climate change and to avail of positive impacts. The NAF was developed under the Climate Action and Low Carbon Development Act and built upon the work already carried out under the NCCAF.

The annual review of the adaptation progress in Ireland[2] gives a summary of the progress made by various sectors on the adaptive capacity, resource and mainstreaming, and governance of the implementation of climate change adaptations. The Climate Action Regional Offices (CARO) and Local Authorities are listed under the Local Government Sector, which has shown good overall progress in 2022. The key challenge remains the resourcing of dedicated staff to ensure consistency, coordination, and implementation. The realised desire noted for closer working with national agencies on risk assessments, adaptation policies and tools for use by local authorities is essential to enabling progress on adaptation by the local authorities and national agencies. This is highlighted again in the CARO progress report[3] where delays in the delivery of implementation are due to lengthy stakeholder consultation processes; capacity and capability constraints across the public sector; and desires for alignment with other measures to enhance impact.

Section 16 of the Climate Action and Low Carbon Development (Amendment) Act 2021 requires each local authority to prepare a Climate Action Plan. The preparation of the Climate Change Risk Assessment is a key part of the initiation stage of preparing a Local Authority Climate Action Plan and it will serve to underpin evidence-based adaptation planning.

[2] ECOPRO Project. Climate Change Advisory Council - Annual Review 2022. 2022

[3] CARO. CARO - Progress Report 2022 Implementation of Actions for Climate Change Adaptation Strategy. 2022

Based on the Local Authority Climate Action Plan guidelines[4], this Climate Change Risk Assessment (CCRA) will inform the adaptation section of the new Kilkenny County Council Climate Action Plan[5] which will constitute part of the NAF.

CCRAs aim to further our understanding of the risks posed from the changing climate and form an integrated part of any climate change adaptation planning process. CCRAs provide a basis for making decisions on whether risks, and what level of those risks, are acceptable to society or the community by obtaining, collating and analysing information on the projected impacts and consequences of climate change.

[4] DCCAE. "Local Authority Adaptation Strategy Development Guidelines," 2018. gov.ie - Guidelines for Local Authority Climate Action Plans (www.gov.ie)

[5] CARO. Local Authority Climate Action Plan Guidelines 2023. 2023

3 INTRODUCTION

RPS was contracted in November 2022 to carry out a Tier 1 Qualitative Local Authority Climate Change Risk Assessment (CCRA) for Kilkenny County Council, as part of the development of their Local Authority Climate Action Plan LACAP, in accordance with the methodology provided in Annex B of the Local Authority Climate Action Plan Guidelines. The CCRA focuses on the delivery of services and functions by the local authority.

In line with the methodology provided within Annex B of the Guidelines, the CCRA provides for:

- Current Climate Risks and Impacts Assessment i.e. An assessment of the current climate hazards, exposure and vulnerabilities of climate change on the operations and efficient delivery of services by the local authority.
- Future Climate Risks and Impacts Assessment i.e. An assessment of future climate risks and impacts on the operations and efficient delivery of services by the local authority.

3.1 Tier 1 Assessment

Climate change risk assessments can be qualitative (Tier-1), semi-quantitative (Tier-2), or fully quantitative (Tier-3), with each tier building on the previous and requiring an increasing level of data, information, and complexity to develop[6]. This climate risk assessment uses a qualitative (Tier-1) approach.

A first-pass assessment (Tier 1) is a rapid qualitative process that can be carried out without detailed local data to develop a preliminary understanding of the climate change risks over a range of scales, from local to regional.

A climate change risk assessment is a systematic process to identify risks from climate-related events. This report is a Tier 1 high-level qualitative Climate Change Risk Assessment based on available information. It is based primarily on nationally available datasets, and localised mapping and information. It will be used to:

- Provide a broad understanding of climate change risk in County Kilkenny;
- Raise awareness of the consequences of climate change;
- Identify and prioritise risks for service areas within Kilkenny County Council;
- Prioritise systems/areas that need further strategic responses, research or risk assessment ;
- Communicate about risks to relevant stakeholders;
- Identify broad areas where adaptation planning may be required;
- Track changes and inform monitoring and evaluation;
- Support a social and organisational licence to act on adaptation;
- Inform the preparation of the Kilkenny County Council Climate Action Plan.

This process helps users to screen climate-related hazards and identify specific risks that may arise from these hazards, and which should be investigated further (through second- and third-pass risk assessments). This first-pass screening is ideal when carrying out a CCRA with resource constraints, including limited data and information. It also allows integration of data and information from a variety of (qualitative and quantitative) sources. This is an important early step in climate adaptation planning. Usually, the initial first-pass risk assessment is conducted with limited project-specific data, instead using qualitative information, evidence from published literature and available data such as default national figures. The outcome of a first-pass risk assessment provides a broad understanding of the impacts of climate change in a specific context (be that a region, sector or business).

Appendix A further clarifies the different characteristics and requirements of each of the three risk assessment tiers.

[6] Stephen Flood et al., National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action, Report 346 (EPA Research, 2020).

3.2 Approach

Assessment of climate change risk underpins evidence-based adaptation planning and implementation. Climate change risks differ from other risks as it can be difficult or even impossible to quantify short-term or long-term probabilities. As a result, conventional risk assessments that use statistical probabilities can be ineffective.

To assess climate change, risk is composed of three inter-related components[7]:

- **Hazards:** Refers to potential source of harm in terms of damage/loss of property/infrastructure, potential injury, loss of life or other health impacts, livelihoods, service provision, ecosystems, and environmental resources. In this document, this term refers to climate-related physical events or trends or their physical impacts.
- **Exposure:** Refers to the presence of assets, infrastructure, property, people, livelihoods, species or ecosystems, environmental functions, services, resources in places or settings that could be affected. It is important to note that exposure can change over time, e.g., because of land use change.
- **Vulnerability:** Refers to the propensity or predisposition to be adversely affected. This encompasses sensitivity (which refers to the degree to which an exposure will be adversely or beneficially affect by climate hazards) and adaptive capacity which refers to ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Figure 3-1 shows the direct and indirect interconnections between the three components of climate risk and highlights the need to understand elements of both climate and socioeconomic processes to assess risk. Therefore, to understand the possible impacts of climate change, a climate change risk assessment is required.

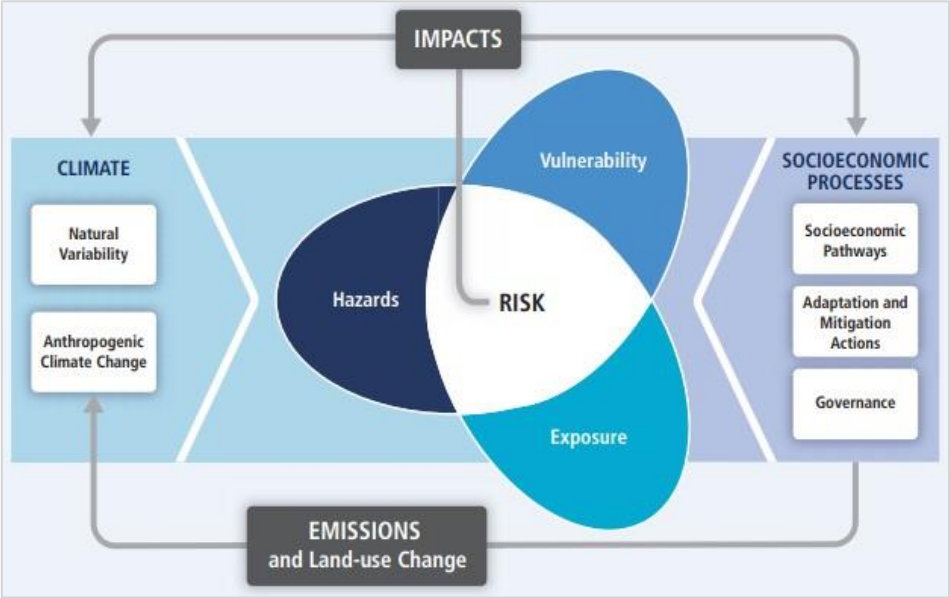


Figure 3-1: The Intergovernmental Panel on Climate Change Assessment Report 5 Framework of Climate Risk which shows how the three components of risk (hazards, exposure, vulnerability) are connected to climate and socioeconomic processes[8]

[7] ISO, "Adaptation to Climate Change – Guidelines on Vulnerability, Impacts and Risk Assessment (14091)," vol. ISO 14091:, 2021.

[8] IPCC, Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, ed. C.B. Field et al., Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth

Climate risk assessments provide several benefits:

- Raising awareness: Risk assessments help increase awareness of the consequences of climate change.
- Identification and prioritisation of risks: Many factors can contribute to a climate risk, and climate change risk assessments provide insight into these factors, and this helps the organisation to prioritise the risks to be addressed.
- Identification of entry points for climate change adaptation intervention: The results and the process of risk assessment can help identify possible adaptation responses. Risk assessments can show where early action is required, e.g., to avoid locking-in future impacts and to highlight the need for development of adaptive capacity.
- Tracking changes in risk, and monitoring and evaluating adaptation: Repeating risk assessments can help to track changes over time and generate knowledge on the effectiveness of adaptation.

This Report provides a qualitative (Tier-1) climate change risk assessment undertaken for County Kilkenny and was developed on the basis of the existing local authority adaptation strategy guidelines[9] , along with the *'Adaptation to climate change - Guidelines on vulnerability, impacts and risk assessment'* International Standard[10] , guidance on the climate proofing of infrastructure[11] , the National Risk Assessment of Impacts of Climate Change[12] , and ongoing risk assessment research.

In addition, the approach outlined within this Report builds upon the data and information produced within the previous local adaptation strategy. **Figure 3-2** provides an overview of the key stages of developing the CCRA. 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'.

A workshop was held with multi-party input across a wide range of services areas within Kilkenny County Council, where historic climate events, existing hazards, exposures and vulnerabilities were discussed.

Figure 3-2: Overview of the stages of the Climate Change Risk Assessment Spreadsheet

Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2014), papers2://publication/uuid/B8BF5043-C873-4AFD-97F9-A630782E590D.

[9] DCCAE, "Local Authority Adaptation Strategy Development Guidelines," 2018.

[10] ISO, "Adaptation to Climate Change - Guidelines on Vulnerability, Impacts and Risk Assessment (14091)."

[11] European Commission, "Technical Guidance on the Climate Proofing of Infrastructure in the Period 2021-2027," 2021.

[12] Flood et al., National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action.

4 COUNTY KILKENNY

County Kilkenny is located in the south-east of Ireland and is bordered by counties Carlow, Laois, Tipperary, Waterford and Wexford. Topographically the county is characterised by the lowland areas of the river valleys of the Barrow, Nore and Suir, with the central area of the county and the south-west characterised as lowland areas. Outside of these areas the land rises to the upland areas of the Castlecomer Plateau to the north and the Slieveardagh Hills to the north-west, with the southern area of the county being largely characterised as an Upland area.

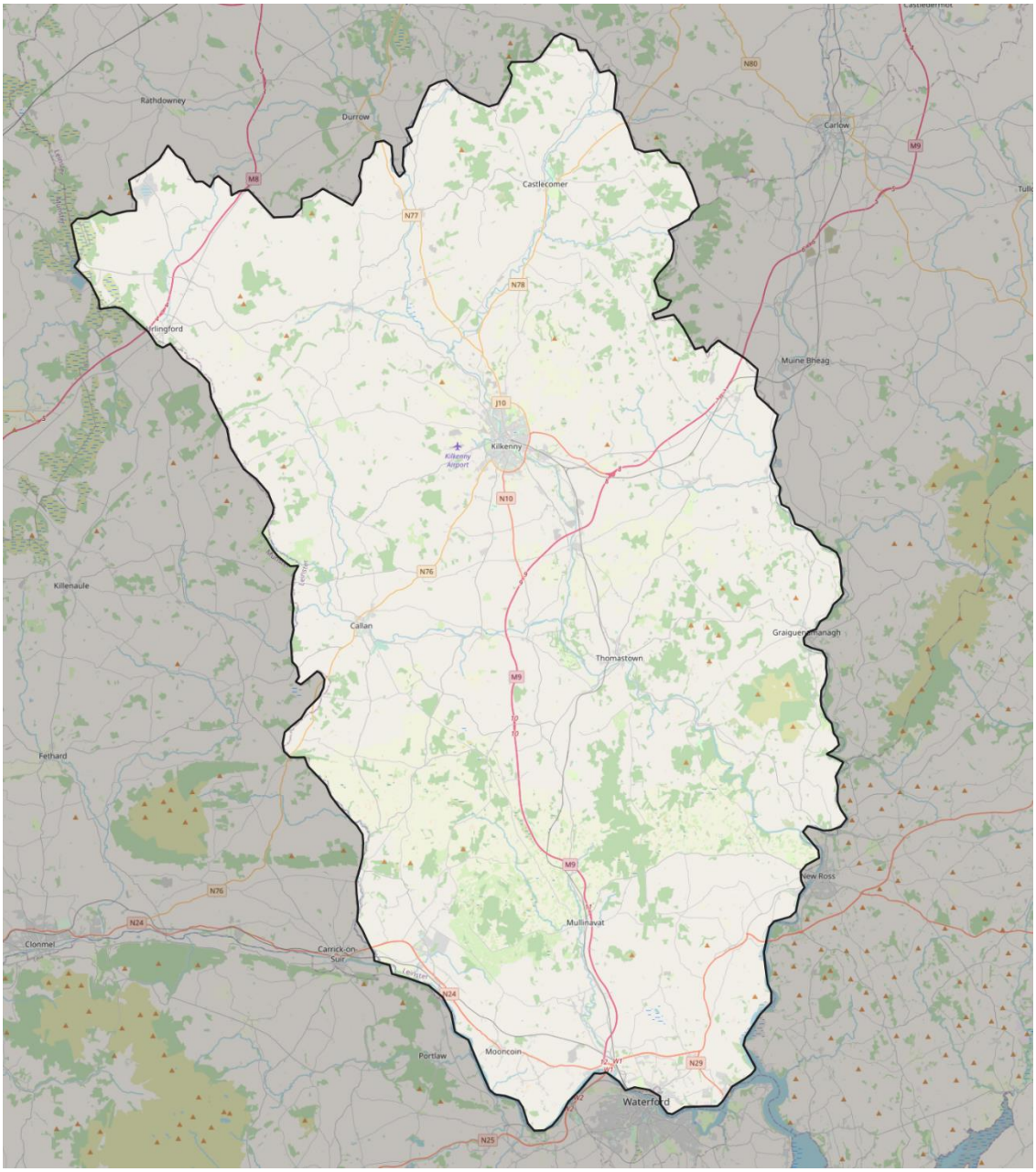
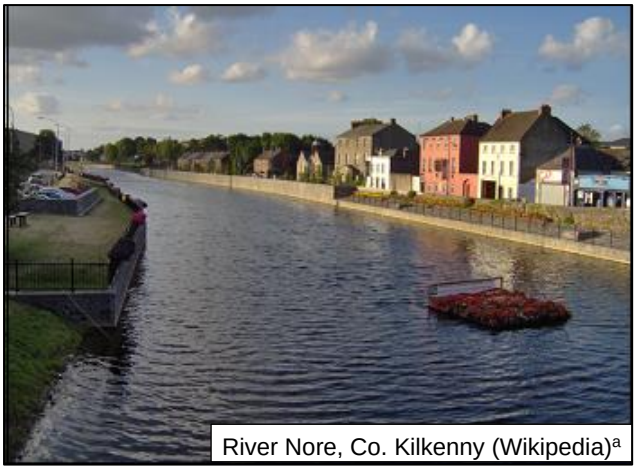


Figure 4-1: Characteristics of Kilkenny

The highest concentration of urban population is located within the lowland river valleys in Kilkenny City and the Environs of Waterford City in Kilkenny (Ferrybank). The area of County Kilkenny is 2,072 km^2. The county is drained by the rivers Barrow, Nore and Suir that are collectively known as The Three Sisters. The smaller rivers of the Kings, Dinin, Duiske, Goul, Glory and the Blackwater form part of the catchment of the Three Sisters Rivers. The river Nore bisects the county on a north-south axis; it passes through Kilkenny City



River Nore, Co. Kilkenny (Wikipedia)[a]

and is joined by the Kings River south of Bennettsbridge. The River Barrow flows along the eastern boundary of the county and joins the river Nore north of New Ross. The river Suir flows along the southern boundary of the county and is joined by the Nore and the Barrow south of Belview Port. The combined catchment area of the Three Sisters is 9,207 km^2, made up of the Suir's 3,610 km^2, the Barrow's 3,067 km^2 and the Nore's 2,530 km^2. The Three Sisters Rivers and associated rivers join up to create one of the largest estuarine systems in Ireland. The tidal limits extend to Carrick-on-Suir on the Suir River, Saint Mullins on the Barrow, and Inistioge on the Nore. The main channels of the Suir and the Barrow-Nore system converge at Cheekpoint east of Waterford City and continue out into the Celtic Sea. County Kilkenny has direct access to the Irish Sea, through Belview Port on the River Suir and through New Ross on the River Barrow.

Population: 103,685

40% of the population reside in urban centre.

Source: CSO 2016

The Census of 2022 recorded a population of 103,685 for County Kilkenny. Kilkenny City is the predominant urban centre within the county. The Ferrybank neighbourhood which is comprised of the Environs of Waterford City within County Kilkenny is the second largest centre of population within the county, with a recorded population in the 2016 Census of 5,246. Based on this Census, approximately 40% of the county population resided within the urban centres of Kilkenny City, Ferrybank, Callan, Thomastown, Castlecomer and Graiguenamanagh.

Since January 2014, water and wastewater has been the responsibility of Irish Water while Kilkenny County Council provides water services in accordance with a service level agreement with Irish Water. Water distribution input in the county has amounted to 27,166 m^3 per day over 365 days, amounting to 9,915,500 m^3 of potable water per year. Wastewater in similar quantities is disposed of back to the environment.

The Council's natural heritage provides significant economic benefits for the county. It underpins important economic sectors such as agriculture, tourism and recreation, and is a core component of the county's green infrastructure. Protection of the county's natural resources is regarded as necessary to sustain economic growth. The multi-functional role of green infrastructure enhances opportunities for recreation and tourism, encourages new business to invest in the county and has a role in climate change adaption. County Kilkenny's green infrastructure is a key strategic asset for the county.

There is 58km of Motorway going through Kilkenny and roughly 90km of national road throughout the County. There are two passenger railway lines in use in the county. A spur from Kilkenny City at Lavistown connects to the Dublin-Waterford main passenger line. The Waterford-Limerick passenger line runs in the south of the county, serving Waterford and Carrick-on-Suir stations. Belview Port is served by rail, connecting to the Waterford line, which facilitates the movement of freight.

Land area of over **207,000 ha**

Over **145km** of combined road length of motorway and national roads

Having regard to the dominance of the Three Sisters River Basin catchment, and the location of a number of settlements within the river valleys, together with the tidal nature of these rivers in the southern and eastern areas of the county, a significant area of Kilkenny is susceptible to climate change risks.

[a] *River Nore*. Wikipedia. https://en.wikipedia.org/wiki/River_Nore

5 WORKSHOP

RPS facilitated a workshop with Kilkenny County Council on Tuesday 22nd November 2022.

The workshop was productive in providing a platform to share understanding of current climate hazards across KCC Service Areas and to familiarise the local authority teams with the CCRA process, relating it to previous risk assessment and adaptation planning, and cementing understanding and support for the CCRA.

Critical to the success of developing a CCRA is ensuring multi-party input to the process to ensure that all relevant triggers, events and receptors are suitably captured and addressed. The workshop served as the key medium to engage with all service departments within Kilkenny County Council and allow for a multi-expert input to the final risk classifications. As noted by the guidance, the CCRA process focuses on the delivery of services and functions by the local authority.

The following Kilkenny County Council services were represented within the workshop:

- Head of Enterprise
- Corporate Services
- Environment
- Active Travel
- Planning
- Conservation
- Water
- Parks & Special Projects
- Housing
- Civil Defence
- I.T.
- Finance
- Municipal District
- Fire Service
- Civil Defence
- Arts
- Community & Culture

The risk assessment tables, and output matrices produced within the appendices of this report were guided by national level risk assessment and further developed through both objective and anecdotal evidence brought forward by Kilkenny County Council, to create a bespoke but consistent CCRA output that meets the needs at a local authority level.

A consultation meeting was held on 28th February 2023 with the KCC Climate Action Steering Committee to ensure relevant triggers, events, and receptors were captured within the assessment.

6 ASSESSING CURRENT CLIMATE RISKS AND IMPACTS

Understanding current climate impacts is critical to developing an understanding of future climate risks. Assessment of the current climate impacts involved:

- Identifying the range of climate hazards that have previously affected Kilkenny and its administrative area, and
- Assessing the exposures and vulnerabilities of the local authority and its administrative area to these hazards.

6.1 Climate Hazards Profile

In collaboration and consultation with Kilkenny County Council, and with the collective input by the Eastern & Midlands CARO County Councils of Wexford, Waterford, Tipperary, and Carlow, a timeline of climate hazards historically affecting the local authority area have been identified and developed within this report. Climate hazards include extreme weather events and periods of climate variability, for example:

- Extreme weather events, e.g., extreme rainfall, flooding, storms, extreme heat, or drought.
- Deviations from average climatic conditions over a given period of time e.g. periods of above or below average conditions in the spatial and/or temporal distribution of precipitation, or changes in average temperature.

It is important to consider and identify, that many climate hazards are created or exacerbated by a pre-condition, e.g., a heavy rainfall event on saturated soils resulting in flooding. In addition, it is important to consider that the co-occurrence of multiple climate hazards can directly or indirectly exacerbate existing hazards or create new hazards, e.g., a storm causing a coastal storm surge and precipitation resulting in high river and coastal water levels resulting in river and coastal flooding, or a heavy rainfall event after a period of drought creating surface water flooding.

