TIER 1 CLIMATE CHANGE RISK ASSESSMENT

Waterford City & County Council

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1 EXECUTIVE SUMMARY

On behalf of Waterford City & County Council (WCCC), RPS has prepared a Tier 1 Qualitative Local Authority Climate Change Risk Assessment (CCRA) as part of the Development of the Local Authority Climate Action Plan (LACAP). In accordance with the methodology provided in Annex B of the LACAP, this report provides for an assessment of the current and future climate risks and impacts on the operations and efficient delivery of services by the local authority. The assessment of these risks will raise awareness of the consequences of climate change, identify climate change adaptation intervention, helps to prioritise risks, and helps to monitor and track changes in climate risks.

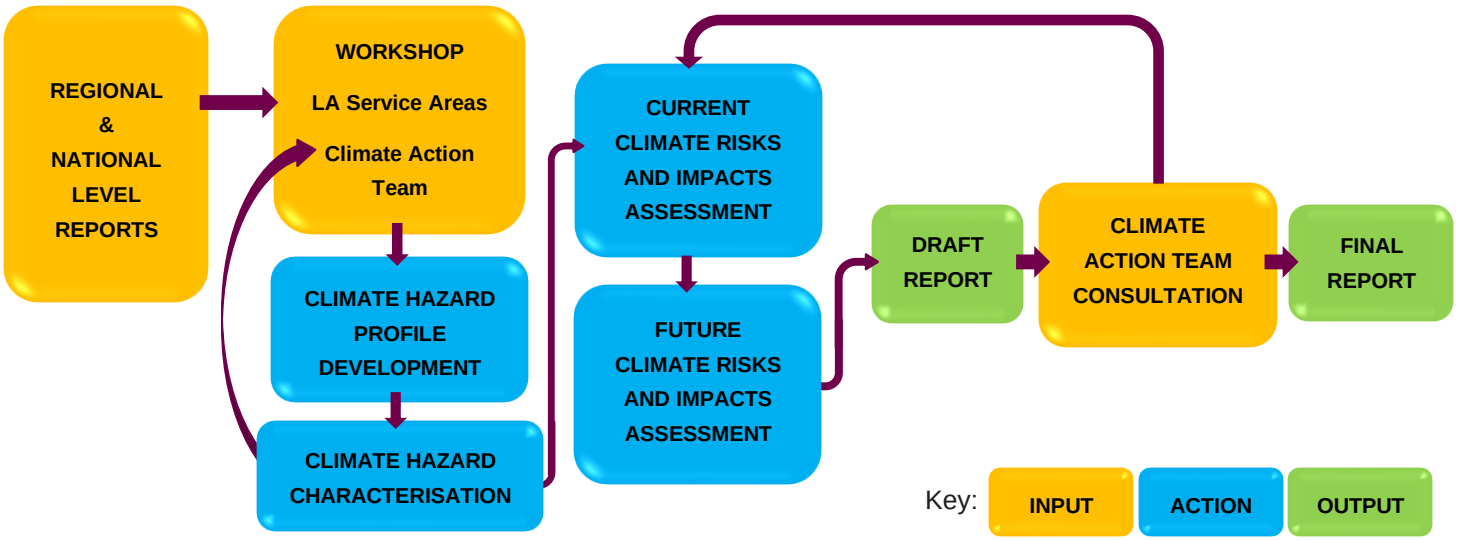
The review undertaken for this CCRA included collating existing regional and national level data relating to climate event followed by a multi-party workshop with key service area stakeholders within Waterford City & County Council to review of historic climate events, hazards, impacts, exposures and vulnerabilities.

This process resulted in the development of a climate hazard profile for County Waterford. 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 Waterford were identified as: River Flooding; Coastal Flooding; and Coastal Erosion.

Increasing impacts are envisaged for future climate events across the majority of climate hazards however future projections indicate that flooding and erosion risk are likely to remain as the most significant.

This CCRA can be used to inform the general strategies to mitigate current and future impacts. Based on these strategies and further quantitative assessment, supported by detailed climate event records as recommended in this report, more detailed mitigation measures can be identified.