The climate hazards profile presented in **Figure 6-1** provides a review of the extreme weather events in County Kilkenny over the past 30 years. All climate hazards identified within a single event are noted within the profile. An expanded summary of each event is provided in **Appendix C**.

Table 6-1 lists the climate hazard types identified as providing existing risk to County Kilkenny. This hazard type classification was adapted from IPCC[13].

[13] "Summary for Policymakers." In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, edited by V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, et al. Cambridge University Press, Cambridge, 2021. https://www.ipcc.ch/report/ar6/wg1/.

Table 6-1: Climate Hazards Identified for Kilkenny County

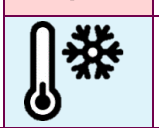
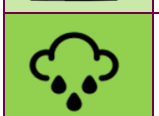
Type	Climate Hazards	
Heat and Cold		Above Average Surface Temperature
		Heatwave
		Drought
		Cold Spell
Wet and Dry		Above Average Precipitation
		Extreme Precipitation
		River Flood
		Pluvial Flood
		Groundwater Flood
Wind		Severe Windstorms
Snow and Ice		Heavy Snowfall
Coastal		Increase in Relative Sea Level

Figure 6-1: Profile of Climate Hazards in County Kilkenny: Representative timeline of climate hazards illustrated to show type of hazard and frequency 1995-2023

6.2 Characterising Climate Hazards

Understanding the nature and frequency of the identified climate hazards helps to produce a deeper appreciation of the scale of risk presented by each hazard type.

6.2.1 Description

A character profile was developed from available information for each of the identified hazard types. Whilst keeping to the scale of a Tier 1 assessment, geographical and spatial characteristics, including relevant specific details associated with past hazards events are included where possible.

6.2.1.1 Flooding

The *National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action*[14] indicates that flooding represents one of the most immediate risks on a national basis, highlighting the significance of this hazard. According to *Climate Change Adaptation: Risks and Opportunities for Irish Businesses*[15], research in 2016 concluded that based on European projections, damage from flooding could amount to €1bn per year in Ireland.

In acknowledgement of the magnitude of risk that flooding presents to the county, Kilkenny County Council developed a Flood Emergency Response Plan which covers advanced preparation, pre-flood actions, and flood awareness, highlighting the presence of flood risk[16]. Kilkenny County Council mobilises the Local Authority Crisis Management Team to deal with a severe weather event, as per the protocol in the Kilkenny County Council Major Emergency Response Plan and the Kilkenny County Council Flood Emergency Response Plan. Other actions which can be carried out to reduce the risk of flooding and its impacts have been listed by the Council to track yearly progress on these mitigation measures (Subaction[17] and Action[18] reporting). Examples include continual updates of emergency weather plans, liaising with OPW regarding flood awareness campaigns, etc.

6.2.1.1.1 River Flooding

River (fluvial) flooding occurs when the capacity of a river channel is exceeded, leading to rivers bursting their banks. This can be exacerbated by high tide levels impeding the flow of the river out into the sea. Factors influencing the severity of the flood include the size and slope of the catchment, the physical qualities of the soil and underlying rock, surface run-off, and drainage network.

Twelve occurrences of significant river flooding in County Kilkenny are noted within the 30-year profile of climate hazards. Local impacts of flooding noted within the County include damage to critical infrastructure, reduced function of transport routes, increased maintenance and repair works, water quality impacts, environmental contamination, stress on biodiversity and environmentally sensitive areas in addition to ongoing socio-economic implications and pressure on overworked emergency response staff over prolonged periods.

[14] Stephen Flood et al., National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action, Report 346 (EPA Research, 2020).

[15] Karen Deignan et al., Climate Change Adaptation: Risks and Opportunities for Irish Businesses, Report 402 (EPA Research, 2022).

[16] KCC. 2022-2023 Kilkenny County Council Flood Emergency Response Plan. 2022

[17] KCC. CCAS Subactions Flood Resilience. 2022

[18] KCC. CCAS Action Reporting. 2022

KILKENNY COUNTY COUNCIL

In 2011, as a requirement of the EU 'Floods' Directive, the National Preliminary Flood Risk Assessment (PFRA) identified areas where the risks associated with flooding might be significant. Areas for Further Assessment (AFA) were progressed to the Catchment Flood Risk Assessment and Management (CFRAM) Studies in 2016, where more detailed assessment was undertaken to assess the extent and degree of flood risk more accurately. Where the significance of the risk was confirmed, possible measures to manage and reduce the risk were identified. Eleven locations in County Kilkenny were designated AFAs, these were:

Ballyhale, Ballyragget, Callan, Fiddown, Freshford, Graiguenamanagh, Inistioge, Kilkenny – Nore, Kilkenny – Breagagh, Mullinavat, Piltown, and Thomastown.

A Flood Risk Management Plan (FRMP) for the Nore River Basin was completed in 2018. The plan set out the strategy, including a set of measures, for the cost effective and sustainable, long-term management of flood risk in the Nore River Basin, including the areas where the flood risk has been determined as being potentially significant. The Plan includes feasible measures developed through a range of programmes or policy initiatives including:

Flooding in Thomastown, Co. Kilkenny (Kilkenny Live)[b]

- Non-structural flood risk prevention and preparedness measures,
- structural flood protection measures for communities at significant flood risk, aimed at reducing the likelihood and/or degree of flooding, as identified through the National Catchment Flood Risk Assessment and Management (CFRAM) Programme.

In addition to the FRMP, 200 properties in Kilkenny City (Nore) were protected by a Flood Relief Scheme (FRS) in 2006 at an estimated cost of €45.8mn. An additional 112 properties are also due to be protected through the ongoing Ballyhale FRS and Graiguenamanagh-Tinnahinch FRS. Outside of these larger schemes, minor mitigation works undertaken since 2009 include 14 no. projects at a combined cost of €1,105,350 across County Kilkenny. The Flood Relief Capital Office was set up in 2019 by Kilkenny County Council in collaboration with the OPW as the funding Authority. A total of €29.8million was approved for Kilkenny to implement 6 no. Flood Relief Schemes across the County including Graiguenamanagh, Ballyhale, Freshford, Thomastown, Inistoige & Piltown over a 10-year period[19]. Tranche 1 Schemes commenced in March 2020 with a significant Capital expenditure of over €9.5million for Graiguenamanagh & Ballyhale. The 4 no. other flood relief schemes of Freshford, Thomastown, Inistioge, and Piltown are yet to be approved by the OPW to commence.

Storm Frank 2015/2016

Extreme flooding caused significant damage to Thomastown library resulting in closure of the library for 7 weeks.

[19] www.kilkennycoco.ie

[b] *BREAKING: Quay and properties flooded in Thomastown, County Kilkenny.* 2022. Kilkenny Live. Thomastown flooding

6.2.1.1.2 Pluvial Flooding

Pluvial Flooding

Pluvial flooding occurs when the amount of rainfall exceeds the capacity of urban storm water drainage systems or the ground to absorb it. As a result, there is overland flow of excess water leading to ponding in depressions in the ground, behind obstructions, or in man-made hollows. This type of flooding typically arises as a rapid response to intense rainfall before the flood waters eventually enter a piped or natural drainage system.

The collated record of hazard events for Kilkenny identifies seven instances of pluvial flooding in the past 30 years. Pluvial flooding is typically more localised than river flooding and occurs over a shorter time span. However, it has also been noted within Council to result in damage to critical infrastructure, reduced function of transport routes, increased maintenance and report works, water quality impacts, environmental contamination. Suspended material is known to block surface drainage systems which could lead to standing bodies of water and prolong the flooding period.

Dec-Feb 2015/2016

Severe flooding in towns and villages in Kilkenny, with Graiguenamanagh one of the worst affected.

6.2.1.2 Extreme Precipitation

Extreme Precipitation

Extreme precipitation events are typically short durations of rainfall occurring at a higher frequency and intensity than normal, often leading to flash flooding or storm water damage to buildings and infrastructure. There is also the possibility of water bodies being contaminated and having increased turbidity, reducing water quality. Extreme precipitation may also lead to the cancellation of outdoor events.

Ireland has two monitoring stations which have been monitoring rain levels since the late 1700s and has reached almost 500 rain gauges across the country to this day[20].

Nov 2000

Heavy rainfall experienced in Kilkenny leading to roads being flooded.

19 instances of extreme precipitation are noted in the hazard events record, highlighting its regular occurrence.

[20] www.met.ie

6.2.1.3 Severe Windstorm

Severe Windstorm

Severe windstorms are strong wind events which may or may not be accompanied by precipitation. Infrastructure is particularly vulnerable to severe windstorms as strong winds can damage building facades or destroy habitats. The fallen debris can then be carried away and act as projectiles leading to further damage or serious injury. In the *National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action*[21], windstorms are listed as one of the priority climate risks in Ireland.

Storm damage from Storm Barra (Kilkenny Live)[c]

The hazard events record shows a total of 21 severe windstorm events in County Kilkenny, the most regularly occurring event in the County. Severe windstorms are an event which are listed in the Severe Weather Response Plan which sets out arrangements for KCC's response following this event[22].

Feb 2022

Wind speeds reached 130km/hr in Kilkenny, with trees felled across the County, due to Storm Eunice.

6.2.1.4 Heavy Snowfall

Heavy Snowfall

Heavy snowfall is the large accumulation of snow usually accompanied with snow drifts. This can lead to precarious footing, potential road or building closure, or damage to infrastructure through excessive roof loading. A major concern from large amounts of snowfall is the serious damage to overhead powerlines and communication lines. This event is becoming less frequent, as the general warming of the atmosphere and oceans has reduced the volume of snow and ice. January and February are the typical months when snow is experienced, but it is not uncommon for snow to be present in the period from November to April[23].

Feb/Mar 2018

Storm Emma resulted in snowfall and extreme cold, forcing KCC to increase salt runs.

There have been only three recorded heavy snowfall events in Kilkenny in the last 30 years according to the hazard events record. The last time a heavy snowfall event was recorded was in February/March 2018 during Storm Emma and the Beast from the East. Heavy snowfalls are an event which are listed in the Severe Weather Response Plan which sets out arrangements for KCC's response following this event[24].

[21] Stephen Flood et al., National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action, Report 346 (EPA Research, 2020).

[22] KCC. 2022-2023 Kilkenny Severe Weather Response Plan. 2022

[23] www.met.ie

[24] KCC. 2022-2023 Kilkenny Severe Weather Response Plan. 2022

[c] *Storm Barra: Newpark Fen in Kilkenny remains inaccessible for certain groups.* 2021. Kilkenny Live. Storm Barra

6.2.1.5 Heatwave

Heatwave

The working national definition of a heatwave is five consecutive days or more with maximum temperature over 25 degrees Celsius[25]. Heatwaves can lead to a few issues, such as uncomfortable working conditions and the potential for heat stroke if there are inadequate measures in place to counteract the heat. There is a chance of a reduction in water quality as waterbodies may have a high concentration of dissolved material due to evaporation, and an increase in the risk of fires.

The Fires, Land and Atmospheric Remote Sensing of Emissions (FLARES) project records wildfires throughout Ireland, providing a useful source of data. Kilkenny County Council have a Draft Fire and Emergency Operations Plan [26] in place outlining strategies to mitigate the impacts of wildfires.

Summer 2018

Kilkenny faced a temperature of 30.3°C. Highest since 1975.

Heatwave conditions (Kilkenny Live)[d]

In addition, heatwaves usually place recreational areas under stress, putting pressure on existing infrastructure. Another impact due to heatwaves is the altering of the road constitution, where the bitumen in the roads melt. A major concern with predicted changes in heatwaves is the cascading biophysical consequences they may have nationally and locally, e.g., a change in the growing season and changing the habitats that species depend on[27].

In the last 30 years, there has been evidence of six heatwave events experienced in Kilkenny based on the hazard events record.

[25] www.met.ie

[26] KCC. Kilkenny County Council Draft Fire and Emergency Operations Plan. 2022

[27] KCC. 2022-2023 Kilkenny Severe Weather Response Plan. 2022

[d] *Taking the plunge - the best wild swimming spots in Kilkenny.* 2022. Kilkenny Live. Thomastown

6.2.1.6 Drought

Drought

Drought refers to the lack of access to water due to reduced water levels from high temperatures because of evaporation. This lack of water can prove to be detrimental to the county as drought is usually accompanied by high temperatures, and with it, high demand for water. If there is an inadequate supply of water, it will have to be imported by water tankers, which is a high-cost affair. With drought, there is also an increased risk in the transmission of diseases and a risk of treating water with too high a concentration of organic material. Additional emergency response callouts may also be experienced, leading to overworked employees, who are also being exposed to the impacts of drought.

Summer 2013

Drought condition in Kilkenny affected agriculture, costing €60 per cow.

There were five records of droughts being experienced in Kilkenny in the last 30 years according to the hazard events record.

6.2.1.7 Above Average Surface Temperature

Above Average Surface Temperature

Above average surface temperatures are periods of heat exceeding the average temperatures of the given period over an extended span of time. Risks related to this event include the same risks found in both drought and heatwave events, but with more emphasis on increased stress on recreational areas, and less so on reduced water quality and supply. There is the same concern for the ecological structure of the county, as growing seasons will change, causing a shift from normal seasonal activities seen in nature, such as pollination and/or hibernation.

May – August 2018

Warmest Kilkenny summer since 1975.

Through the workshop it was also noted that increased humidity and above average temperatures increase algal and vegetation growth which increases the potential to undermine vulnerable heritage structures.

In the last 30 years, there were seven events in the hazard events record where above average surface temperatures were noticed. It is important to note that above average temperatures are not limited to summer. Drops in the frequency and/or intensity of snowfall events and the presence of warmer winters are linked to the increase in average surface temperatures.

6.2.1.8 Increase in Relative Sea Level

Increase in Relative Sea Level

An increase in relative sea level refers to the gradual increase in baseline conditions of sea levels. Some rivers have a tidal influence, making this hazard a vulnerability to the likes of river flooding. Studies from the *National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action*[28] also indicate that sea level rise is amongst the highest priority climate risks on a national basis.

Tidally influenced Rivers:

River Nore to Inistioge

River Barrow to St Mullins

River Suir to Carrick-On-Suir

There are a number of rivers in County Kilkenny which contain tidal stretches and are therefore impacted by rises in sea levels as they exacerbate river flooding. The rivers which have tidal influence include River Nore up to Inistioge, River Barrow up to St. Mullins, and River Suir up to Carrick-On-Suir.

6.2.1.9 Above Average Precipitation

Above Average Precipitation

Above average precipitation events are periods of rainfall exceeding the average rainfall of the given period over an extended span of time. Drainage systems may be at risk of reaching capacity as they would be designed for storage volumes associated with a lower level of precipitation. Observations from the *National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action*[28] indicate that average levels of national rainfall have increased by approximately 60mm (5%) for the period from 1981 to 2010 compared with the period from 1961 to 1990.

Above average precipitation can result in many indirect impacts such as more time spent indoors which can affect mental health. A decrease in active travel may also result, leading to increased use of vehicles running on fossil fuels.

Three events in the hazard events record indicate above average precipitation levels in Kilkenny. The main issue for this increase in average precipitation levels is the increase in the risk of both pluvial and river flooding. Urban areas may not be designed to manage prolonged periods of increased levels of rain, resulting in an increase in flood frequency.

Winter 2013/2014

Kilkenny faced 270% above average rainfall causing risk of river flooding.

[28] Stephen Flood et al., National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action, Report 346 (EPA Research, 2020).

6.2.1.10 Cold Spell

Cold Spell

Cold spells are events where temperatures reach record low temperatures over a short period of time. Cold spells can lead to uncomfortable working conditions if there is a lack of heat sources. Mental health is again a possible issue as less time would be spent outdoors. Water supply may be affected due to frozen water bodies or distribution lines. Cold stress on buildings is another possible risk of cold spells, causing infrastructure to crack. Based on Climate Indices from Met Eireann, cold extremes are becoming both less severe and less frequent[29].

Ice and snow build up during cold spell (KCLR)[e]

Winter 2009/2010

Second lowest temperature in the county recorded in Kilkenny at -16.4°C.

Cold spells, based on the hazard events record, have been experienced four times in the last 30 years. The big issue with cold spells can be the duration. Cold spells are an event which are listed in the Severe Weather Response Plan which sets out arrangements for KCC's response following this event[30].

6.2.1.11 Groundwater Flood

Groundwater Flood

Groundwater flooding is caused by the emergence of water originating from underground and is particularly common in karst landscapes. Areas in Kilkenny that are exposed to this are Loughmacask, Ballykeoghan, Baungarrif, and Northwest Kilkenny, east of Urlingford. The occurrence of groundwater flooding is usually very local and unlike flooding from rivers and the sea, does not generally pose a significant risk to life due to the slow rate at which the water level rises. However, groundwater flooding can cause significant damage to property, especially in urban areas and pose further risks to the environment and ground stability.

Winter 2015/2016

Property at Fanningstown qualified for OPW Voluntary Homeowners Relocation Scheme due to groundwater flooding.

The Winter period of 2015/2016 had Ireland facing the worst groundwater flooding conditions in history. The vulnerable areas of Kilkenny had a high probability of seeing groundwater flooding during this period.

[29] www.met.ie

[30] KCC. 2022-2023 Kilkenny Severe Weather Response Plan. 2022

[e] *Snow & ice alert lifted but drivers urged to take extra care.* 2018. Kilkenny and Carlow Local Radio (KCLR). Snow & Ice

6.2.2 Frequency

Through development of the Climate Hazards Profile, the frequency of climate hazard types affecting County Kilkenny becomes more apparent. Using the classification categories adopted from Annex B shown in **Table 6-2**, the frequency of existing climate hazard types can be grouped into 5 broad categories. These have then been applied to the hazard types historically affecting County Kilkenny. The recorded information indicated that Severe Windstorms often combined with Extreme precipitation, are the more frequently occurring climate hazards for County Kilkenny. **Table 6-3** presents the categorised frequency for each of the identified hazard types based on occurrences in the last 30 years.

Table 6-2: Classifying the frequency of occurrence of climate hazards.

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

Table 6-3: Frequency of Current Hazard Types in County Kilkenny

	Hazard Type	Occurrences	Frequency
	**Extreme Precipitation**	**15**	**Frequent**
	**Severe windstorm**	**11**	**Common**
	**Pluvial flooding**	**8**	**Common**
	**River flooding**	**8**	**Common**
	Above average surface temperature	**6**	**Common**
	**Heatwave**	**5**	**Common**
	**Drought**	**4**	**Common**
	**Cold spell**	**2**	**Common**
	**Above Average Precipitation**	**2**	**Common**
	**Heavy snowfall**	**2**	**Occasional**
	**Increase in Relative Sea Level**	**1**	**Occasional**
	**Groundwater flooding**	**1**	**Occasional**

6.3 Overall Impact to the Kilkenny County Council

For each of the climate hazards identified, and on the basis of the exposure, vulnerability, and impacts assessment, the overall severity of impact for the following risk areas were estimated:

- Asset Damage,
- Health and Wellbeing,
- Environment (including biodiversity),
- Social,
- Financial,
- Reputation, and
- Cultural Heritage.

The criteria for assessment, as taken from Annex B, is provided in **Table 6-4**. The resultant current impact summary matrix showing the impact versus the frequency for the current climate risks is included in **Appendix E.** The overall level of impact is calculated as the average of impacts across the risk areas. River flooding is concluded to have the highest impact and is therefore the climate hazard type that presents the most risk to County Kilkenny.

After producing the current impact summary matrix, the current climate impacts of hazards identified can be illustrated according to the current frequency of the hazard, as illustrated in **Figure 6-2**. This allows a simple visual communication of the key risks for the County and a starting point of which events to prioritise.

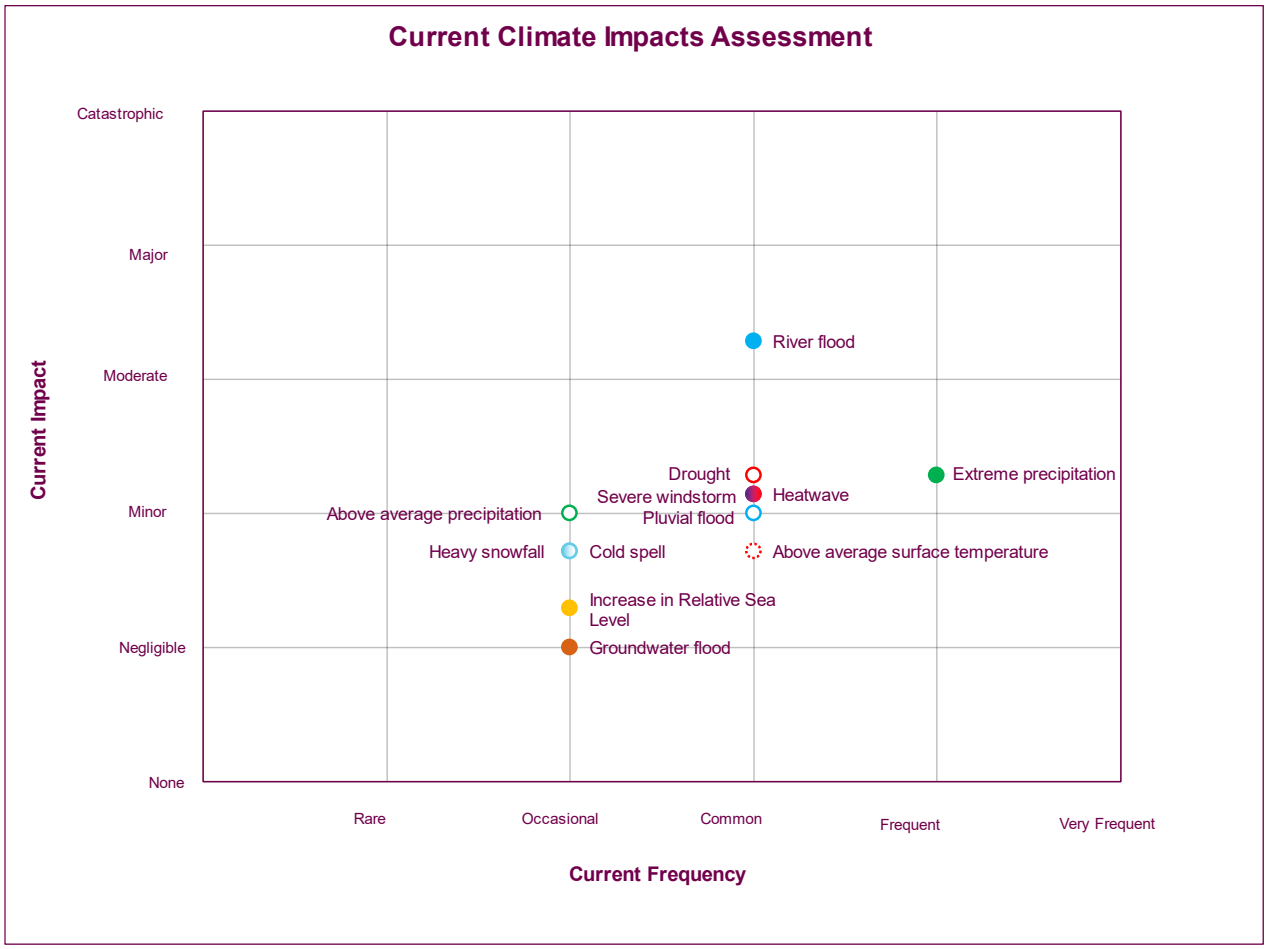


Figure 6-2: Current Climate Impacts Assessment for County Kilkenny

Table 6-4: Magnitude of impact across various risk areas. Adapted from European Commission (2021)

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

6.4 Characterising Impacts, Exposures, and Vulnerabilities

Throughout **Section 6.2** each of the identified climate hazards were characterised to provide on overall appreciation for the nature and scale of each hazard type. Through this characterisation, the national level research, local level environmental and engineering research and reports, the workshop held with the input from Kilkenny County Council Service Areas, and the developed climate history were all used to inform the Impacts, Exposures and Vulnerabilities at the local scale. **Appendix D** presents this collation of information into a tabular output.

For each of the extreme weather events and periods of climate variability identified through the climate hazards characterisation:

1. The impacts of the hazard are identified and described.
2. Specific exposures within each identified climate impact are detailed.
3. For each of the exposures, the associated physical, environmental, and socioeconomic vulnerabilities to the impact were assessed.

Table 6-5 describes each of the three vulnerabilities in more detail. It is important to note that vulnerability can increase or decrease the risk associated with a specific exposure.

Table 6-5: Vulnerability Types

Vulnerability Type	Description
Physical vulnerability	Properties of an asset related to the structure or facilities can exacerbate/reduce the impacts before, during, or after a hazard event, e.g., poor design and construction of building, provision of active cooling. **OR** Ability of a population/persons to access equipment or resources that can exacerbate/reduce the impacts before, during, or after a hazard event.
Environmental Vulnerability	Properties of the environment surrounding the asset/persons that exacerbate/reduce the impacts before, during, or after a hazard event, e.g., limited access to green space that provides respite during heatwave events.
Socioeconomic vulnerability	Properties of a population/persons related to the society, demographics, and economy that can exacerbate/reduce the impacts before, during, or after a hazard event e.g., low income, age, health, English language ability.

6.5 Impact Assessment

This CCRA is focused on the delivery of services and functions of Kilkenny County Council. For each of the identified climate hazard exposures, the level of disruption to the delivery of services and functions are identified and assessed. The impact assessment is provided within **Appendix D** and includes the perceived degree of impact on the delivery of services by Kilkenny County Council for each exposure in accordance with the high-level criteria for assessment shown in **Table 6-6**[31]. An overall impact score is calculated for each exposure based on a weighted average across each of the Service Areas. The higher the impact score, the greater the overall impact on service delivery and functions of Kilkenny County Council. This can be used to inform priority actions to address exposures which provide the greatest impact. The key to which, can be to increase resilience through mitigation of the vulnerabilities which increase the severity of risks associated with a particular exposure.

[31] Edinburgh Adapts Steering Group, "Edinburgh Adapts: Climate Change Adaptation Action Plan 2016-2020," 2016.

As a Tier 1 qualitative study, this is a first-pass risk assessment to develop a quick and broad understanding of climate change risk. It is intended to provide the means to identify a need for strategic and ongoing responses/ commitments, to identify key localities for attention and to build awareness of risk among community and senior management. As it is a high-level screening, it is therefore not suitable for making any final decisions on adaptation actions but should be used to inform the general actions required.

Table 6-6: Description of the levels of impact due to the disruption of Local Authority Services

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

7 ASSESSING FUTURE CLIMATE RISKS AND IMPACTS

Understanding how climate change risks are likely to evolve in the future is crucial to identify how existing risks may be exacerbated by climate change or give rise to the emergence of new risks. To understand how climate change risks, and the subsequent impacts, might change into the future, it is useful to first consider how the frequency of climate hazards might change and how levels of impact may also change as a result of changes in the hazard, exposure, and vulnerability components of risk.

7.1 Future Changes in Climate Hazards

Any identification of climate hazards that are likely to be of significance in the future should begin with those that are significant in the present. To understand how levels of climate hazards might change in the future, available climate projection information needs to be examined to understand how the frequency and intensity of extreme weather events and periods of climate variability might change in the future.

For the purposes of adaptation strategy development, fine scale climate information and data is not required. National statements of projected climate changes and impacts are considered appropriate. More detailed assessment and appraisal should be employed when specific plans or measures are to be implemented and more detailed information is necessary.

The information required has been produced through nationally funded research projects, e.g., Nolan and Flanagan[32] and Desmond[33], and is summarised and available online through Climate Ireland.

National level information on projected changes in Ireland's Climate can be accessed through Climate Ireland's Essential Climate Information Tool.

National level information on projected changes in the biophysical impacts of climate change can be accessed through Climate Ireland's Climate Hazard Scoping Tool.

For each of the climate hazards identified through the assessment of current climate hazards and impacts, and on the basis of available projection data, the projected frequency of each of the identified climate hazards was estimated. See **Appendix F** for projected frequencies of climate hazards.

7.2 Future Changes in Exposure and Vulnerability

Climate risks may develop or increase in the future because of the change in frequency and intensity of climate hazards. However, changes in exposure and vulnerability also affect future climate risks.

In order to establish future levels of impacts, available projections of non-climatic factors on a local level (e.g., County Development Plan, Local Area Plans, Local Economic and Community Plan etc.) were examined to assess potential changes in levels of exposure and vulnerability. Sources include the Kilkenny City & County Development Plan 2021-2027[34], Kilkenny Socio-Economic Statement 2023-2028[35], and Kilkenny Local Economic and Community Plan 2016-2021[36]. For some impacts, there was little existing information to support future impact and vulnerability assessment, resulting in estimates based on available information. See **Appendix F** for the assessment of projected changes in exposure and vulnerability.

[32] Nolan and Flanagan (2020) Research 339: High-resolution Climate Projections for Ireland – A Multimodel Ensemble Approach

[33] "National Preparedness to Adapt to Climate Change: Analysis of State of Play," 2018, https://www.epa.ie/pubs/reports/research/climate/Research_Report_256.

[34] KCC. Kilkenny City & County Development Plan 2021-2027. 2021

[35] KCC. Kilkenny Socio-Economic Statement 2023-2028. 2023

[36] KCC. Kilkenny Local Economic and Community Plan 2016-2021. 2016

7.3 Uncertainty

In assessing the future climate risks, there was a degree of uncertainty in how hazards, exposure, and vulnerability will change. Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood. A range of data and information sources were used in order to mitigate uncertainty in the future risk assessment, but there is still a varying degree of uncertainty present. Therefore, when selecting evidence to inform the climate risk assessment, information related to the uncertainty of projected changes in climate hazards, exposure, and vulnerability are noted within the Rationale column of **Appendix F**.

7.4 Emerging Hazards and Climate Change Risks

Although some activities and services may not currently be affected by climate hazards, it is important to consider the full range of projected changes to hazard, exposure, and vulnerability as these changes may result in increased risk, leading to an exacerbation of impacts to the Local Authority. Following discussion with Kilkenny County Council and considering the character of Kilkenny and its assets, risks associated with the phenology of the county are likely to emerge in the years ahead.

The predicted extended growing season and changes in phenology will have impacts on plant growth, which will impact on the delivery of local authority services. For example, the growing seasons of grass, tree, weed and invasive species will increase. This will impact on the management and resourcing local authority grass cutting services for parks, amenity areas, and roadsides, and the management of invasive species.

Projected changes in temperature are expected to result in a lengthening of the growing with the start of the growing season expected to start 15 and 24 days earlier for the RCP 4.5 (low-medium emissions) and RCP 8.5 (high emissions) scenario, respectively[37].

7.5 Overall Future Impact on the Local Authority

For each hazard and each impact category (Asset Damage, Health and Wellbeing, Environment, Social, Cultural Heritage, Financial, and Reputational), the projected level of impact has been estimated and the rationale for this provided using the national level research. This future impact assessment accounts for projected changes in hazard, exposure and vulnerability and assumes that no additional adaptation actions are taken to offset future impacts. See **Appendix G** for the Future Impact Summary Matrix showing the projected impact versus the projected frequency for the future climate risks. The level of impact is calculated as the average level of impact across the impact categories of Asset Damage, Health and Wellbeing, Environment, Social, Financial, Reputation, and Cultural Heritage.

7.6 Future Climate Impacts Assessment Summary

After producing the Future Impact Summary Matrix, the future climate impacts of hazards projected to impact Kilkenny's Local Authority can be presented according to the future frequency and future level of impact of the hazard, see **Figure 7-1**. The level of future impact is calculated as the average level of impact across the impact categories of Asset Damage, Health and Wellbeing, Environment, Social, Financial, Reputation, and Cultural Heritage. This allows for the simple communication of the key risks that are projected for the County and how to prioritise them.

[37] Nolan and Flanagan (2020) Research 339: High-resolution Climate Projections for Ireland – A Multimodel Ensemble Approach

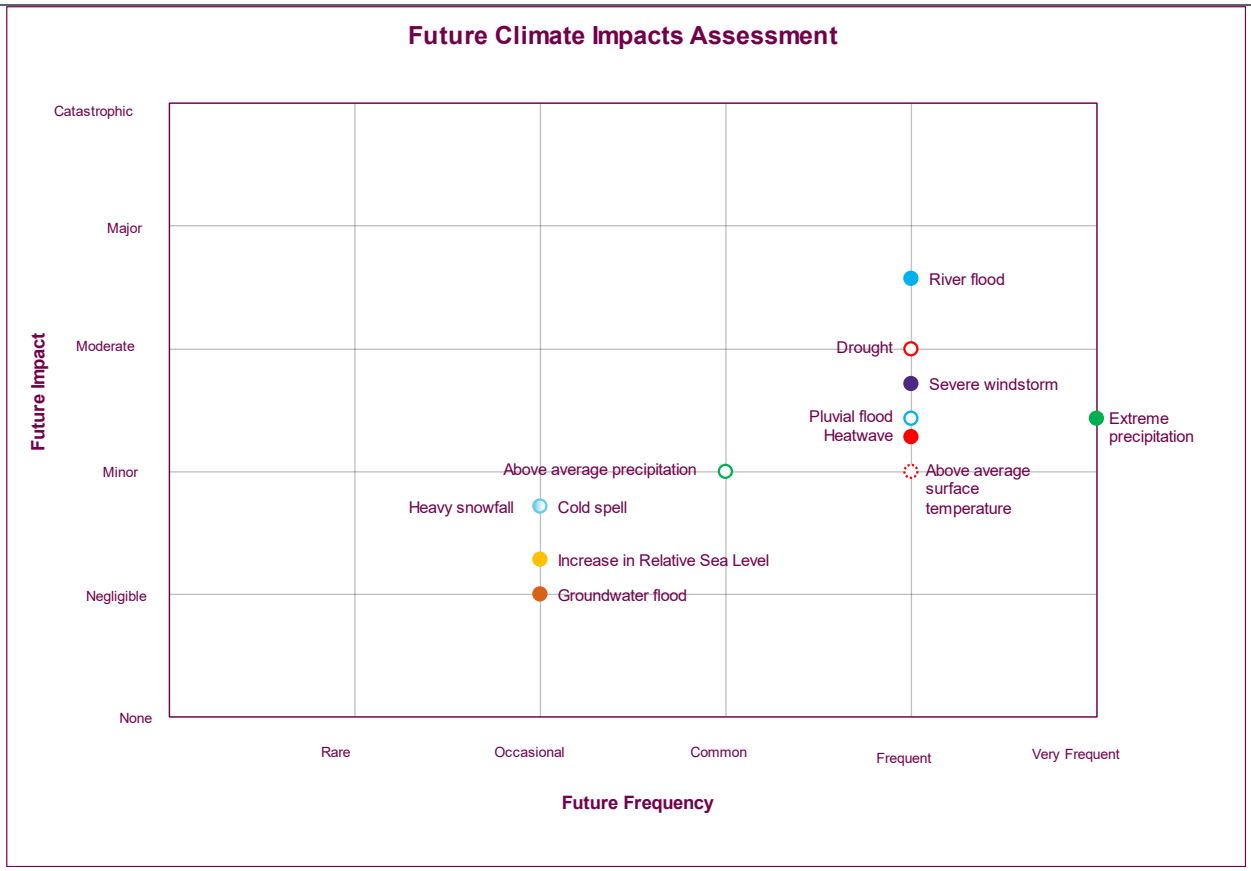


Figure 7-1: Future Climate Impacts Assessment Chart of County Kilkenny

8 SUMMARY AND CONCLUSION

This CCRA Report summarises the steps undertaken to assess the climate change risks within Kilkenny County Council. The more detailed tabular risk assessment outputs are included in the Appendices.

A CCRA is integral to informing the preparation of the Local Authority Climate Action Plan by identifying and prioritising current and future risks. It assists in the identification of possible adaptation responses to reduce or remove climate change risks within the Local Authority. Accordingly, the climate change risk assessment sits as part of the evidence base to support the local authority climate action plan.

As a Tier 1 qualitative study, this is a first-pass risk assessment to develop a quick and broad understanding of climate change risk. It is intended to provide the means to identify:

- a need for strategic and ongoing responses/commitments,
- key localities for attention and
- to build awareness of risk among community and senior management.

As it is a high-level screening, it is therefore not suitable for making any final decisions on adaptation actions but should be used to inform the general actions required.

Key Climate Hazards identified for County Kilkenny:

River Flooding

Extreme Precipitation

Drought

Throughout this CCRA, the publicly accessible national level research, local level environmental and engineering research and reports, the workshop held with the input from Kilkenny County Council Service Areas, and the developed climate history formed the evidentiary basis for assessment.

Future projections of climate change indicate that Cold spell, heavy snowfall, groundwater flood, above average precipitation and increase in relative sea level remain relatively consistent with existing conditions. However, risk is predicted to increase for all other identified climate hazards particularly for drought and severe windstorm, while River Flooding remaining the perceived highest risk to County Kilkenny.

8.1 Recommendations

- To support the effective implementation and management of adaptation action, there is a need to transition from qualitative to semi-quantitative to quantitative approaches to risk assessment, with each step providing greater level of information on which to base adaptation decisions.
- It was noted during the workshop that most costs due to the resultant impacts of climate hazards are not typically budgeted for and it would be very helpful to provide a separate operational cost code for emergency or repair works due to certain events be provided to each service. This will allow the true cost of storm events and climate events to be calculated and facilitate future contingencies in budgets and climate adaptation funding etc. Currently, a “Severe Weather” job code is used in Kilkenny County Council for event in 1994, 2104, 2016, 2017, and 2018. If explored and developed further, it may prove to be a useful tool for the Finance Dept. to capture the costs of the different hazard types and climate events, as well as provide a record of events.
- Within the data gathering phase it was noted that Local Authorities do not maintain a consistent or detailed approach to recording climate related observations and records in an indexed or easily accessible method. It would be recommended that all Service Areas within the KCC adopt a consistent approach to recording service disruptions, mitigation and recovery measures implemented, and associated costs for any areas within their remit, and that Kilkenny County Council produce an annual summary report documenting all climate hazard impacts across all Service Areas as part of Kilkenny County Council’s Risk Management Planning.
- Review the Climate Risk Assessment, at appropriate intervals, to allow for updates in datasets and impacts to be added, and to inform actions in the Local Authority Climate Action Plan.
- To support planning for climate hazards, there is a need to ensure that all relevant baseline datasets are identified and collated by Kilkenny County Council. This includes, but is not limited to, the following: (i) Pluvial Flood - Review current Drainage Maps for urban areas and identify areas for further assessments or updates; (ii) Groundwater Flood - Identify and map vulnerable areas at risk to Groundwater Flood and put in place monitoring measures.

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Appendix A Risk Assessment Tiers

	First-pass risk assessment	Second-pass risk assessment	Third-pass risk assessment
Objective	Develop a quick high-level understanding of climate change risk to determine whether or not further research or adaptation planning is required at this time	Conduct a risk assessment (generally involving expert judgement) to identify specific risks that may become problematic under future climate change	Understand the vulnerability of different systems exposed to climate change-related hazards using more detailed and finer scale data; conduct a detailed risk assessment (quantitative or qualitative) to identify specific risks of different systems
Time and resource requirement	Minimum	Moderate	High
Data requirement	Nationally available datasets, which may be in published sources (e.g. summary regional projections and/or visualisations of climate and sea level variables). Available localised mapping and information. Data should be available at no cost	Nationally available climate change datasets, both observed and projected (e.g. from national meteorological centres), together with existing information available from government (e.g. local municipality) studies and/or expert knowledge. Data should be available at no or low cost	Some site-specific data (depending on the objective of the assessment and may not be necessary every time), e.g. lidar (light detection and ranging) data, in conjunction with high-resolution (daily, spatially explicit) climate scenario data and local expert knowledge to understand the exact scale of the risk. A substantial cost may be involved
Base knowledge requirement	• Minimum expertise required to acquire data • Local knowledge required to interpret data • Some understanding of climate change and its potential risks (readily available in many decision support tools such as Climate Ireland)	• Moderate knowledge required to acquire appropriate data • Moderate expertise required to interpret data • Moderate expertise required to understand the consequences of a specific climate risk	• High level of expertise required to acquire site-specific data (may not be necessary for all assessments) • High level of expertise required to apply data and analyse and interpret results • High level of expertise required to understand how a given climate risk can translate into a number of consequences for business
When should it be used?	• To develop a quick and broad understanding of climate change risk • To identify a need for strategic and ongoing responses/ commitments • To identify key localities for attention • To build awareness of risk among community and senior management • To seek a social and organisational licence to act on adaptation	• To develop a more detailed understanding of climate change risk and opportunities for a community or organisation • To identify key risk localities with follow-up resourcing requirements (e.g. new data, new study) • To get buy-in from community or senior management for developing an adaptation strategy or plan • To produce targeted climate risk communication materials • To identify adaptation options and support development of a plan or strategy	• To produce detailed impact studies of climate change effects on specific installations and activities, with a full understanding of the probabilities and uncertainties involved • To estimate the costs of adaptation action and prioritise resource allocation • To confirm emergency response procedures/requirements • To develop strategic and economic evaluations of adaptation options • To develop adaptation action plans for specific issues, including supporting detailed design
Limitations	Based on high-level screening and therefore not suitable for making any final decisions on adaptation actions	Based primarily on qualitative expert judgement of risk and therefore the results are as good as the qualitative judgement of the experts	Resource and time intensive, therefore requires expert input

Source: National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action (EPA, 2020)

Appendix B Workshop Notes

Notes

Innishmore, Ballincollig
Co. Cork P31 KR68
T +353 21 466 5900

Reference:	IE000586A
Workshop Name:	CCRA Workshop Notes - Kilkenny County Council
Workshop date:	22 November 2022
Workshop location:	River Court Hotel, Kilkenny

Attendees

Name	Initials	Sector/Service
Denis Malone	DM	Environment
Anne Marie Shortall	AS	Environment
Dearbhala Ledwidge	DL	Environment
Nicolaas Louw	NL	Planning
Francis Coady	FC	Conservation
Frank Stafford	FS	Parks & Special Projects
Aileen McGrath	AMG	Head of Enterprise
Anne Marie Walsh	AMW	Corporate Services
Brendan Sheehan	BS	MDC City
Seamus Kavanagh	SK	Water Services
Declan Murphy	DM	NDC Callan/Town
Caitroina Corr	CC	Active Travel
Noelle Brett	NB	Finance
Kevin Hanley	KH	IT
Annette Fitzpatrick	AF	Community & Culture
Micheal Murphy	MM	Housing
Mary Butler	MB	Arts
Ray Regan	RR	Fire Services
Michelle Colclough	MC	Civil Defence
Tim Cooke	TC	RPS

Notes

Name	Initials	Sector/Service
James Peters	JP	RPS
Aidan Ware	AW	RPS

Climate Event History:

A discussion of the climate event history and the workshop attendee's recollection of significant effects and there impacts on services was used to kick off the workshop. The climate history was developed from the existing Climate Change Adaption Strategy covering events up to 2019 and additional events between 2019 and present day populated by members of the Climate Action Group prior to the workshop. The below notes outline the relevant climate events and impacts on services discussed during this period of the workshop:

- Heavy Rainfall during the Christmas Period of 2015/16 resulted ins significant flooding.
- There is a vulnerability of towns and cities along rivers to flooding due to rivers bursting their banks and it has a significant impact on commerce and trade as they have to shut for sometimes long periods of time dure to flood damage incurred.
- Services during prolonged periods of bad weather and storm events become really stretched and come under significant pressure.
    - In prolonged cold spells there are no relief crews for those out salting roads and clearing roads, so it is the same crews being relied on to work long hours in hazardous conditions over long periods and burnout is a real concern.
    - The civil defence also experience the same issues and are reliant on volunteers.
    - It was noted that during the snow in 2010 there was a significant instance of staff burn out due to working 12hr days back-to-back over a long period of time.
- During prolonged snow events and cold spells in the past the supply of food and supplies to people who were cut off sue to road conditions was a significant draw on the council and had to rely on the cooperation of the army to ensure people got food and supplies as needed as they could not travel themselves.
- There are 3,400km of road network in the county with a capacity to salt and pre-treat only 12%
- so main arteries are clear which results in more rural and isolated areas becoming cut off during cold spells and snow falls. During these events the council are heavily reliant on the Civil Defence for getting out to theses isolated areas as well as sub-contractors to go out and clear roads.
- The point was raised that the warming climate is resulting in the changes in growing seasons and plant blooming before pollinators are active which can have a detrimental impact on biodiversity and food production. This is a particular issue in relation to migrating pollinators. In general, the changing of the growing season and climate change in general is impacting on delicate eco-systems and the interaction between flora & fauna.
- More frequent and intense rainfall events are impacting on SS in water bodies which is having a detrimental effect on the survival of some aquatic animal species.
- There are a number of rural water supply schemes in operation across the county and these are very vulnerable to the impacts of climate change in particularly local water supplies coming under increased pressures and drying up in some cases as well as contamination of same due to increased rainfall, drought flooding etc.
- Uncertainty in responsibility now that Irish Water are in charge of water distribution.