2 CONTEXT

The National Climate Change Adaptation Framework (NCCAF) developed in 2013 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.

2012
NCCAF

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.

2015
CA & LCDA

The Climate Action and Low Carbon Development Act 2015 (CA & LCDA) 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 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.

2017
NMP
2018
NAF

The annual review of the adaptation progress in Ireland[1] 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[2] 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.

2019
CCAS

This Climate Change Risk Assessment (CCRA) will inform the next iteration of the Waterford City & County Council Climate Change Adaptation Strategy (CCAS) which will constitute part of the NAF.

CCRAs aim to further our understanding of the risks posed from the changing climate and form an integral 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.

2023
CCRA

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

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

3 INTRODUCTION

RPS was contracted in November 2022 to carry out a Tier 1 Qualitative Local Authority Climate Change Risk Assessment (CCRA) for Waterford City & 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[3]. 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. 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.

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[4]:

- **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.

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

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

- **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. It has been acknowledged that the Sixth Assessment Report was published on the 20 March 2023, however this report refers to the Fifth IPCC Assessment Report as this was available at the date of completing the CCRA.

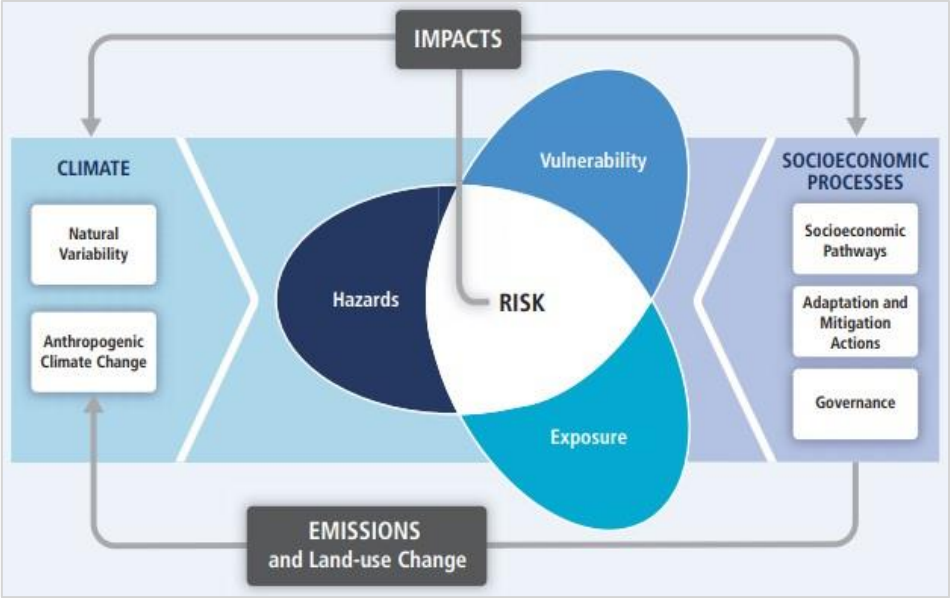


Figure 3-1: The Intergovernmental Panel on Climate Change Assessment Report 5 Framework of Climate Risk which shows how the three components of risk (hazards, exposure, vulnerability) are connected to climate and socioeconomic processes[5]

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.

[5] 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 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.

- 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 Waterford and was developed on the basis of the existing local authority adaptation strategy guidelines[6] , along with the *'Adaptation to climate change - Guidelines on vulnerability, impacts and risk assessment'* International Standard[7] , guidance on the climate proofing of infrastructure[8] , the National Risk Assessment of Impacts of Climate Change[9] , 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 Waterford City & 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

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

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

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

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

4 COUNTY WATERFORD

Waterford is a coastal county in the southeast of Ireland with a total area of 1857 km^2. It is bordered by four counties, Kilkenny, Wexford, Cork and Tipperary. The geography of the county is relatively flat with about 10% of the land area being mountainous and the remainder being small hills dispersed throughout the county.