Effects on Services:

For the second stage of the workshop TC invited each attendee to discuss what they saw as the biggest impacts on their service due to climate change and were asked to identify the hazards impacts, exposures and vulnerabilities.

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Climate Action Group:

- The changes being experienced in Irelands climate is beginning to favour invasive species, both flora and fauna, and as a result are outcompeting native species at a quicker rate. It is not 100% know what exact changes are facilitating this (ongoing research) but it is thought that the primary driver is the increasing temperatures and changes to the growing season.
- The increased frequency of flooding events and more intense rainfall is also aiding in the spread of invasive species seeds and spores aiding them in spreading to new areas. An example was provided were and invasive species is outcompeting native plants on river banks that are critical to bank stability , the invasive species shade the native species and as a result the die off and the river bank becomes unstable and erosion of the river bank is increased.

Civil Defence:

- Weather events are becoming more and more extreme and as a result the hazards to personnel safety are increasing and mobilising crews is putting people in more risk than what would have been see in the past and a more frequent basis.
- The civil defence relies upon volunteers, and it is a small pool of people to draw on during emergency events in particular those over a prolonged period of time. The Civil Defence has a wide range of responsibilities during emergency events and can be called upon by the council do aid the community in any way possible.
- Search & Rescue is a primary role of the Civil Defence and the more extreme weather conditions being experienced can make routine search and rescue operation extremely difficult and nearly impossible in some cases.
- The changing climate and increased frequency and severity of weather events has made the civil defence vulnerable in a number of areas:
    - Their equipment cannot perform as well in extreme weather conditions one example given is their older ribbed boats cannot cope with the higher flows and debris in water and can become damaged easily and as such have to switch to ridged hull boats.
    - The accessibility to launch areas can be difficult, it can be difficult just to get to the equipment to respond to calls.
    - They Work on the TETRA system so have increased resilience form a communications point of view.
    - Accessibility to launch points for boats and launching in more severe weather conditions increases risk to personnel and equipment.
- Varying frequency of call outs over the years and called out for a very wide variety of things, including swans pulling down power lines.

Fire & Rescue:

- It was raised that they are completely dependent o the ESB powers supply and there are no back-up generators in place in any of their stations. There alert/call out system has 24-48hrs battery backup, but long-term power outages could cause significant issues. With increasing instances of power outages due to weather events and subsequent damage to the supply network back-up generation needs to be explored.
- They have recently started to switch to more batter powered equipment which in the case of power outages and no reliable source to charge can be a vulnerability.
- More frequent weather events are increasing the call outs during these periods to non-life-threatening emergencies and putting increased pressures on the emergency services base load. In addition, response time is increased due to poor weather conditions and road conditions etc.
- It was noted that as part of the firefighters contract they must live within a certain vicinity to their station so that in case of emergency they will be able to get to the station ASAP and should not be impacted by poor road conditions as much as if they were living farther away.
- When queried about the availability of water during extreme weather events that may affect water networks it was stated that they will find a source and draw water form wherever it is available, and they

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are used to working in isolated areas without mains supply and can draw from local water bodies or any source they can find.

Community Planning:

- Recreational amenities are prone to flooding events of all types and can be damaged and closed for long periods of times. Flood risk is the main concern to public amenities and services.
- The frequency of weather events increasing, and their severity is causing more widespread fear and anxiety in the wider community of the potential impacts of the flooding and how they will be affected, this can be particularly applicable to the older population who may live alone or are heavily reliant on services for food and fuel deliveries, community services etc.
- The progress of re-generation projects ahs been impacted by the impacts of climate change, projects need to be planned with future climate change in mind which can limit the available space or the viability of projects etc. There is more apprehension in funding these projects due to potential unknown future climate risks.
- There is a lot of uncertainty as to what can be done based on the reliance of other major infrastructure works being completed such as flood defences, storm network upgrades, road infrastructure etc. which is being impacted by the same issues as above. As such there is a new restriction to on development and regeneration that is directly due to climate change and the impacts that are being observed and the predicted future impacts.
- TC queried as to the provision of green spaces and areas of shade etc for the community and the council representative felt like this was not an issue in Kilkenny and that sufficient areas are provided.
- While Kilkenny is not a coastal county it still experiences increased pressure on it bathing areas (primarily rivers) during hot weather and this results in increased demand on services within the area as noted by Wexford & Waterford Councils.

Environmental Monitoring and Enforcement:

- The major impact in this sector is the ability of staff to get to work and actually be able to go out to site to carry out inspections and compliance monitoring etc.
- They would typically see increased complaints and demand on inspectors during periods of low river levels due to extended dry periods or drought etc. with the main complaint being odour issues.
- Conducting regulatory inspections can be impacted during weather events and can delay them being carried out. Even if the inspector can get to site there can be increased hazards on the site that can impact on H&S.
- A big issue during flooding events is the mixing of flood/storm water with foul water, particularly and issue in combined systems, this can have significant impacts on health and wellbeing of people as well as environmental impacts. With the increases incidences of extreme rainfall events this has become more common.
- During the cold spell of 2009/10 where there was a shortage of road salt nation wide there was instances of fertiliser being used as a substitute to treat rural roads by locals. This had a significant impact on the surrounding environment as the run-off from the roads had very high nutrient levels which severely impacted water quality in these areas. The impact was seen at potable water abstractions and treatment facilities.
- Prolonged treatment of roads during cold spells can have a similar impact by increasing the salinity of water bodies as well as soil.

Parks & Special Projects:

- The impact of weather events on Woodstock Gardens and the damage to the forest and gardens were of main concern to the representative form Parks. There are a number of Champion trees in the forest that if damaged are irreplaceable and will never see the likes of them again and they are becoming increasingly vulnerable due to stronger windstorms.
- Storm winds have a particular impact on the tree stock and can have an impact on the availability of the amenity for use, has had to close in the past due to high winds and tree falls for public safety.

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- There are a number of walking trails through the woods and gardens which are populated with warning signs once there is a yellow weather warning, the increased frequency of these is impacting on the number of days it is open in a year and it is a significant tourism attraction for the county.
- There are approximately 55,000 visitors to Woodstock Gardens a year so increased closures is affecting tourism and revenue.
- Amenities in low lying areas are particularly susceptible to flooding and result in closures quite often.
- There has been a noted increase in calls form the public who are concerned about large trees bordering properties and looking for them to be removed for fear of them falling during storm events. This increases public pressures on the parks service to go out and cut down trees that would otherwise not be removed.
- Sustained rainfall and wet periods make it particularly difficult to maintain amenities and there is increased costs with trying to bring it back to its original condition as ongoing maintenance and up keep is impacted by weather.
- It was noted that playgrounds are impacted by weather events in particularly those in low lying areas susceptible to flooding resulting in closures and costs to repair and clean up.
- It was noted that there can be an increase in footfall to some of the walking trails and forests during or after snowfall events as they can be particularly pretty during these events, however this can cause issues with people travelling and walking in poor conditions/ getting lost and needing assistance from services.
- The fire service jumped back in at this point raising further concerns:
    - Raised risk of fires in forested areas due to longer dry spells and hotter weather exacerbated by the increased use of the areas for camping and lighting of fires and BBQ's etc.
    - It was noted that farmers carrying out burn off is becoming a greater issue nationally and resulting in a greater number of fires in recent years due to them losing control.
    - Up until not the fire lines in the forest across the county are serving their purpose but may need to be looked at going forward due to increased risk of forest fires.
    - There is a growing concern that forest fires will become more frequent, and these could impact on more rural housing located in and around forested areas, the fact that forestry activity is on the rise also adds to this concern.

Roads (3,400km of road network in the county):

- A general statement from the roads department was that they impact from weather events and climate change in the larger scale of things are typically minor in nature (short term impacts more than minor in terms of cost and manpower needed etc.) and can be dealt with relatively quickly with long term impacts on infrastructure being limited.
- As was seen across all other counties flooding was a big concern for the road department. There is a climate adaptation fund of almost €2 million per year made available to the roads department and this is used up very quickly.
- Windstorms are not of a great concern, typically will only result in downed trees and debris that can be cleared quite quickly, or roads closed, and diversions put in place. Typically, won't cause significant damage to infrastructure.
- Staff burnout was raised again, and prolonged events are particularly intense for roads crews and support staff in the offices to deal with calls and clearing/treating roads, carrying out emergency repairs etc. External help was required from the IFA during the Beast from the East.
- It was noted that there are 6 flood schemes in development within the county and that the roads infrastructure needs to be designed to take account for this and for predicted climate impacts to ensure that reliance is designed into the infrastructure going forward.
- The New Ross bridge (as noted by Wexford CC) needs to be closed during high winds with traffic diverted.

Notes

- The incidence of isolated flooding is increasing, the council are seeing flooding in areas where it was never seen before.
- Road slippage has been occurring more in recent years this causes significant damage to roads causing long term closures and diversions of sections of roads, attributed to both prolonged wetter periods being experienced and intensive rainfall events that cause wash out of roads due to de stabilising the sub-base. Roads submerged for long periods of time during flood events are also very suspectable to this.
- More frequent and more intense weather events are impacting on annual maintenance programme due to diversion of resources during the events and carrying out emergency repair works etc. It was also mentioned that there is more money available due to climate adaptation funds etc but not enough time to get things done quick enough as there are no additional resources available.
- An observation was made that the roads have only had to treat the road network for freezing once so far this year and it is almost December which is highly irregular.
- In October of this year alone there was multiple flooding events experienced and they are becoming more localised and at an increasing frequency. During these vents all resources need to be mobilised and draws resources from day-today work. The localised nature of these flooding events means there is little warning (may not have a weather waring in place for Met Eireann) as its localised conditions and this can increase the impacts and damage that the flooding causes.
- Intense rainfall events cause significant issues for storm networks (surcharging MH's gullies etc) as they are just not designed for the rainfall that we are experience now, the more development that is taking place the more this issue is increasing.
- There is reliance on storm pumps in several areas, have a number of mobile pumps on stand-by in case these go down but still a vulnerability.
- Some drainage networks are reaching capacity and can't have an increase in intakes.
- It was noted as in other Counties the effects of high temperatures altering the road integrity.

I.T.:

- They are the primary route of communications to the public and push any messages out on all media platforms they are also the support network for all services which is critical during emergency events.
- Power supply is the biggest vulnerability, there is limited back up power generation available. It was noted the city hall does have a back-up generator.
- High winds can cause damage to masts and ariels which transmit signals across to and from area offices and telemetry. Getting crews out to repair these in high winds in more or less impossible due to the H&S of working at heights in high winds.
- As was noted in Wexford if the mobile phone network goes down then communications is significantly impacted and can exacerbate any problems being experienced by the services.
- Winter of 2009/10 proved difficult time for getting access to fix communications.

Housing:

- There are approx. 2,800 LA houses under the remit of the council. Only a small percentage of these are impacted by flooding but they can be one off properties that the solution to the problem can be extremely difficult to come up with bar moving the tenants.
- Personnel having to be sent out to respond to emergencies at LA properties is an ever increasing concern and the call outs are becoming more frequent and having to ask a people to go out in conditions that may put them at risk is a significant responsibility.
- There is increased incidences of flooding occurring in areas where it was never seen before, an example of a house that was flooded twice in the last few weeks due to heavy rain and run-off from adjacent land was given, a property that had never flooded before. It was notes that there was forestry activity in the area and this may have increased the surface run off and created new flow path that directed significant water to the property.
- A good point was raised that typically the FRA's and flood management plans done for forestry is based on their initial planning submission and by the time they come to harvest the forest these may be

decades out of date and not fit for purpose or may not take account of new development which puts the surrounding areas at significant risk.

- The increased use of heating systems that rely on electricity (particularly air to water) puts houses at increased risk due to power outages. These systems can take days to re-heat the home and although the electricity outage may be short term the effect on re-heating a home can be significant, this is exacerbated by the policy to only have a single source of heating within properties (removal of fires & stoves etc). It was also noted that sometimes these systems to not reset automatically after a power outage so it may be days before someone can get out and reset the system.
    - Double edged sword, move to a more renewable heating system causes a vulnerability to households to power outages as only single heat source and no back up.
- Power supply to WTP & WWTP is a vulnerability if power goes down there is limited treatment available if no back-up power generation in place.
- Burst pipes has been an issue in the past with lower temperatures impacting on water supply to properties as well as flooding of properties.
- The tenant profile of the LA houses is typically older, and this is going to grow moving into the future with predicted population trends as such any impacts on houses is exacerbated by older tenants who may need additional assistance.
- Getting insurance going forward is seen as a potential issue due to new areas flooding, once they flood once it can be very difficult to get cover form insurance companies for flooding which is a significant risk.
- There is two designated halting sites in the county but it was noted that the majority of tenants on these sites are housed reducing the vulnerability of the travelling community.

Planning:

- From an operational perspective the hazard events tend not to impact the planning department.
- The major impacts of climate change on this department is the actual planning of projects and the consideration of applications to ensure that planned development is taking account of the impact of climate change.
- There is an increasing demand for detailed FRA's for planning applications and demonstrating the consideration for climate change and its associated impacts and providing resilience for proposed developments.
- There is debate for granting planning if the property is safe from flooding but access is affected.
- Based on population trends being seen there is a steady growth with an ageing profile being observed following the national trend.
- There is a steady growth in the demand of more rural housing in the county. Larger rural growth would increaser road usage between rural and urban areas, increasing the travel times due to congestion.

Arts:

- A main driver in supporting the arts is promoting more sustainable practices in the arts and how powerful the arts can be in helping communicate issues and change opinions of people etc.
- They have a big role in educating artists in how they can help through their different art forms.
- Climate hazards have an impact on LA funded events in particular rainfall and flooding, festivals can be rained off and cancelled in short notice and there is a potential for this to increase in the future due to more frequent rainfall events etc.
- There is a significant amount of non-art areas used for the arts and a large amount of events are outdoor making them vulnerable to weather. Yule festival is one of the largest festivals in the county and is outdoor and during the winter months.
- Festivals have an effect on mental health/ morale (socioeconomic vulnerability). Difficult to quantify/ hard to provide rationale for resourcing.

Finance:

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- Function of the people being able to physically get into work and do their work. Resilin ace to this has been built up since COVID.
- However, it was noted that there is a vulnerability to power outages.
- Reduced vulnerability if offices are shut down due to ability to work from home

MDC City:

- Largest impact seen is just on general operation and the draw of resources for clean up operations.
- Communities are completely reliant on the mobile phone network for communications, if this is down it can be very difficult to communicate messages to the wider public.
- It was noted that the very nature of active travel it will become increasingly more vulnerable to the impacts and hazards of climate change as the users are directly exposed to the elements.
- Complaints of the state of the cycling infrastructure post events – not a priority.

Heritage:

- There are a large number of protected bridges that are becoming more vulnerable to damage due to increased flows in rivers, additional debris in flows path, increased flooding incidences etc. putting the structural integrity of these structures at risk.
- Flooding is a significant issue on historic towns as they were located on rivers and in low lying areas and as such have an innate vulnerability and more needs to be done to protect architectural heritage.
- Wind damage to roofs, chimney stacks on older historic structures can lead to water ingression to structures and significant damage causing loss of historic fabric. The structures are typically older and more susceptible to damage than would be seen for more modern construction methods. Tiles / slate from roofs being blown off pose a risk to public.
- The increase in warmer and wetter weather is having an impact on built heritage, it is causing increased growth of mould and different types of mould and insects that are that are difficult to treat for and can cause considerable damage to heritage structures.
- The growth of vegetation on older structures in particularly ruins increases their vulnerability to damage form high winds and they can have a sail effect. In addition, the ingress of root structures can comprise the structural stability of building and structures. Ruins in historical graveyards are noted as being particularly at risk.
- There have been incidences of landslides exposing historic burial grounds, human remains being exposed. There is 200+ historic graveyards in the county.

Corporate Services/HR:

- Increased need for better communication and press releases to inform public of the impacts of climate change and the hazards its I posing to the community.
- It was noted that supporting services and departments has been made a lot easier since COVID with more people familiar with remote working and communication through zoom/teams and limiting the need for everyone to be in one room.
- There has been an observation that the demands on the council and the services they provide on a whole are ever increasing and they are being called upon on a much more frequent basis.
- There is a decrease in self sufficiency within the wider community and a much greater reliance on the council, what people and communities used to do themselves in the past is increasingly becoming someone else's problem and ultimately landing on the council's door. This over reliance on the council is a vulnerability to the community as it puts huge demand on services.
- There is a duty of care to the employees – can't always provide for the public if employee health is at risk.

Economic Development & Tourism:

Notes

- All impacts identified by other sectors and issues they are facing, and they need to be dealt with are critical to ensure that Kilkenny is an attractive place for businesses to come to as well as tourism to continue to thrive.
- When trading of businesses is impacted by weather events such as flooding it can have effect on the revenue generated by council rates as emergency repairs can eat into these.
- Tourism within the county is heavily dependent on foreign tourism and change in travel patterns may affect this going into the future. The move to more sustainable travel methods may decrease the number of tourists flying into the country and have a direct impact on tourism.
- Domestic tourism usually flock to the coastal areas and Kilkenny is heavily reliant on international tourists.

Levels of Impact Across Risk Areas:

The frequency and impact of hazard events on each of the risk areas were discussed and scored by the group. This was tracked by JP on the relevant spreadsheet.

Appendix C Hazard Events Record

Hazard Events Record - County Kilkenny				Hazard Type											
Year	Date	Event	Summary	River flood	Pluvial flood	Extreme precipitation	Severe windstorm	Heavy snowfall	Heatwave	Drought	Above average	Above average	Cold spell	Increase in Relative	Groundwater Flood
2022	Oct-Nov	Period of Severe Rain, Weather and Thunderstorm Warnings	Flooding in Callan. Flooding in Freshford (27th and 28th Oct)		■	■									
2022	August	Prolonged Dry period	Fire Danger Notices issued by Dept Agriculture. 2022 was the warmest year on records in Kilkenny.							■					
2022	July	Heatwave	Prolonged extreme heat of 25-30°C. Extreme and prolonged temperatures, fire safety warnings issued by Fire Department and Department of Agriculture						■		■				
2022	March	Flood warning	Met Eireann National Orange flood Warning.			■									
2022	18-Feb	Storm Eunice	The mean Wind speed reached in the range of 65-80 km/hr with severe or damaging gusts up to 130 km/hr. Trees felled by the storm across the county.				■								
2022	15-Feb	Storm Dudley	Status orange Wind warning				■								
2021	7th December	Storm Barra	Fallen trees & power outages; Lacken Boardwalk closed due to fallen trees			■	■								
2020	August	Storm Francis and Storm Ellen	A Status Yellow wind warning was in place for Carlow, Kilkenny, Wexford and Wicklow. Southwest winds to reach mean speeds of 55 to 65km/h, with widespread gusts of 90 to 110km/h as Storm Francis crosses Ireland. Up to 200,000 homes left without power mainly in Cork, Waterford and Tipperary. Strong winds brought down trees and power lines. Severe localised flooding due to heavy rainfall. Trees felled by the storm across the county		■	■	■								
2020	Summer	Heatwave & prolonged Dry period	Hosepipe ban issued							■	■				
2019	3rd-4th October	Storm Lorenzo	MET Eireann issued yellow warning. The yellow weather alert was for rain and winds of speed 50 to 60 km/hr and was in place from 9am Thursday 3rd October to 6am Friday 4th October. There were branches, debris and surface water on the roads.				■								
2018	May – August	Extreme Temperatures	Warmest Kilkenny summer since 1975. Kilkenny experienced 58 days with temperatures above 20°C between May-July. Peak temperature of 30.3°C. Restrictions were put in place to conserve water, e.g., hose pipe bans.						■	■	■				
2018	February/ March	Storm Emma/ Beast from the East	Status Yellow weather warning for Kilkenny. Snow and Extreme cold. Low temperatures of -5.5°C recorded, coldest March in Kilkenny since 2010. Kilkenny County Council undertook almost double the number of salting runs during 2017-2018, largely due to the extreme cold during Storm Emma.				■	■					■		
2017	October	Storm Ophelia	Gusts of 111km/h recorded. Status Red weather warning for Kilkenny, schools closed throughout the county. Fire crews had to be brought into stations prior to the event. All 7 no Fire Brigades were called out to unblock the roads and removal of trees.				■								
2015/ 2016	Winter	Groundwater flooding	Most areas across Ireland experinced the largest groundwater flood event on record. Karst areas are extremely vulnerable to groundwater flooding. Areas that are exposed to this are Loughmacask, Ballykeoghan, Killonerry, Whitechurch, Fanningstown, Clogga, Arderra, Molum, Baungarrif, and Northwest Kilkenny, east of Urlingford. Property at Fanningstown qualified for OPW									■			■

Hazard Events Record - County Kilkenny				Hazard Type											
Year	Date	Event	Summary	River flood	Pluvial flood	Extreme precipitation	Severe windstorm	Heavy snowfall	Heatwave	Drought	Above average	Above average	Cold spell	Increase in Relative	Groundwater Flood
			Voluntary Homeowners Relocation Scheme due to flooding during this period.									■			■
2015/ 2016	December – February	Storm Frank	Severe flooding in towns and villages in Kilkenny with Graiguenamanagh one of the worst affected. Rainfall of 60.0mm recorded. Extreme flooding caused significant damage to Thomastown library during this period necessitating the closure of the library for 7 weeks with damage of circa 40,000 to the internal spaces within the building including damage to stock and ICT equipment. Local Authority Flood Response Plan Activated at 8:30 AM on 30 December 2015. The property which were impacted includes: Kilkenny City (6 properties in Robertshill); Graiguenamanagh (40+); Thomastown (30+); Inistioge (17); Freshford (6); Callan (2); Castlecomer (1 in Moneenroe). One off properties in the South of the County • Kilcooley Tipperary • Ardaloo – Severe Flooding but properties not flooded • Bleach Road – Severe Flooding but properties not flooded • Burnchurch – House Flooded, sandbags delivered Rescues/Evacuations: • Graiguenamanagh (8 persons rescued by the Fire Service) ; Thomastown (9 Persons rescued by the Fire Service): Inistioge (15 Persons rescued by the Civil Defence by boat); Mullinavat (3 persons rescued by Fire Service from a car); St Mullins (1 person rescued by boat). Total=36 • Accommodation provided to three (3) people displaced.	■	■	■	■							■	
2014	14th February	Storm Darwin	Gusts of 126km/h recorded. Status Orange/Yellow warning for Kilkenny. Trees fallen along with structural damage to buildings. All 7 no Fire Brigades were called out to unblock the roads and remove the trees. €329,000 received from Dept for storm damage			■	■								
2013/ 2014	Winter	Winter storms	Rainfall values above long-term average were recorded at nearby Met Eireann Oak Park Weather Station (Co. Carlow) (i.e. 208%), and also from "Kilkenny Weather" (e.g. 270% in Feb 2014)			■						■			
2013	Summer	High temperatures and Drought	High temperatures accompanied with drought conditions were experienced in Kilkenny with major impacts to agriculture, costing "€60 per cow".						■	■	■				
2009/ 2010	Winter	Winter Storms	Second lowest temp in the country recorded in Kilkenny at -16.4°C. Coldest winter on record since 1962/1963. Extreme Snow, Ice and low temperatures (Dec 2009 and Jan 2010).					■					■		
2009	November	Heavy rainfall	Above average rainfall was recorded in Kilkenny and across Ireland resulting in severe flooding.	■	■	■	■								
2008	August	Heavy Rain	High rainfall throughout Kilkenny. Precipitation level highs of 42mm experienced in one day. Roads blocked due to flooding throughout the county.	■	■	■									
2006	Nov/Dec	Heavy Rain	Highest daily rainfall for November in Kilkenny on record. Correspondence with Minister to request funding to deal with damage to roads from severe weather in Nov & Dec.			■									
2006	Summer	Heat wave	Warmest summer on record since 1995 in Kilkenny. Average July temperature of 23°C in Kilkenny.						■		■				
2002	November	Heavy Flooding	Severe flooding in towns throughout Kilkenny due to heavy rainfall in the days preceding the event.	■	■	■									
2000	November	Severe Flooding	Heavy flooding experienced, particularly in South Kilkenny causing mudslides. Precipitation levels of 80.1mm recorded in one day.	■	■	■									
1997	December	Windstorm	Gusts of 87km/h recorded in Kilkenny, highest wind speeds in 40 years for the county.				■								
1997	November	Extensive Flooding	Heavy rainfall caused countywide flooding which claimed the life of a woman outside Freshford.	■	■	■									

Hazard Events Record - County Kilkenny				Hazard Type											
Year	Date	Event	Summary	River flood	Pluvial flood	Extreme precipitation	Severe windstorm	Heavy snowfall	Heatwave	Drought	Above average	Above average	Cold spell	Increase in Relative	Groundwater Flood
1996	January	Severe flooding and Heavy Rainfall	Kilkenny, Callan, Thomastown and Inistioge endured floods on 6th January 1996 following heavy rainfall. Rivers burst their banks. Some areas were under a metre of water.	■		■									
1995	Summer	Extreme Temperatures	Warmest summer on record with temperatures of greater than 25°C experienced for 27 days. Highest temp of the summer recorded in Kilkenny at 30.8°C.						■		■				
1995	January	Severe flooding and Heavy Rainfall	Ballyragget, Kilkenny, Callan and Thomastown experienced flooding due to heavy rain, causing river banks to burst. At least 68 porperties were flooded. Kilkenny suffered an estimated £28,000, although this is underestimated.	■		■									
1991	January	Windstorm	High winds of 118km/h recorded in Kilkenny				■								
1990	February	Severe flooding and Heavy Rainfall	Fooding occurred in Ballyragget, Freshford, Kilkenny, and Callan due burst banks from heavy rainfall. Cars werer stranded, tractors were used to ferry people through flooded areas.	■		■									
1987	January	Heavy Snowfall	Snow depths of 100mm noted in Kilkenny. The county experienced 11 days without sunshine					■							
1986	August	Severe flooding and Heavy Rainfall	A flood event occurred in Ballyragget, Freshford, Kilkenny and Callan on 25th August 1986 due to heavy rainfall. Many houses were inundated and depths of up to 0.3m were experienced.	■		■									
1960	December	Severe flooding and Heavy Rainfall	Flooding occurred in Kilkenny, Callan, Thomastown and Inistioge due to heavy rainfall and snowmelt. Houses in low lying regions were flooded. Event probability was estimated as a 10% AEP.	■		■									
1954	October	Severe flooding and Heavy Rainfall	a flood event occurred in Kilkenny, Callan and Thomastown on 29th October caused by heavy rainfall. Water levels reached up to 400mm and the estimated AEP was 10%.	■		■									
1947	March	Severe flooding and Heavy Rainfall	Freshford, Kilkenny, Callan, Thomastown and Inistioge suffered flooding due to heacy rainfall, leading to the bursting of river banks. The estimated AEP of 0.5% lead to one of the worst floods in Kilkenny. Around 350 houses and 40 shops were affected by the flooding, with some houses rendered temporarily unfit for habitation and some were permanently unfit. Flood water levels reached up to 2m in some areas.	■		■									
1926	January	Severe flooding and Heavy Rainfall	Kilkenny and Thomastown suffered heavy rainfall, leading to river banks bursting and causing severe flooding. Estimated AEP of 2%. Peak flood levels of 44.99mOD (Malin) in Kilkenny and a corresponding flow of 359m^3/s.	■		■									

Sources:

- Met Eireann records.
- Minutes of Kilkenny County Council meetings.
- www.kilkennyweather.com
- Kilkenny County Council Climate Action Steering Committee.
- www.floodinfo.ie

Appendix D Characterisation of Climate Hazards, Impacts, Exposures, Vulnerabilities and Assessment

Hazard Event:	**River Flood**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Rivers exceeding the capacity of their river banks. Bursting of river banks. Riverside infrastructure particulalry affected.

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		Impact Score
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	
Damage to infrastructure	Flood water affecting built environment. Can lead to closure of facilities	LA buildings	Physical	Use of material Built Heritage Fixed or manual flood defences Flooded outfalls Structural loading	Moderate	None	Negligible	None	Minor	None	Minor	None	Minor	None	Negligible	Minor	None	None	None	None	None	None	0.72
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
		Roads & Bridges	Physical	Use of material Built Heritage Structural loading	None	None	None	None	Minor	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	None	None	0.44
			Environmental	Proximity to rivers																			
			Socioeconomic	-																			
		Railway	Physical	-	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	0.33
			Environmental	Proximity to rivers																			
			Socioeconomic	-																			
		Housing	Physical	Use of material Built Heritage Fixed or manual flood defences Flooded outfalls Structural loading	None	None	None	Negligible	None	None	Minor	None	None	Moderate	Negligible	None	None	None	None	None	None	None	0.39
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
		Construction sites	Physical	Security of materials Silt netting	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
		Commerce	Physical	Storage of stock/ equipment	Negligible	None	Minor	None	None	None	Negligible	None	None	None	None	Minor	None	None	None	None	Minor	None	0.44
			Environmental	Proximity to rivers																			
			Socioeconomic	-																			
		Agricultural land	Physical	Efficiency of drainage network Flooded outfalls	None	None	Minor	None	None	Negligible	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Proximity to rivers																			
			Socioeconomic	-																			
		Drainage networks	Physical	Capacity Build up of silt	None	None	None	None	None	Minor	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	-																			
			Socioeconomic	-																			
		Land use suitability	Physical	Adequacy of drainage network	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	Moderate	None	None	None	0.22
			Environmental	Proximity to rivers																			
			Socioeconomic	-																			
		Power supply	Physical	Fixed or manual flood defences Flooded outfalls Structural loading Backup generator availability	Negligible	Negligible	Major	Negligible	Moderate	Negligible	Minor	Negligible	Negligible	Negligible	Minor	Moderate	Negligible	Negligible	Negligible	Moderate	Negligible	Moderate	1.72
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
Damage to environment	Loss of biodiversity	SAC/SPA/natural habitats	Physical	Flora sensitivity to saturation Anchorage of flora	None	None	None	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.28
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
Damage to riverside amenities	Damage to amenities on riverbanks, leading to closure for public safety	Walkways and trails	Physical	-	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Minor	None	0.39
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
Unuseable roads	Roads will become inundated with water and become inaccessable	Road network	Physical	Efficiency of drainage network Flooded outfalls	None	None	Negligible	Negligible	Moderate	None	Negligible	Negligible	None	None	None	None	Negligible	None	None	Moderate	Negligible	None	0.67
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
		Pathways/ cycle lanes	Physical	Drainage network	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	Moderate	Negligible	None	0.50
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
		General public	Physical	-	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.28
			Environmental	Road congestion																			
			Socioeconomic	Exposure to warnings/ alerts																			
		Emergency responders	Physical	-	None	None	Minor	None	Major	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.39
			Environmental	Road congestion																			
			Socioeconomic	Reliance on TII for alerts on National roads Extended workload and overtime leading to burnout and availability of monitoring staff																			

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Reduced water quality	Foreign substances entering water systems. Boil water notices issued in some cases	Water bodies	Physical	Sewage overflow inputs into water bodies Water turbidity Combined foul and surface system	None	None	Negligible	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	Major	0.56
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
		Water supply distribution	Physical	Back up generator availability	None	None	Negligible	Negligible	None	None	Minor	None	None	Negligible	Negligible	None	None	None	None	None	None	None	Major	0.56
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	Extended workload and overtime leading to burnout and availability of monitoring staff Resoonsibility (Irish Water)																			
Inundated wastewater treatment systems	Private systems located in poor drainage areas and/or flood zones become inundated	Wastewater infrastructure	Physical	Capacity and fullness of septic tanks	None	None	None	Minor	None	None	Minor	None	None	None	None	None	None	None	None	None	None	Major	0.44
			Environmental	Water table level Proximity to rivers																			
			Socioeconomic	-																			
Temporary housing	Relocation of homeless and residents of flooded properties	General public	Physical	-	None	None	None	None	None	None	Negligible	Negligible	None	Moderate	Minor	None	Negligible	None	None	None	Minor	None	0.56
			Environmental	Proximity to rivers																			
			Socioeconomic	Population age Population constitution Housing availability																			
		LA staff	Physical	-	None	None	None	None	None	None	Negligible	Negligible	None	Moderate	Minor	None	None	None	None	None	Negligible	None	0.44
			Environmental	Proximity to rivers																			
			Socioeconomic	Population age Population constitution Housing availability																			
		Homeless	Physical	-	None	None	None	None	None	None	Negligible	Negligible	None	Moderate	Minor	None	None	None	None	None	None	None	0.39
			Environmental	Proximity to rivers																			
			Socioeconomic	Population age Population constitution Housing availability																			
Health and Safety risks	Drowning/ presence of submerged hazards leading to injury or death	General public	Physical	-	None	None	Minor	None	Minor	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.44
			Environmental	Proximity to rivers																			
			Socioeconomic	Human desire to watch the event from an unsafe location Population age Population constitution Exposure to warnings/ alerts																			
		LA staff	Physical	-	None	None	Minor	None	Minor	None	Negligible	Negligible	None	None	None	None	None	Minor	None	None	Negligible	None	0.50
			Environmental	Proximity to rivers																			
			Socioeconomic	Population age Population constitution																			
		Homeless	Physical	-	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Proximity to rivers																			
			Socioeconomic	Population age Population constitution																			
Cancellation/ postponing of cultural events	Adverse weather disrupting ability to hold a cultural event	Cultural events	Physical	-	None	Moderate	Negligible	None	None	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.44
			Environmental	Proximity to rivers																			
			Socioeconomic	-																			

Hazard Event:	**Extreme Precipitation**
Frequency of Occurrence:	Frequent
Description of the Hazard Event: (including relevant meteorological / climatological conditions and locations affected)	An unusually large volume of rainfall in a short period of time. Red Warning 70mm or greater in 24 hours. Orange Warning 50-70mm in 24 hours. Yellow Warning 30-50mm in 24 hours.

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																	
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Flooding	Excessive rainfall resulting in flooding, causing damage. Can lead to closure of facilities	LA buildings	Physical	Use of material Built Heritage Fixed or manual flood defences Flooded outfalls Structural loading	Moderate	None	Negligible	None	Minor	None	Minor	None	Minor	None	Negligible	Moderate	None	None	None	None	None	None	0.78
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
		Roads & Bridges	Physical	Use of material Built Heritage Adequacy of drainage systems	None	None	None	None	Minor	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	None	None	0.44
			Environmental	Faster rate of deterioration in roads due to prolonged exposure of road surfaces to flooding																		
			Socioeconomic	-																		
		Housing	Physical	Use of material Built Heritage Fixed or manual flood defences Flooded outfalls Structural loading	None	None	None	Negligible	None	None	Minor	None	None	Moderate	Negligible	None	None	None	None	None	None	None	0.39
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
		Construction sites	Physical	Security of materials Silt netting	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
		Commerce	Physical	Storage of stock/ equipment	Negligible	None	Minor	None	None	None	Negligible	None	None	None	None	Minor	None	None	None	None	Minor	None	0.44
			Environmental	Proximity to urban environment																		
			Socioeconomic	-																		
		Drainage networks	Physical	Capacity Build up of silt	None	None	None	None	None	Minor	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	-																		
			Socioeconomic	-																		
		SAC/SPA/natural habitats	Physical	Flora sensitivity to saturation Anchorage of flora	None	None	Minor	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.33
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
		Agricultural land	Physical	Efficiency of drainage network Flooded outfalls	None	None	Minor	None	None	Negligible	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Proximity to urban environment																		
			Socioeconomic	-																		
		Land use suitability	Physical	Adequacy of drainage network	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	Moderate	None	None	None	0.22
			Environmental	Proximity to urban environment																		
			Socioeconomic	-																		
Unuseable roads	Roads will become inundated with water and become inaccessable	Road network	Physical	Efficiency of drainage network	None	None	None	Minor	Minor	None	Negligible	None	None	None	None	None	Negligible	None	Negligible	Moderate	Negligible	None	0.61
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
		Pathways/ cycle lanes	Physical	-	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	Moderate	Minor	None	0.56
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
		General public	Physical	-	None	Negligible	Minor	Minor	Negligible	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.56
			Environmental	Road congestion																		
			Socioeconomic	Exposure to warnings/ alerts																		
		Emergency responders	Physical	-	None	None	Moderate	Minor	Major	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.56
			Environmental	Road congestion																		
			Socioeconomic	Reliance on TII for alerts on National roads Extended workload and overtime leading to burnout and availability of monitoring staff																		
Reduced water quality	Washed out nutrients/chemicals from surface run off entering water bodies. Boil water notices issued in some cases	Water bodies	Physical	Sewage overflow inputs into water bodies Gradient of ground Water turbidity Capacity	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	Major	0.44
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
		Water supply distribution	Physical	Increase in peak flows Back up generator availability	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Major	0.39
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	Extended workload and overtime leading to burnout and availability of monitoring staff Responsibility (Irish Water)																		
Inundated wastewater treatment systems	Private systems located in poor drainage areas and/or flood zones become inundated	Wastewater infrastructure	Physical	Capacity and fullness of septic tanks	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Major	0.39
			Environmental	Water table level Proximity to urban environment																		
			Socioeconomic	-																		

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Health and Safety risks	Heavy rain affects safe travel and poses a risk of injury from uncertain footing	General public	Physical	-	None	Negligible	Minor	Minor	Minor	None	Negligible	None	None	None	None	None	Negligible	None	None	None	None	None	0.50
			Environmental	Available cover Proximity to urban environments Adequacy of drainage systems																			
			Socioeconomic	Population age Population constitution																			
		Council staff	Physical	-	None	None	Moderate	None	Minor	None	Negligible	Negligible	None	None	None	None	None	Minor	None	None	None	None	0.50
			Environmental	Available cover Proximity to urban environments Adequacy of drainage systems																			
			Socioeconomic	Population age Population constitution																			
		Outdoor workers	Physical	Transport method used	None	None	Minor	Minor	Minor	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.39
			Environmental	Available cover Proximity to urban environments Adequacy of drainage systems																			
			Socioeconomic	Population age Population constitution																			
Land erosion	Rainfall causing ground saturation, weakening ground strength	Saturated cliffs	Physical	Soil properties	None	None	None	Minor	None	Moderate	Negligible	None	None	None	None	None	None	None	Negligible	None	None	None	0.39
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	-																			
Erosion of structures	Chemical reaction dissolving structures/ scour	LA buildings	Physical	Use of material Built Heritage	None	None	None	None	Negligible	None	Negligible	None	Minor	None	None	None	None	None	None	None	None	None	0.22
			Environmental	-																			
			Socioeconomic	-																			
		Road network	Physical	Use of material Built Heritage	None	None	Negligible	None	Negligible	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	0.33
			Environmental	-																			
			Socioeconomic	-																			
		Housing	Physical	Use of material Built Heritage	None	None	None	None	None	None	Negligible	None	None	Minor	None	None	None	None	None	None	None	None	0.17
			Environmental	-																			
			Socioeconomic	-																			
Cancellation/ postponing of cultural events	Adverse weather disrupting ability to hold a cultural event	Cultural events	Physical	Available cover	None	Moderate	Negligible	None	None	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.44
			Environmental	Proximity to urban areas																			
			Socioeconomic	-																			

Hazard Event:	**Severe Windstorm**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Red Warning indicating mean gusts >80km/h. Gusts in excess of 130km/h Orange Warning indicating mean gusts of 65-80km/h. Gusts ranging between 110-130km/h Yellow Warning indicating mean gusts of 50-65km/h. Gusts ranging between 90-110km/h

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																	
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Damage to infrastructure	Wind causing damage to infrastructure. Can lead to closure of facilities	LA buildings	Physical	Use of material Built Heritage Structural loading Building heights	Negligible	None	Moderate	Minor	Minor	None	Minor	None	Moderate	Minor	Negligible	None	None	Minor	Negligible	None	Negligible	None	1.11
			Environmental	Proximity to vegetation Wind tunnels in urban environments																		
			Socioeconomic	-																		
		Bridges	Physical	Use of material Built Heritage Structural loading	None	None	None	None	Minor	None	Negligible	None	Moderate	None	None	None	None	None	None	Moderate	None	None	0.50
			Environmental	-																		
			Socioeconomic	-																		
		Housing	Physical	Use of material Built Heritage Structural loading Building heights	None	None	None	Minor	None	None	Minor	None	None	Minor	None	None	None	None	None	None	None	None	0.33
			Environmental	Proximity to vegetation Wind tunnels in urban environments																		
			Socioeconomic	-																		
		Commerce	Physical	-	Negligible	None	Moderate	None	None	None	Negligible	Negligible	None	None	None	Negligible	None	Negligible	None	None	Moderate	None	0.61
			Environmental	Proximity to vegetation Wind tunnels in urban environments																		
			Socioeconomic	Nature of business																		
		Telemetry	Physical	-	None	None	Moderate	Moderate	None	None	Negligible	Negligible	None	None	Negligible	Moderate	Minor	Negligible	None	Minor	Minor	Minor	1.17
			Environmental	Proximity to vegetation																		
			Socioeconomic	-																		
		Water abstraction and wastewater infrastructure	Physical	Integrity of treatment plant infrastructure	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	0.22
			Environmental	Proximity to vegetation																		
			Socioeconomic	-																		
Damage to environment	Loss of biodiversity	SAC/SPA/natural habitats	Physical	Integrity of habitats Available shelter	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	Minor	None	0.33
			Environmental	Level of exposure to wind																		
			Socioeconomic	-																		
Loose debris/material	Debris picked up by wind creating blockages and causing damage to infrastructure and population	LA buildings	Physical	Use of material Built Heritage	Negligible	None	Moderate	Minor	Minor	None	Negligible	None	Minor	Minor	None	None	None	Minor	Negligible	None	Negligible	None	0.94
			Environmental	Proximity to vegetation Wind tunnels in urban environments																		
			Socioeconomic	-																		
		Bridges	Physical	Use of material Built Heritage	None	None	None	None	Minor	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	Minor	None	0.56
			Environmental	Proximity to vegetation Wind tunnels in urban environments																		
			Socioeconomic	-																		
		Construction sites	Physical	Use of material Security of materials Potential to compromise scaffolding	Negligible	None	Moderate	Minor	None	None	Negligible	None	None	Minor	None	None	None	None	Moderate	None	None	None	0.67
			Environmental	Proximity to vegetation Wind tunnels in urban environments																		
			Socioeconomic	-																		
		Derelict buildings	Physical	Use of material Built Heritage	None	None	None	Minor	Negligible	None	Negligible	None	None	None	None	None	None	None	Minor	None	None	None	0.33
			Environmental	Proximity to vegetation Wind tunnels in urban environments																		
			Socioeconomic	-																		
		Water treatment plants	Physical	Contamination prevention/ mitigation measures	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	0.22
			Environmental	Proximity to vegetation																		
			Socioeconomic	-																		
		Water bodies	Physical	Size of water body Contamination prevention/ mitigation measures	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	0.39
			Environmental	Proximity to vegetation																		
			Socioeconomic	-																		
Health and Safety risks	High winds affect safe travel and poses a risk of injury	General public	Physical	-	None	Negligible	Minor	Minor	Moderate	None	Negligible	None	None	None	None	None	None	Negligible	None	None	None	None	0.56
			Environmental	Available shelter Wind tunnels in urban environments																		
			Socioeconomic	Human desire to watch the event from an unsafe location Population age Population constitution Homeless																		
		Council staff	Physical	-	None	None	Moderate	None	Moderate	None	Negligible	Negligible	None	None	None	None	None	Minor	None	None	None	None	0.56
			Environmental	Available shelter Wind tunnels in urban environments																		
			Socioeconomic	Population age Population constitution																		
		Outdoor workers	Physical	Transport method used	None	None	Minor	Minor	Moderate	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.44
			Environmental	Available shelter Wind tunnels in urban environments																		
			Socioeconomic	Population age Population constitution																		

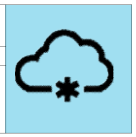
Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		Impact Score
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	
Power supply cuts	Damage to powerlines leading to loss of power to urban and regional centres	Commerce	Physical	Presence of overhead lines Backup generator availability	Negligible	None	Moderate	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	Moderate	None	0.44
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
		LA buildings	Physical	Presence of overhead lines Backup generator availability	Negligible	None	Moderate	Minor	Minor	None	Negligible	Negligible	Moderate	Minor	None	Minor	None	Minor	Minor	Minor	None	Moderate	None	1.33
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
		Housing	Physical	Presence of overhead lines Backup generator availability	None	None	None	Minor	None	None	Negligible	None	None	Minor	None	None	None	None	None	None	None	None	None	0.28
			Environmental	Proximity to vegetation																			
			Socioeconomic	Population age Population constitution																			
		Hospital/Health Centres	Physical	Presence of overhead lines Backup generator availability	Negligible	None	None	Minor	Negligible	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.28
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
		Communication/ servers	Physical	Presence of overhead lines Backup generator availability	Minor	Negligible	Minor	Minor	Major	Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Negligible	Minor	Minor	Moderate	Moderate	Minor	2.17
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
		Water and wastewater treatment plants	Physical	Presence of overhead lines Backup generator availability Emergency supply storage Overflow from wastewater systems due to power outage	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	Moderate	0.28
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
Falling trees/ branches	Wind destroying trees and carrying material leading to a variety of disruption to services	Outdoor workers	Physical	Personal Protective Equipment	None	Negligible	Moderate	Minor	Minor	None	Negligible	None	None	None	Minor	None	None	None	None	None	None	None	None	0.61
			Environmental	Influenced by time of year Proximity to/ volume of vegetation Available cover																			
			Socioeconomic	Population age Population constitution																			
		Emergency services	Physical	Personal Protective Equipment	None	Negligible	Moderate	Minor	Minor	None	Negligible	None	None	None	Minor	None	None	None	None	None	None	None	None	0.61
			Environmental	Influenced by time of year Proximity to/ volume of vegetation Available shelter																			
			Socioeconomic	Population age Population constitution																			
		Parks	Physical	Soil properties	None	None	None	Minor	None	Moderate	Negligible	None	None	None	None	None	Minor	None	None	None	Moderate	None	0.61
			Environmental	Influenced by time of year Proximity to/ volume of vegetation																			
			Socioeconomic	-																			
		Transport infrastructure including roads, rail, and pathways	Physical	Use of material Built Heritage	None	None	None	Minor	Minor	None	Negligible	None	None	None	None	None	Negligible	None	Negligible	Moderate	Minor	None	0.67
			Environmental	Influenced by time of year Proximity to/ volume of vegetation																			
			Socioeconomic	Remote working Alternate transport methods Reliance on TII for alerts on National roads																			
		Water and wastewater treatment plants	Physical	Debris management measures	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	0.33
			Environmental	Influenced by time of year Proximity to/ volume of vegetation																			
			Socioeconomic	Extended workload and overtime leading to burnout and availability of monitoring staff																			
Cancellation/ postponing of cultural events	Adverse weather disrupting ability to hold a cultural event	Cultural events	Physical	Available shelter	None	Moderate	Negligible	Minor	None	None	Negligible	None	None	None	None	None	None	None	None	None	Minor	None	0.50
			Environmental	Level of exposure to wind																			
			Socioeconomic	-																			

Hazard Event:	**Pluvial Flood**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Period of wet weather resulting in saturated soils. Heavy precipitation levels causes surface water flooding. Precipitation levels exceeding historic levels.

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		Impact Score
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	
Damage to infrastructure	Flood water affecting built environment. Can lead to closure of facilities	LA buildings	Physical	Use of material Built Heritage Adequacy of drainage network Flooded outfalls Structural loading	Moderate	None	Negligible	None	Minor	None	Minor	None	Minor	None	Negligible	Moderate	None	None	None	None	None	None	0.78
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to vegetation																			
			Socioeconomic	-																			
		Roads & Bridges	Physical	Use of material Built Heritage Adequacy of drainage network Structural loading	None	None	None	None	Minor	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	None	None	0.44
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
		Housing	Physical	Use of material Built Heritage Fixed or manual flood defences Flooded outfalls Structural loading	None	None	None	Negligible	None	None	Minor	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	0.39
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to vegetation																			
			Socioeconomic	-																			
		Construction sites	Physical	Security of materials Silt netting	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to vegetation																			
			Socioeconomic	-																			
		Commerce	Physical	Storage of stock/ equipment	Negligible	None	Minor	None	None	None	Negligible	None	None	None	None	Minor	None	None	None	None	Minor	None	0.44
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			
		Drainage networks	Physical	Capacity Build up of silt/leaves	None	None	None	None	None	Minor	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
		Agricultural land	Physical	Adequacy of drainage network Flooded outfalls	None	None	Minor	None	None	Negligible	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			
		Power supply	Physical	Fixed or manual flood defences Flooded outfalls Structural loading Backup generators	Negligible	Negligible	Major	Negligible	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Minor	Moderate	Negligible	Negligible	Negligible	Moderate	Negligible	Moderate	1.67
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	-																			
Damage to environment	Loss of biodiversity	SAC/SPA/natural habitats	Physical	Flora sensitivity to saturation Anchorage of flora	None	None	None	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.28
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	-																			
Unuseable roads	Roads will become inundated with water and become inaccessable	Road network	Physical	Efficiency of drainage network Flooded outfalls	None	None	Negligible	Negligible	Moderate	None	Negligible	Negligible	None	None	None	None	Negligible	None	None	Moderate	Negligible	None	0.67
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	-																			
		Pathways/ cycle lanes	Physical	Drainage network	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	Moderate	Negligible	None	0.50
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	-																			
		General public	Physical	-	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.28
			Environmental	Road congestion																			
			Socioeconomic	Exposure to warnings/ alerts																			
		Emergency responders	Physical	-	None	None	Minor	None	Major	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.39
			Environmental	Road congestion																			
			Socioeconomic	Reliance on TII for alerts on National roads Extended workload and overtime leading to burnout and availability of monitoring staff																			
Reduced water quality	Vegetation debris or leachate from surface run off entering water systems. Boil water notices issued in some cases	Water bodies	Physical	Sewage overflow inputs into water bodies Water turbidity Combined foul and surface system	None	None	Negligible	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	Major	0.56
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment Proximity to agricultural land																			
			Socioeconomic	-																			
		Water supply	Physical	-	None	None	Negligible	Negligible	None	None	Negligible	None	None	Negligible	Negligible	None	None	None	None	None	None	Major	0.50
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	Extended workload and overtime leading to burnout and availability of monitoring staff Responsibility (Irish Water)																			
Inundated wastewater treatment systems	Private systems located in poor drainage areas and/or flood zones become inundated	Wastewater infrastructure	Physical	Capacity and fullness of septic tanks	None	None	None	Minor	None	None	Minor	None	None	None	None	None	None	None	None	None	None	Major	0.44
			Environmental	Water table level Proximity to urban environment																			
			Socioeconomic	-																			

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																	
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Temporary housing	Relocation of homeless and residents of flooded properties	General public	Physical	-	None	None	None	None	None	None	Negligible	Negligible	None	Moderate	Minor	None	Negligible	None	None	None	Minor	None	0.56
			Environmental	Proximity to urban environment																		
			Socioeconomic	Population age Population constitution Housing availability																		
		LA staff	Physical	-	None	None	None	None	None	None	Negligible	Negligible	None	Moderate	Minor	None	None	None	None	None	Negligible	None	0.44
			Environmental	Proximity to urban environment																		
			Socioeconomic	Population age Population constitution Housing availability																		
		Homeless	Physical	-	None	None	None	None	None	None	Negligible	Negligible	None	Moderate	Minor	None	None	None	None	None	None	None	0.39
			Environmental	Proximity to urban environment																		
			Socioeconomic	Population age Population constitution Housing availability																		
Health and Safety risks	Drowning/ presence of submerged hazards leading to injury or death	General public	Physical	-	None	None	Minor	None	Minor	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.44
			Environmental	Proximity to urban environment																		
			Socioeconomic	Human desire to watch the event from an unsafe location Population age Population constitution Exposure to warnings/ alerts																		
		LA staff	Physical	-	None	None	Minor	None	Minor	None	Negligible	Negligible	None	None	None	None	None	Minor	None	None	Negligible	None	0.50
			Environmental	Proximity to urban environment																		
			Socioeconomic	Population age Population constitution																		
		Homeless	Physical	-	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.06
			Environmental	Proximity to urban environment																		
			Socioeconomic	Population age Population constitution																		
Cancellation/ postponing of cultural events	Adverse weather disrupting ability to hold a cultural event	Cultural events	Physical	-	None	Moderate	Negligible	None	None	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.44
			Environmental	Proximity to urban environment																		
			Socioeconomic	-																		

Hazard Event:	**Heavy Snowfall**
Frequency of Occurrence:	Occasional
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Red warning: significant falls of snow likely to cause accumulations of 8cm or greater below 250m above mean sea level. Orange warning: significant falls of snow likely to cause accumulations of 3cm or greater below 250m above mean sea level. Yellow warning: scattered snow showers giving accumulations of less than 3cm below 250m above mean sea level.

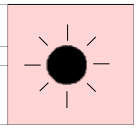


Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																	Impact Score
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	
Damage to infrastructure	Heavy buildup of snow exceeding structural limits	LA Buildings	Physical	Use of material Built Heritage Structural loading Time to thaw	Minor	None	Minor	Minor	Minor	None	Minor	Negligible	Minor	None	None	None	None	Minor	None	None	Minor	None	0.94
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	-																		
		Housing	Physical	Use of material Built Heritage Structural loading Time to thaw	None	None	None	Minor	None	None	Minor	None	None	Minor	None	None	None	None	None	None	None	None	0.33
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	-																		
		Bridges	Physical	Use of material Built Heritage Structural loading Time to thaw	None	None	Negligible	None	Minor	None	Negligible	None	Negligible	None	None	None	None	None	None	Moderate	None	None	0.44
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	-																		
		Power supply	Physical	Presence of overhead lines Time to thaw	Negligible	Negligible	Major	Negligible	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Minor	Moderate	Negligible	Negligible	Negligible	Moderate	Negligible	Moderate	2.33
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	-																		
		Water and wastewater treatment plants	Physical	Use of material Built Heritage Structural loading Back up generator availability Time to thaw	None	None	Minor	None	Minor	None	Negligible	None	None	None	Minor	None	None	None	None	None	Negligible	Major	
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	-																		
		Telemetry	Physical	Structural loading Backup generators Time to thaw	Negligible	Negligible	Major	Negligible	Minor	Negligible	Minor	Negligible	Negligible	None	Minor	Moderate	Negligible	Negligible	Negligible	Moderate	Negligible	Moderate	1.61
			Environmental	Proximity to vegetation																		
			Socioeconomic	-																		
Damage to environment	Erosion due to freeze-thaw action	SAC/SPA/natural habitats	Physical	Cliff stability	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	Negligible	None	None	None	Negligible	None	0.33
			Environmental	Elevation relative to sea level																		
			Socioeconomic	-																		
Disruption to infrastructure/ facilities	Snow buildup disrupting transport networks, building access, amenity access, and water treatment processes	Transport infrastructure	Physical	Time to thaw	None	None	Moderate	Minor	Major	None	Negligible	None	None	None	Negligible	None	Minor	None	None	Moderate	Moderate	None	1.06
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	Snow removing measures High impact for people who reside in isolated locations who are cut off with no access to services																		
		Buildings	Physical	Time to thaw	None	None	Minor	Minor	Moderate	None	Negligible	Negligible	None	None	None	None	Negligible	Minor	None	None	Minor	None	0.78
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	-																		
		Amenities	Physical	Time to thaw	None	None	None	Moderate	None	None	Negligible	None	None	None	Negligible	None	Minor	Moderate	None	None	Minor	None	0.67
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	Snow removing measures																		
		Water and wastewater treatment systems	Physical	Time to thaw	None	None	Negligible	None	Minor	None	Minor	None	None	None	Minor	None	None	None	None	None	Negligible	Major	0.67
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	Snow removing measures																		
		Schools	Physical	Time to thaw	None	None	Minor	Moderate	None	None	Negligible	None	None	None	Negligible	None	None	None	None	None	None	None	0.39
			Environmental	Ground elevation relative to sea level																		
			Socioeconomic	Snow removing measures																		
Health and Safety risks	Heavy snowfall affects safe travel and poses a risk of injury	General public	Physical	-	None	Negligible	Minor	Minor	Minor	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.44
			Environmental	Available cover Proximity to urban environments																		
			Socioeconomic	Population age Population constitution																		
		Council staff	Physical	-	None	None	Moderate	None	Moderate	None	Negligible	Negligible	None	None	None	None	None	Minor	None	None	None	None	0.56
			Environmental	Available cover Proximity to urban environments																		
			Socioeconomic	Population age Population constitution Training required to operate vehicles/equipment to aid in emergency events																		
		Outdoor workers	Physical	Transport method used	None	None	Minor	Minor	Moderate	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.44
			Environmental	Available cover Proximity to urban environments																		
			Socioeconomic	Population age Population constitution Training required to operate vehicles/equipment to aid in emergency events																		
Minor flooding issues	Fast thawing of large amounts of snow can lead to excessive amounts of surface run off	Drainage network	Physical	Capacity fo drainage network	None	None	Negligible	None	None	None	Negligible	None	None	None	None	None	None	None	None	Minor	None	None	0.22
			Environmental	-																		
			Socioeconomic	-																		
Reduced air quality	Heavy snow leads to less active travel and the need for more heat in buildings, increasing burning of fossil fuels	Air	Physical	Level of insulation of buildings	None	None	None	None	None	Minor	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Proximity to urban environment																		
			Socioeconomic	-																		
		People	Physical	-	None	None	None	Negligible	Negligible	None	Negligible	None	None	None	Negligible	None	None	None	None	None	None	None	None	0.22
			Environmental	-																		
			Socioeconomic	Population age Population constitution																		
Frostbite	Exposure to snow can lead to frostbite	People	Physical	-	None	None	Minor	Minor	Minor	None	Negligible	None	None	None	Minor	None	Minor	None	None	None	Minor	None	0.72
			Environmental	Proximity to urban environment Available cover																		
			Socioeconomic	Human desire to watch the event from an unsafe location Population age Population constitution Homeless																		

Hazard Event:	**Heatwave**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Record high temperatures with temperatures exceeding 30°C over a number of consecutive days. Urban areas particularly affected.

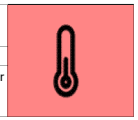
Hazard Impact	Impact Description:	Exposure	Vulnerability: Type	Vulnerability: Description	Service Areas: Level of Disruption: Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Hot and uncomfortable working conditions	High temperatures in homes and office causing discomfort	Outdoor workers	Physical	-	None	None	Moderate	None	Negligible	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	0.56
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water/ sun screen/ cooling apparatus																			
			Socioeconomic	Population age Population constitution																			
		Indoor workers	Physical	-	None	None	Moderate	None	Negligible	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	0.56
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water/ cooling apparatus																			
			Socioeconomic	Population age Population constitution																			
Risk of fires	Wildfires or domestic fires are easily started in heatwaves due to the dryness of the environment	People	Physical	Campfires going out of control BBQ's in urban areas gives of stray flame	None	None	None	None	Moderate	None	Negligible	None	None	None	None	None	Negligible	None	None	None	None	None	0.28
			Environmental	Proximity to fire Exposure to fire																			
			Socioeconomic	Population age Population constitution																			
		Environment	Physical	-	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Proximity to fire upland areas and gorse areas typically affected																			
			Socioeconomic	-																			
Heat stroke	High heat can lead to heat stroke if careless	People	Physical	-	None	None	Negligible	Minor	Major	None	Negligible	None	None	None	Moderate	None	Negligible	None	None	None	Minor	Major	1.00
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water and sun screen																			
			Socioeconomic	Population age Population constitution Homeless																			
Agricultural pressure	Issues with provision of water for animals, insufficient water for crops, and reduced grass	Farm animals	Physical	Status of water supply system Number of farm animals present	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Water source location																			
			Socioeconomic	Type of farm animals present																			
		Crops	Physical	Irrigation infrastructure	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	-																			
			Socioeconomic	-																			
Pressure on recreational areas	High temperatures promotes the use of recreational facilities and puts pressure on existing infrastructure and emergency rescue services	Green areas	Physical	Access to recreational areas Capacity	None	None	Negligible	Minor	Minor	Minor	Negligible	None	None	None	None	None	Moderate	None	None	Minor	Moderate	Moderate	1.06
			Environmental	Proximity to urban environment Water and waste services																			
			Socioeconomic	Resourcing of staff																			
Heat stress on buildings/ infrastructure	High temperatures resulting in structures being warped/ road surfaces being damaged	Roads and Bridges	Physical	Surface dressed roads susceptible to boiling of bitumen Built Heritage	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	0.33
			Environmental	Available shade cover Proximity to urban environment																			
			Socioeconomic	-																			
		LA Buildings	Physical	Material properties Built Heritage	None	None	None	None	None	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	0.28
			Environmental	Available shade cover Proximity to urban environment																			
			Socioeconomic	-																			
		Housing	Physical	Material properties Built Heritage	None	None	None	None	None	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	0.28
			Environmental	Available shade cover Proximity to urban environment																			
			Socioeconomic	-																			
		Pavements	Physical	Historical mixes of concrete prone to heaving	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	Minor	None	None	0.39
			Environmental	Located within areas of high solar radiation																			
			Socioeconomic	-																			
Damage to monuments	Drying out of soil can destabilise monuments	Built heritage	Physical	Use of material Built heritage	None	None	None	None	None	None	Negligible	None	Minor	None	None	None	None	None	None	None	Negligible	None	0.22
			Environmental	Located within areas of high solar radiation																			
			Socioeconomic	-																			
Reduced water quality and supply	Water supplies drawing from water with high levels of dissolved material due to evaporation of water sources and water supply plants	Water bodies	Physical	Capacity Concentration of dissolved material	None	None	None	None	Negligible	Moderate	Negligible	None	None	None	Minor	None	Moderate	None	None	None	Moderate	Major	0.94
			Environmental	Presence of shade Located within areas of high solar radiation																			
			Socioeconomic	-																			
		Water supply plants	Physical	Backup water supply	None	None	Moderate	None	Major	None	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	Major	1.00
			Environmental	Presence of shade Located within areas of high solar radiation																			
			Socioeconomic	-																			
Damaged water treatment plants	Flows to treatment plants experiencing large amounts of organic loading due to evaporation, disrupting the treatment plant	Wastewater treatment plants	Physical	Capacity Concentration of dissolved material Combined foul and surface system	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	None	None	None	None	None	Major	0.33
			Environmental	Proximity to urban environment Water and waste services																			
			Socioeconomic	-																			
Damage to environment	High temperatures can cause vegetation to dry up and die	SAC/SPA/natural habitats	Physical	Vegetation sensitivity to heat	None	None	None	None	Negligible	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.28
			Environmental	Influenced by time of year Proximity to water bodies																			
			Socioeconomic	-																			

Hazard Event:	**Drought**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Restrictions on water use. Low rainfall during periods of high temperatures or freezing of water sources/ distribution. There is evidence of a decreasing trend in summer rainfall.



Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																	
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Hot and uncomfortable working conditions	High temperatures in homes and office causing discomfort	Outdoor workers	Physical	-	None	None	Moderate	None	Minor	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	0.61
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water/ sun screen/ cooling apparatus																		
			Socioeconomic	Population age Population constitution																		
		Indoor workers	Physical	-	None	None	Moderate	None	Negligible	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	0.56
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water/ cooling apparatus																		
			Socioeconomic	Population age Population constitution																		
Pressure on recreational areas	High temperatures promotes the use of recreational facilities and puts pressure on existing infrastructure	Green areas	Physical	Access to recreational areas Capacity	None	None	Negligible	Minor	Minor	Minor	Negligible	None	None	None	None	None	Major	None	None	Minor	Major	Moderate	1.17
			Environmental	Proximity to urban environment Water and waste services																		
			Socioeconomic	-																		
Agricultural pressure	Issues with provision of water for animals, insufficient water for crops, and reduced grass	Farm animals	Physical	Status of water supply system Number of farm animals present	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Water source location																		
			Socioeconomic	Type of farm animals present																		
		Crops	Physical	Irrigation infrastructure	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	-																		
			Socioeconomic	-																		
Heat stress on buildings/ infrastructure	High temperatures resulting in structures being warped/ road surfaces being damaged	Transport infrastructure	Physical	Material properties Built Heritage	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	0.33
			Environmental	Available shade cover Proximity to urban environment																		
			Socioeconomic	-																		
		Buildings	Physical	Material properties Built Heritage	None	None	None	None	Minor	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	0.39
			Environmental	Available shade cover Proximity to urban environment																		
			Socioeconomic	-																		
Reduced water quality and supply	Water supplies drawing from water with high levels of dissolved material due to evaporation of water sources and water supply plants	Water bodies	Physical	Capacity Concentration of dissolved material Availability of groundwater	None	None	None	None	Negligible	Moderate	Negligible	None	None	None	Minor	None	Moderate	None	None	None	Moderate	Major	0.94
			Environmental	Presence of shade Located within areas of high solar radiation																		
			Socioeconomic	-																		
		Water supply plants	Physical	Backup water supply Odour issues First flush due to rainfall after drought	None	None	Moderate	None	Major	None	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	Major	1.00
			Environmental	Presence of shade Located within areas of high solar radiation																		
			Socioeconomic	Responsibility (Irish Water)																		
Damaged water treatment plants	Flows to treatment plants experiencing large amounts of organic loading due to evaporation, disrupting the treatment plant	Wastewater treatment plants	Physical	Capacity Concentration of dissolved material Combined foul and surface system First flush due to rainfall after drought	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	None	None	None	None	None	Major	0.33
			Environmental	Proximity to urban environment Water and waste services																		
			Socioeconomic	-																		
Damage to environment	High temperatures can cause vegetation to dry up and die	SAC/SPA/natural habitats	Physical	Vegetation sensitivty to heat Lowered water levels	None	None	None	None	Negligible	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.28
			Environmental	Influenced by time of year Proximity to water bodies																		
			Socioeconomic	-																		

Hazard Event:	**Above Average Surface Temperature**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Prolonged periods of higher than average temperatures. Observations indicate an increase in the surface temperature for Ireland of 0.9°C over the last 120 years. Urban areas particulalry affected.



Hazard Impact	Impact Description:	Exposure	Vulnerability: Type	Vulnerability: Description	Service Areas: Level of Disruption: Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Change in biodiversity	Changes in surface temperatures leads to a promotion in growth of invasive species to the detriment to native species	Invasive species	Physical	Growing conditions required of the invasive flora	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Influenced by time of year																			
			Socioeconomic	Invasive Alien Plant Species protocols in place to reduce the spread of invasice species																			
		Native species	Physical	Growing conditions required of the native flora	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Influenced by time of year																			
			Socioeconomic	-																			
Change in phenology	Changes in surface temperatures leads to a disruption to the phenology cycle, affecting pollinators and seasonal interactions	Pollinators	Physical	Sensitivity of pollinaters to changes in temperatures	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	-																			
			Socioeconomic	-																			
Mold growth	Increased temperatures encourages algae growth in heritage structures, causing irreparable damage	Heritage structures	Physical	Ventilation in structures	None	Minor	None	None	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Minor	None	0.39
			Environmental	Humidity																			
			Socioeconomic	-																			
Hot and uncomfortable working conditions	High temperatures in homes and office causing discomfort	Dwellings	Physical	Inadequate cooling mechanisms	None	None	None	Minor	Negligible	None	Negligible	None	None	Minor	None	None	None	None	None	None	None	Minor	0.44
			Environmental	Proximity to high density urban areas																			
			Socioeconomic	-																			
		Outdoor workers	Physical	-	None	None	Moderate	None	Minor	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	0.61
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water/ sun screen/ cooling apparatus																			
			Socioeconomic	Population age Population constitution																			
		Indoor workers	Physical	-	None	None	Moderate	None	Negligible	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	0.56
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water/ cooling apparatus																			
			Socioeconomic	Population age Population constitution																			
Agricultural pressure	Issues with provision of water for animals, insufficient water for crops, and reduced grass	Farm animals	Physical	Status of water supply system Number of farm animals present	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Water source location																			
			Socioeconomic	Type of farm animals present																			
		Crops	Physical	Irrigation infrastructure	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	-																			
			Socioeconomic	-																			
Pressure on recreational areas	High temperatures promotes the use of recreational facilities and puts pressure on existing infrastructure	Green areas	Physical	Access to recreational areas Capacity	None	None	Negligible	Minor	Minor	Minor	Negligible	None	None	None	None	None	Moderate	None	None	Minor	Moderate	Moderate	1.06
			Environmental	Proximity to urban environment Water and waste services																			
			Socioeconomic	-																			
Heat stress on buildings/ infrastructure	High temperatures resulting in structures being warped/ road surfaces being damaged	Transport infrastructure	Physical	Material properties Built Heritage	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	0.33
			Environmental	Available shade cover Proximity to urban environment																			
			Socioeconomic	-																			
		Buildings	Physical	Material properties Built Heritage	None	None	None	None	Minor	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	0.39
			Environmental	Available shade cover Proximity to urban environment																			
			Socioeconomic	-																			
Reduced water quality and supply	Water supplies drawing from water with high levels of dissolved material due to evaporation of water sources and water supply plants	Water bodies	Physical	Capacity Concentration of dissolved material	None	None	None	None	Negligible	Moderate	Negligible	None	None	None	Minor	None	Moderate	None	None	None	Moderate	Moderate	0.89
			Environmental	Presence of shade Located within areas of high solar radiation																			
			Socioeconomic	-																			
		Water supply plants	Physical	Backup water supply	None	None	Moderate	None	Major	None	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	Moderate	0.94
			Environmental	Presence of shade Located within areas of high solar radiation																			
			Socioeconomic	Responsibility (Irish Water)																			
Damaged water treatment plants	Flows to treatment plants experiencing large amounts of organic loading due to evaporation, disrupting the treatment plant	Wastewater treatment plants	Physical	Capacity Concentration of dissolved material Combined foul and surface system	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	0.28
			Environmental	Proximity to urban environment Water and waste services																			
			Socioeconomic	-																			
Damage to environment	High temperatures can cause vegetation to dry up and die	SAC/SPA/natural habitats	Physical	Vegetation sensitivity to heat	None	None	None	None	Negligible	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.28
			Environmental	Influenced by time of year Proximity to water bodies																			
			Socioeconomic	-																			

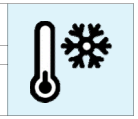
Hazard Event:	**Increase in Relative Sea Level**
Frequency of Occurrence:	Occasional
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Satellite observations indicate that sea level around Ireland has risen by approximately 2-3mm per year since the early 1990s. This increases the risk of river flooding as three rivers of note in Kilkenny have tidal stetches which influence the level of flooding.

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Increased risk of river flooding	Higher sea levels affect the baseline water levels of tidally influenced rivers	Rivers	Physical	River bank protection	None	None	None	None	Moderate	Minor	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.33
			Environmental	Level of influence from tides																			
			Socioeconomic	-																			

Hazard Event:	**Above Average Precipitation**
Frequency of Occurrence:	Occasional
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Prolonged periods of rainfall. Change in pattern of typical rainfall periods.

Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																	
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Reduced water quality	Vegetation debris or leachates from surface run off entering water systems	Water bodies	Physical	Sewage overflow inputs into water bodies Gradient of ground Water turbidity Capacity	None	None	None	Minor	None	Minor	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	0.44
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
		Water supply distribution	Physical	-	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	0.33
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	Extended workload and overtime leading to burnout and availability of monitoring staff Resoonsibility (Irish Water)																		
Land erosion	Rainfall causing ground saturation, weakening ground strength	Land/cliffsides	Physical	Soil properties	None	None	None	None	Moderate	Moderate	Negligible	None	None	None	None	None	None	None	Negligible	None	None	None	0.44
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
More time spent indoors	Increased rainfall dissuading people to be outdoors	Mental health	Physical	-	None	None	Minor	Moderate	Negligible	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	None	0.56
			Environmental	Proximity to facilities																		
			Socioeconomic	Population age Population constitution Home dynamics - living alone or with family																		
		Commerce	Physical	-	None	None	Moderate	None	None	None	Negligible	None	None	None	None	Minor	Moderate	None	None	None	Moderate	None	0.67
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																		
			Socioeconomic	-																		
Erosion of structures	Chemical reaction dissolving structures/ scour	LA buildings	Physical	Use of material Built Heritage	None	None	None	None	Minor	None	Negligible	None	Minor	None	None	None	None	None	None	None	None	None	0.28
			Environmental	-																		
			Socioeconomic	-																		
		Road network	Physical	Use of material Built Heritage	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	Negligible	None	None	0.22
			Environmental	-																		
			Socioeconomic	-																		
		Housing	Physical	Use of material Built Heritage	None	None	None	None	Negligible	None	Negligible	None	None	Negligible	None	None	None	None	None	None	None	None	0.17
			Environmental	-																		
			Socioeconomic	-																		

Hazard Event:	**Cold Spell**
Frequency of Occurrence:	Occasional
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Record low temperatures with temperatures between 0 and -10 degrees C throughout Winter.



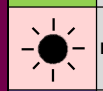
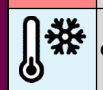
Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		Impact Score
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	
Cold and uncomfortable working conditions	Low temperatures in homes and office causing discomfort	Outdoor workers	Physical	-	None	None	Moderate	None	Minor	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	0.61
			Environmental	Limited access to heating apparatus/ shelter																			
			Socioeconomic	Population age Population constitution																			
		Indoor workers	Physical	-	None	None	Moderate	None	Minor	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	0.61
			Environmental	Limited access to heating apparatus																			
			Socioeconomic	Population age Population constitution																			
Frostbite	Low temperatures can lead to frostbite if careless	People	Physical	-	None	None	Negligible	Minor	Moderate	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Major	0.78
			Environmental	Proximity to urban environment																			
			Socioeconomic	Population age Population constitution Homeless																			
Cold stress on buildings/ infrastructure	Low temperatures resulting in structures being warped/ road surfaces being damaged	Tranpsort infrastructure	Physical	Material properties Built Heritage Changes in rates of deterioration - faster rate of deterioration in areas subject to sustained low temperatures	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	0.33
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			
		LA Buildings	Physical	Material properties Built Heritage	None	None	Minor	None	Minor	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	0.50
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			
		Housing	Physical	Material properties Built Heritage	None	None	None	None	Negligible	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	0.33
			Environmental	Proximity to urban environment																			
			Socioeconomic	Requirement for additional heat and additional insulation of housing stock																			
Reduced water quality and supply	Frozen water restrict extraction and distribution of water	Water bodies	Physical	Depth of water	None	None	None	None	None	Major	Negligible	None	None	None	Minor	None	Moderate	None	None	None	Moderate	Major	0.94
			Environmental	Elevation in relation to sea level																			
			Socioeconomic	-																			
		Water supply infrastructure	Physical	Backup water supply Air volume in pipes	None	None	Moderate	None	Major	None	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	Major	1.00
			Environmental	Elevation in relation to sea level																			
			Socioeconomic	-																			
Damaged water supply and treatment plants	Frozen water damaging treatment systems	Water and wastewater treatment plants	Physical	Air volume in pipes Combined foul and surface system	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	None	None	None	None	None	Major	0.33
			Environmental	Elevation in relation to sea level																			
			Socioeconomic	-																			
Change in phenology	Changes in surface temperatures leads to a disruption to the phenology cycle	River habitats	Physical	Low temperatures bring about changes in species distribution and phenology of river systems	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental																				
			Socioeconomic	-																			
More time spent indoors	Cold temperatures dissuades people from going outdoors	Mental health	Physical	-	None	None	Minor	Moderate	Minor	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	None	0.61
			Environmental	Proximity to facilities																			
			Socioeconomic	Population age Population constitution Home dynamics - living alone or with family																			
Reduced air quality	Low temperatures lead to less active travel and the need for more heat in buildings, increasing burning of fossil fuels	Air	Physical	Level of insulation of buildings	None	None	None	None	None	Minor	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			
		People	Physical	-	None	None	None	Negligible	Minor	None	Negligible	None	None	None	Negligible	None	None	None	None	None	None	None	0.28
			Environmental	-																			
			Socioeconomic	Population age Population constitution Homeless																			
Damage to environment	Low temperatures can cause vegetation to freeze and die	SAC/SPA/natural habitats	Physical	Vegetation sensitivty to cold	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Prolonged road salting affecting salinity of surrounding ground Influenced by time of year																			
			Socioeconomic	-																			
		Agricultural land	Physical	-	None	None	Negligible	Minor	Negligible	Minor	Negligible	None	None	None	None	None	Major	None	None	Minor	Major	Moderate	1.11
			Environmental	Prolonged road salting affecting salinity of surrounding ground Influenced by time of year																			
			Socioeconomic	-																			

Hazard Event:	**Groundwater Flood**
Frequency of Occurrence:	Occasional
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Caused by the emergence of water originating from underground and is particularly common in karst landscapes. Large amounts of rainfall causes the water table to be elevated, preventing rainwater to filter through the ground.

Hazard Impact	Impact Description:	Exposure	Vulnerability: Type	Vulnerability: Description	Service Areas: Level of Disruption: Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Impact Score
Damage to infrastructure	Flood water affecting built environment. Can lead to closure of facilities	LA buildings	Physical	Use of material Built Heritage Adequacy of drainage network Structural loading	Moderate	None	Negligible	None	Minor	None	Minor	None	Minor	None	Negligible	Moderate	None	None	None	None	None	None	0.78
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to vegetation																			
			Socioeconomic	-																			
		Roads & Bridges	Physical	Use of material Built Heritage Adequacy of drainage network Structural loading	None	None	None	None	Minor	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	None	None	0.44
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
		Housing	Physical	Use of material Built Heritage Fixed or manual flood defences Flooded outfalls Structural loading	None	None	None	Negligible	Negligible	None	Minor	None	None	Moderate	Negligible	None	None	None	None	None	None	None	0.44
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to vegetation																			
			Socioeconomic	-																			
		Construction sites	Physical	Security of materials Silt netting	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.06
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to vegetation																			
			Socioeconomic	-																			
		Commerce	Physical	Storage of stock/ equipment	Negligible	None	None	None	None	None	Negligible	None	None	None	None	Minor	None	None	None	None	Minor	None	0.33
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			
		Drainage networks	Physical	Capacity Build up of silt/leaves	None	None	None	None	None	Minor	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.17
			Environmental	Proximity to vegetation																			
			Socioeconomic	-																			
		Agricultural land	Physical	Adequacy of drainage network Flooded outfalls	None	None	Minor	None	None	Negligible	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			
		Power supply	Physical	Fixed or manual flood defences Flooded outfalls Structural loading Backup generators	Negligible	Negligible	Moderate	Negligible	Moderate	Negligible	Negligible	Negligible	Negligible	Negligible	Minor	Moderate	Negligible	Negligible	Negligible	Moderate	Negligible	Moderate	1.61
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	-																			
Damage to environment	Loss of biodiversity	SAC/SPA/natural habitats	Physical	Flora sensitivity to saturation Anchorage of flora	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.22
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	-																			
Inundated wastewater treatment systems	Private systems located in poor drainage areas and/or flood zones become inundated	Wastewater infrastructure	Physical	Capacity and fullness of septic tanks	None	None	None	Minor	Negligible	None	Minor	None	None	None	None	None	None	None	None	None	None	Moderate	0.44
			Environmental	Water table level Proximity to urban environment																			
			Socioeconomic	-																			
Temporary housing	Relocation of homeless and residents of flooded properties	General public	Physical	-	None	None	None	None	Negligible	None	Negligible	Negligible	None	Minor	Minor	None	Negligible	None	None	None	Minor	None	0.56
			Environmental	Proximity to urban environment																			
			Socioeconomic	Population age Population constitution Housing availability																			
		LA staff	Physical	-	None	None	None	None	None	None	Negligible	Negligible	None	Minor	Minor	None	None	None	None	None	Negligible	None	0.39
			Environmental	Proximity to urban environment																			
			Socioeconomic	Population age Population constitution Housing availability																			
		Homeless	Physical	-	None	None	None	None	None	None	Negligible	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	0.33
			Environmental	Proximity to urban environment																			
			Socioeconomic	Population age Population constitution Housing availability																			
Health and Safety risks	Drowning/ presence of submerged hazards leading to injury or death	General public	Physical	-	None	None	Minor	None	Negligible	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	0.39
			Environmental	Proximity to urban environment																			
			Socioeconomic	Human desire to watch the event from an unsafe location Population age Population constitution Exposure to warnings/ alerts																			
		LA staff	Physical	-	None	None	Minor	None	Minor	None	Negligible	Negligible	None	None	None	None	None	Minor	None	None	Negligible	None	0.50
			Environmental	Proximity to urban environment																			
			Socioeconomic	Population age Population constitution																			
		Homeless	Physical	-	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	0.11
			Environmental	Proximity to urban environment																			
			Socioeconomic	Population age Population constitution																			

Appendix E Current Impact Summary Matrix

CURRENT IMPACTS

	Hazard Type	Current Frequency	Current Frequency (Score)	Asset Damage	Health and Wellbeing	Environment	Social	Financial	Reputation	Cultural Heritage	Current Impact
	River flood	Common	3	Major	Major	Moderate	Moderate	Moderate	Moderate	Moderate	3.29
	Extreme precipitation	Frequent	4	Moderate	Minor	Minor	Minor	Minor	Minor	Moderate	2.29
	Drought	Common	3	Minor	Moderate	Moderate	Moderate	Minor	Minor	Negligible	2.29
	Severe windstorm	Common	3	Minor	Moderate	Moderate	Minor	Negligible	Negligible	Moderate	2.14
	Heatwave	Common	3	Minor	Moderate	Moderate	Minor	Negligible	Negligible	Moderate	2.14
	Pluvial flood	Common	3	Moderate	Minor	Minor	Minor	Negligible	Minor	Minor	2.00
	Above average precipitation	Occasional	2	Moderate	Minor	Minor	Minor	Negligible	Negligible	Moderate	2.00
	Above average surface temperature	Common	3	Negligible	Negligible	Major	Negligible	Negligible	Negligible	Moderate	1.71
	Cold spell	Occasional	2	Minor	Minor	Negligible	Minor	Minor	Negligible	Minor	1.71
	Heavy snowfall	Occasional	2	Minor	Minor	Minor	Negligible	Minor	Negligible	Minor	1.71
	Increase in Relative Sea Level	Occasional	2	Negligible	Negligible	Minor	Negligible	Negligible	Negligible	Minor	1.29
	Groundwater flood	Occasional	2	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	1.00

Appendix F Assessment of Future Climate Hazards and Impacts

Assesment of Future Climate Hazards					
Hazard No.	Hazard Type		Current Frequency	Projected Frequency	Evidence Base
1		River flood	Common	Frequent	An analysis of river flows over a period of more than 50 years of data (1972-2017) indicates an increase in river flows across most of the country (Status of Ireland's Climate, EPA) and an increase in the projected frequency of very wet days (>30mm of precipitation) which will likely increase the frequency of flood events (www.climateireland.ie).
2		Pluvial flood	Common	Frequent	When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA) and an increase in the projected frequency of very wet days (>30mm of precipitation). Projections of precipitation indicate that precipitation is expected to become more variable with increases in dry periods in the summer and heavy precipitation in winter (www.climateireland.ie).
3		Above average precipitation	Occasional	Common	When compared with an annual average rainfall of 1186mm in the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall. The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increasing trend in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA).
4		Extreme precipitation	Frequent	Very Frequent	There is an increase in the projected frequency of very wet days (>30mm of precipitation) (Status of Ireland's Climate, EPA) and observed increases in the levels of winter rainfall but a decrease in summer rainfall (www.climateireland.ie).
5		Severe windstorm	Common	Frequent	No long-term trend in wind speed can be determined with confidence based on the limited analysis carried out to date. Climate projections (www.climateireland.ie) indicate an decrease in the number of less intense storms but an increase in the storms which are rare events. Due to a limited number of studies, these projections should be considered with a high level of caution (A Multi-model ensemble approach, EPA).
6		Groundwater flood	Occasional	Occasional	When compared with an annual average rainfall of 1186mm in the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall. The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increasing trend in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA). This may increase the frequency of groundwater flood events, but not enough to increase to Common.
7		Increase in Relative Sea Level	Occasional	Occasional	Satellite observations indicate that sea levels around Ireland have increased by approximately 2-3 mm per year since the 1990s (The Status of Ireland's Climate, EPA). The effects on river flooding as a result are not expected to raise the frequency to Common.
8		Heatwave	Common	Frequent	Climate projections (www.climateireland.ie) indicate an increase in the average surface air temperatures across all seasons which will likely increase the intensity and frequency of heatwaves. There has been an increase in the number of warm days (temperature > 20°C). This is in line with trends evident for the rest of Western Europe (Status of Ireland's Climate, EPA).
9		Drought	Common	Frequent	Climate projections (www.climateireland.ie) indicate an increase in the average surface temperature as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA) which will likely increase the intensity and frequency of droughts in the summer. An analysis on river flows over a period from 1992-2017 suggests an increase in drought conditions in the summer, particularly in the east of the country (Status of Ireland's Climate, EPA).
10		Above average surface temperature	Common	Frequent	Climate projections (www.climateireland.ie) indicate an increase in the average surface air temperatures across all seasons which will likely increase the intensity and frequency of heatwaves. There has been an increase in the number of warm days (temperature > 20°C). This is in line with trends evident for the rest of Western Europe (Status of Ireland's Climate, EPA).
11		Cold spell	Occasional	Occasional	There has been a decrease in the number of frost days (temperatures below 0°C) and a shortening of the frost season duration (www.climateireland.ie).
12		Heavy snowfall	Occasional	Occasional	Snowfall is projected to decrease substantially by the middle of the century (Nolan and Flanagan), but not to the extent where the frequency is considered rare.

Assesment of Future Climate Impacts - Asset Damage					
Hazard No.	Hazard Type		Current Asset Damage	Projected Change	Rationale
1		River flood	Major	Major	Densification of urban areas to deliver compact growth will potentially increase the amount of properties at risk of flooding. However, the Kilkenny CDP outlines an objective to ensure vulnerable developments are directed away from areas at risk of flooding. Works will also be continued with OPW to develop flood relief schemes and maintain existing defences. There is a likely increase in river flows across most of the country leading to an increase in severity of flooding (Climate Ireland).
2		Pluvial flood	Moderate	Moderate	Similarly to river flooding, densification of urban areas will potentially increase the amount of properties at risk. Adpatation and spatial planning goals include the conversion of land at risk of flooding to less vulnerable uses e.g. parks, gardens and open spaces for natural habitats (Kilkenny CDP). Works will also be continued with OPW to develop flood relief schemes and maintain existing defences. When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
3		Above average precipitation	Moderate	Moderate	Future developments will be required to utilise sustainable urban drainage systems to control the release of water runoff in a managed way (Kilkenny CDP). The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increasing trend in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA). This implies there is an increase in severity in winter periods but a reduction in summer periods.
4		Extreme precipitation	Moderate	Moderate	Future developments will be required to utilise sustainable urban drainage systems to control the release of water runoff in a managed way (Kilkenny CDP). When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
5		Severe windstorm	Minor	Moderate	Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved.
6		Groundwater flood	Negligible	Negligible	Projections indicate an increasing trend in winter rainfall, but climate actions include avoiding vulnerable development in areas under threat from flooding (Kilkenny CDP).
7		Increase in Relative Sea Level	Negligible	Negligible	Satellite observations indicate that sea levels around Ireland have increased by approximately 2-3 mm per year since the 1990s (The Status of Ireland's Climate, EPA). However, this will unlikely increase the impact.
8		Heatwave	Minor	Minor	Average surface air temperatures are expected to increase across all seasons which will likely increase the intensity of heatwaves (Climate Ireland). New building regulations and materials will be required for use in new developments to accomodate this, but there will also be an increase in the impact of heatwaves due to more compacted urban areas (Kilkenny CDP).
9		Drought	Minor	Moderate	Average surface temperature are exptected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA), leading to an increase in the impact of droughts.
10		Above average surface temperature	Negligible	Negligible	Average surface air temperatures across all seasons are expected to increase (Climate Ireland). New building design and materials will be introduced to accomodate hotter summers without compromising resilience to other climate changes, but densification of urban areas will potentially increase the solar radiation of urban areas (Kilkenny CDP).
11		Cold spell	Minor	Minor	No changes in the assets affected. There has been a decrease in the number of frost days (temperatures below 0°C) and a shortening of the frost season duration, with projections to be in line with current trends (Climate Ireland). However, the impact remains as a minor impact.
12		Heavy snowfall	Minor	Minor	No changes in the assets affected. Snowfall is projected to decrease substantially by the middle of the century (Nolan and Flanagan), but impacts will remain the same.

Assessment of Future Climate Impacts - Health and Wellbeing

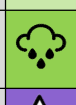
Hazard No.	Hazard Type		Current Health and Wellbeing Impact	Projected Change	Rationale
1		River flood	Major	Major	Densification of urban areas to deliver compact growth will potentially increase the amount of properties at risk of flooding. However, the Kilkenny CDP outlines an objective to ensure vulnerable developments are directed away from areas at risk of flooding. Works will also be continued with OPW to develop flood relief schemes and maintain existing defences. There is a likely increase in river flows across most of the country leading to an increase in severity of flooding (Climate Ireland).
2		Pluvial flood	Minor	Minor	The Kilkenny CDP outlines an objective to ensure vulnerable developments are directed away from areas at risk of flooding. Compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
3		Above average precipitation	Minor	Minor	No change in health and wellbeing. The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increasing trend in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA). This implies there is an increase in severity in winter periods but a reduction in summer periods.
4		Extreme precipitation	Minor	Minor	When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA). This increase in rainfall intensity is seen during the winter season while summers will see a decrease in the level of precipitation, balancing one another.
5		Severe windstorm	Moderate	Major	Changing demographics with an increase in elderly population and densification of urban areas will potentially increase exposure and vulnerability (Kilkenny LECP). Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved.
6		Groundwater flood	Negligible	Negligible	Objectives set out in the Kilkenny CDP outline a goal of ensuring vulnerable developments are directed away from areas at risk of flooding.
7		Increase in Relative Sea Level	Negligible	Negligible	Satellite observations indicate that sea levels around Ireland have increased by approximately 2-3 mm per year since the 1990s (The Status of Ireland's Climate, EPA). However, this will unlikely increase the impact.
8		Heatwave	Moderate	Moderate	Average surface air temperatures are expected to increase across all seasons which will likely increase the intensity of heatwaves (Climate Ireland). Protecting and expanding green infrastructure will help to reduce the increase in intensity of this event (Kilkenny CDP).
9		Drought	Moderate	Major	Changing demographics with an increase in elderly population and densification of urban areas will potentially increase exposure and vulnerability (Kilkenny LECP). Average surface temperature are exptected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).
10		Above average surface temperature	Negligible	Negligible	Average surface air temperatures across all seasons are expected to increase (Climate Ireland). Adaptation goals for County Kilkenny include the expansion of the county's green infrastructure, reducing any impacts to health and wellbeing by ensuring the presence of facilities to use in high temperatures (Kilkenny CDP).
11		Cold spell	Minor	Minor	Increase in vulnerable population, e.g., elderly population, may increase the possible impacts (Kilkenny LECP). However, there has been a decrease in the number of frost days (temperatures below 0°C) and a shortening of the frost season duration, with projections to be in line with current trends (Climate Ireland). However, the impact remains as a minor impact.
12		Heavy snowfall	Minor	Minor	The increasing elderly population increases the possible impacts of heavy snowfalls (Kilkenny LECP). However, snowfall is projected to decrease substantially by the middle of the century (Nolan and Flanagan), but impacts will remain the same.

Assessment of Future Climate Impacts - Environment				
Hazard No.	Hazard Type	Current Environment Impact	Projected Change	Rationale
1	River flood	Moderate	Moderate	Actions to mitigate impacts include managing development in flood risk areas and requiring SuDS to be used in all relevant developments to avoid surface water run-off and pollutants entering watercourses (Kilkenny CDP). There is a likely increase in river flows across most of the country leading to an increase in severity of flooding (Climate Ireland).
2	Pluvial flood	Minor	Moderate	Actions to mitigate impacts include managing development in flood risk areas and requiring SuDS to be used in all relevant developments to avoid surface water run-off and pollutants entering watercourses (Kilkenny CDP). When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
3	Above average precipitation	Minor	Minor	Requirement for the use of SuDS in new developments mitigate the effects of impacts to the environment (Kilkenny CDP). The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increasing trend in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA). This implies there is an increase in severity in winter periods but a reduction in summer periods.
4	Extreme precipitation	Minor	Moderate	Requirement for the use of SuDS in new developments mitigate the effects of impacts to the environment (Kilkenny CDP). When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
5	Severe windstorm	Moderate	Major	Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved. Protection measures are being implemented on ecosystems such as dune habitat systems (Kilkenny CDP).
6	Groundwater flood	Negligible	Negligible	Actions to mitigate impacts include managing development in flood risk areas in all relevant developments to avoid surface water run-off and pollutants entering watercourses (Kilkenny CDP).
7	Increase in Relative Sea Level	Minor	Minor	Satellite observations indicate that sea levels around Ireland have increased by approximately 2-3 mm per year since the 1990s (The Status of Ireland's Climate, EPA). However, this will unlikely increase the impact.
8	Heatwave	Moderate	Major	Changes in phenology are projected to be experienced as average surface air temperatures are expected to increase across all seasons which will likely increase the intensity of heatwaves (Climate Ireland). This will affect the blooming seasons of flora, affecting the pollinating cycle.
9	Drought	Moderate	Major	Given the overall effect of climate change on environmental assets, many will be stressed from a range of factors, reducing the capacity of these assets to sustain acute and chronic events leading to an expected increase in impact. Average surface temperature are exptected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).
10	Above average surface temperature	Major	Catastrophic	Changes in phenology are projected to be experienced as average surface air temperatures across all seasons are expected to increase (Climate Ireland). This will affect the blooming seasons of flora, affecting the pollinating cycle.
11	Cold spell	Negligible	Negligible	There has been a decrease in the number of frost days (temperatures below 0°C) and a shortening of the frost season duration, with projections to be in line with current trends (Climate Ireland). However, the impact remains negligible.
12	Heavy snowfall	Minor	Minor	Snowfall is projected to decrease substantially by the middle of the century (Nolan and Flanagan), but impacts will remain the same.

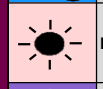
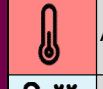
Assessment of Future Climate Impacts - Social					
Hazard No.	Hazard Type		Current Social Impact	Projected Change	Rationale
1		River flood	Moderate	Moderate	Actions to avoid locating vulnerable developments in areas at risk of flooding are envisaged (Kilkenny CDP). There is a likely increase in river flows across most of the country leading to an increase in severity of flooding (Climate Ireland).
2		Pluvial flood	Minor	Minor	Actions to avoid locating vulnerable developments in areas at risk of flooding are envisaged (Kilkenny CDP). When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
3		Above average precipitation	Minor	Minor	Ensuring adequate availability/knowledge of meaningful physical activity (Kilkenny LECP). The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increasing trend in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA). This implies there is an increase in severity in winter periods but a reduction in summer periods.
4		Extreme precipitation	Minor	Minor	Ensuring adequate availability/knowledge of meaningful physical activity (Kilkenny LECP). When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
5		Severe windstorm	Minor	Minor	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability (Kilkenny LECP). Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved for the vulnerable population, e.g., the homeless.
6		Groundwater flood	Negligible	Negligible	Actions to avoid locating vulnerable developments in areas at risk of flooding are envisaged (Kilkenny CDP).
7		Increase in Relative Sea Level	Negligible	Negligible	Satellite observations indicate that sea levels around Ireland have increased by approximately 2-3 mm per year since the 1990s (The Status of Ireland's Climate, EPA). However, this will unlikely increase the impact.
8		Heatwave	Minor	Minor	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability (Kilkenny LECP). Average surface air temperatures are expected to increase across all seasons which will likely increase the intensity of heatwaves (Climate Ireland).
9		Drought	Moderate	Moderate	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability however, not enough to make this a moderate future impact. Average surface temperature are exptected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).
10		Above average surface temperature	Negligible	Minor	Average surface air temperatures across all seasons are expected to increase (Climate Ireland). Uncomfortable conditions for more vulnerable population may be at risk of an increased impact.
11		Cold spell	Minor	Minor	There has been a decrease in the number of frost days (temperatures below 0°C) and a shortening of the frost season duration, with projections to be in line with current trends (Climate Ireland). However, the impact remains as a minor impact.
12		Heavy snowfall	Negligible	Negligible	Snowfall is projected to decrease substantially by the middle of the century (Nolan and Flanagan), but impacts will remain the same.

Assessment of Future Climate Impacts - Financial					
Hazard No.	Hazard Type		Current Financial Impact	Projected Change	Rationale
1		River flood	Moderate	Major	The increase in impact across a range of areas of the local authority could lead to an increasing financial burden on the local authority (Kilkenny CDP). There is a likely increase in river flows across most of the country leading to an increase in severity of flooding (Climate Ireland).
2		Pluvial flood	Negligible	Minor	The increase in impact across a range of areas of the local authority could lead to an increasing financial burden on the local authority (Kilkenny CDP). When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
3		Above average precipitation	Negligible	Negligible	The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increasing trend in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA). This implies there is an increase in severity in winter periods but a reduction in summer periods. It is unlikely the finincial burden will be increased.
4		Extreme precipitation	Minor	Minor	When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
5		Severe windstorm	Negligible	Minor	The increase in impact across a range of areas of the local authority could lead to an increasing financial burden on the local authority (Kilkenny CDP). Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved.
6		Groundwater flood	Negligible	Negligible	It is unlikely there will be a change in impact on finances in terms of groundwater flooding as developments are under guidance to avoid areas at risk (Kilkenny CDP).
7		Increase in Relative Sea Level	Negligible	Negligible	Satellite observations indicate that sea levels around Ireland have increased by approximately 2-3 mm per year since the 1990s (The Status of Ireland's Climate, EPA). However, this will unlikely increase the impact.
8		Heatwave	Negligible	Negligible	Average surface air temperatures are expected to increase across all seasons which will likely increase the intensity of heatwaves (Climate Ireland). Use of new materials to accommodate higher temperatures are unlikely to increase the financial burden to the point where the impacts are minor (Kilkenny CDP).
9		Drought	Minor	Moderate	Average surface temperature are exptected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA). Drier summers result in an increasing financial burden for the provision of water.
10		Above average surface temperature	Negligible	Negligible	Average surface air temperatures across all seasons are expected to increase (Climate Ireland). A possible increase in the measures to protect and enhance green infrastructure to accommodate this increase in baseline temperatures may lead to an increased burden on finances, but not enough to create minor impacts.
11		Cold spell	Minor	Minor	There has been a decrease in the number of frost days (temperatures below 0°C) and a shortening of the frost season duration, with projections to be in line with current trends (Climate Ireland). However, the impact remains as a minor impact.
12		Heavy snowfall	Minor	Minor	Snowfall is projected to decrease substantially by the middle of the century (Nolan and Flanagan), but impacts will remain the same.

Assessment of Future Climate Impacts - Reputational				
Hazard No.	Hazard Type	Current Reputational Impact	Projected Change	Rationale
1	River flood	Moderate	Moderate	There is a likely increase in river flows across most of the country leading to an increase in severity of flooding (Climate Ireland). The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives. The CARO progress report 2022 indicates progress has been made with regards to climate change adaptation implementation with this event.
2	Pluvial flood	Minor	Minor	When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA). The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives. The CARO progress report 2022 indicates progress has been made with regards to climate change adaptation implementation with this event.
3	Above average precipitation	Negligible	Negligible	The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increasing trend in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA). This implies there is an increase in severity in winter periods but a reduction in summer periods. The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives. The CARO progress report 2022 indicates progress has been made with regards to climate change adaptation implementation.
4	Extreme precipitation	Minor	Minor	When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives. The CARO progress report 2022 indicates progress has been made with regards to climate change adaptation implementation.
5	Severe windstorm	Negligible	Negligible	Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved. The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives. The CARO progress report 2022 indicates progress has been made with regards to climate change adaptation implementation.
6	Groundwater flood	Negligible	Negligible	Actions to avoid locating vulnerable developments in areas at risk of flooding are envisaged (Kilkenny CDP).
7	Increase in Relative Sea Level	Negligible	Negligible	Satellite observations indicate that sea levels around Ireland have increased by approximately 2-3 mm per year since the 1990s (The Status of Ireland's Climate, EPA). However, this will unlikely increase the impact.
8	Heatwave	Negligible	Negligible	Average surface air temperatures are expected to increase across all seasons which will likely increase the intensity of heatwaves (Climate Ireland). The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives. The CARO progress report 2022 indicates progress has been made with regards to climate change adaptation implementation.
9	Drought	Minor	Moderate	Average surface temperature are exptected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives.
10	Above average surface temperature	Negligible	Negligible	Average surface air temperatures across all seasons are expected to increase (Climate Ireland). The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives. The CARO progress report 2022 indicates progress has been made with regards to climate change adaptation implementation.
11	Cold spell	Negligible	Negligible	There has been a decrease in the number of frost days (temperatures below 0°C) and a shortening of the frost season duration, with projections to be in line with current trends (Climate Ireland). However, the impact remains negligible.
12	Heavy snowfall	Negligible	Negligible	Snowfall is projected to decrease substantially by the middle of the century (Nolan and Flanagan), but impacts will remain the same.

Assessment of Future Climate Impacts - Cultural Heritage					
Hazard No.	Hazard Type		Current Cultural Heritage Impact	Projected Change	Rationale
1		River flood	Moderate	Major	There could be an increase in the number of cultural heritage assets exposed to river flooding due to an increase in severity of flooding events. There is a likely increase in river flows across most of the country leading to an increase in severity of flooding (Climate Ireland). The objective is to continue to work alongside OPW to carry out flood relief schemes and maintain existing defences (Kilkenny CDP).
2		Pluvial flood	Minor	Moderate	There could be an increase in the number of cultural heritage assets exposed to pluvial flooding due to an increase in severity of flooding events, and an increase in the overall impact is expected. When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA). The objective is to continue to work alongside OPW to carry out flood relief schemes and maintain existing defences (Kilkenny CDP).
3		Above average precipitation	Moderate	Moderate	Above average precipitation does not impact the majority of cultural heritage assets so a significant increase in overall impact is not envisaged. The last decade from 2006 - 2015 has been the wettest period in the period 1711- 2016 and there is evidence of an increase in winter rainfall and a decreasing trend in summer rainfall (Status of Ireland's Climate, EPA). This implies there is an increase in severity in winter periods but a reduction in summer periods.
4		Extreme precipitation	Moderate	Moderate	Extreme precipitation does not impact the majority of cultural heritage assets so a significant increase in overall impact is not envisaged. When compared with an annual average rainfall of 1186mm for the period 1961-1990, the thirty year period 1990-2019 shows a 70mm or almost 7% increase in rainfall (Status of Ireland's Climate, EPA).
5		Severe windstorm	Moderate	Moderate	The projected changes in severe windstorms indicate a reduction in lesser storms but an increase in major storms. The overall impact is expected to remain relatively unchanged as storms may be less frequent but the damage caused may increase. Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved.
6		Groundwater flood	Negligible	Negligible	There could be an increase in the number of cultural heritage assets exposed to groundwater flooding due to an increase in severity of these events, but not enough to raise the impact to minor (Climate Ireland).
7		Increase in Relative Sea Level	Minor	Minor	Satellite observations indicate that sea levels around Ireland have increased by approximately 2-3 mm per year since the 1990s (The Status of Ireland's Climate, EPA). However, this will unlikely increase the impact.
8		Heatwave	Moderate	Moderate	Areas of cultural heritage may have an increase in visitors during these events, increasing pressure on these areas, but not enough to increase the impact. Average surface air temperatures are expected to increase across all seasons which will likely increase the intensity of heatwaves (Climate Ireland).
9		Drought	Negligible	Negligible	Droughts do not impact the majority of cultural heritage assets so a significant increase in overall impact is not envisaged (Kilkenny CDP). Average surface temperature are exptected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).
10		Above average surface temperature	Moderate	Moderate	Areas of cultural heritage may have an increase in visitors as a result of increased average surface temperatures, increasing pressure on these areas, but not enough to increase a major impact. Average surface air temperatures across all seasons are expected to increase (Climate Ireland).
11		Cold spell	Minor	Minor	Cold spells do not impact the majority of cultural heritage assets so a significant increase in overall impact is not envisaged. There has been a decrease in the number of frost days (temperatures below 0°C) and a shortening of the frost season duration, with projections to be in line with current trends (Climate Ireland). However, the impact remains as a minor impact.
12		Heavy snowfall	Minor	Minor	Heavy snowfalls do not impact the majority of cultural heritage assets so a significant increase in overall impact is not envisaged. Snowfall is projected to decrease substantially by the middle of the century (Nolan and Flanagan), but impacts will remain the same.

Appendix G Future Impact Summary Matrix

FUTURE IMPACTS		Hazard Type	Projected Frequency	Projected Frequency (Score)	Asset Damage	Health and Wellbeing	Environment	Social	Financial	Reputation	Cultural Heritage	Projected Impact
		River flood	Frequent	4	Major	Major	Moderate	Moderate	Major	Moderate	Major	3.57
		Drought	Frequent	4	Moderate	Major	Major	Moderate	Moderate	Moderate	Negligible	3.00
		Severe windstorm	Frequent	4	Moderate	Major	Major	Minor	Minor	Negligible	Moderate	2.71
		Pluvial flood	Frequent	4	Moderate	Minor	Moderate	Minor	Minor	Minor	Moderate	2.43
		Extreme precipitation	Very Frequent	5	Moderate	Minor	Moderate	Minor	Minor	Minor	Moderate	2.43
		Heatwave	Frequent	4	Minor	Moderate	Major	Minor	Negligible	Negligible	Moderate	2.29
		Above average precipitation	Common	3	Moderate	Minor	Minor	Minor	Negligible	Negligible	Moderate	2.00
		Above average surface temperature	Frequent	4	Negligible	Negligible	Catastrophic	Minor	Negligible	Negligible	Moderate	2.00
		Cold spell	Occasional	2	Minor	Minor	Negligible	Minor	Minor	Negligible	Minor	1.71
		Heavy snowfall	Occasional	2	Minor	Minor	Minor	Negligible	Minor	Negligible	Minor	1.71
		Increase in Relative Sea Level	Occasional	2	Negligible	Negligible	Minor	Negligible	Negligible	Negligible	Minor	1.29
		Groundwater flood	Occasional	2	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	1.00