The county has two main mountain ranges. The Comeragh Mountains stretch from just north of Dungarvan to beyond the north border and into Tipperary. On the northwest border are the Knockmealdown Mountains which also stretch to Co. Tipperary. There are two other smaller mountainous areas, one being between Dungarvan and the Cork border and the other being between the Comeragh's and Waterford City. The highest peak being, Knockmealdown at 792.4m, is in the north-west region of Waterford.

Land area of **185,700 ha**

Approximately **100km** of coastline

Just under **27,000 ha** of forestry

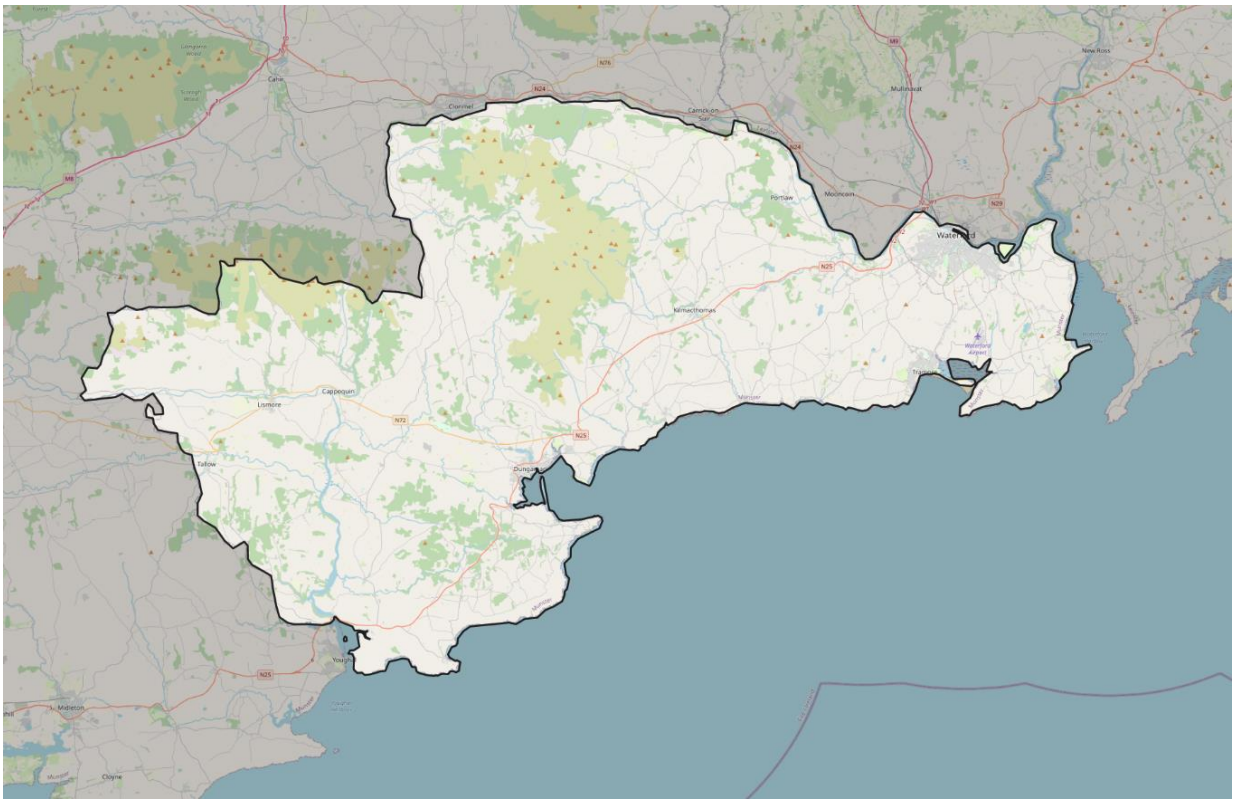


Figure 4-1: Characteristics of Waterford

Population in 2016: 116,086

0 to 24 Years: 27.8%

65 and over: 15%

The Primary and Secondary Service Centres are Waterford City and Dungarvan respectively[10]. The road Network in Waterford consists of 104km of national roads. The population of Waterford County stood at 116,086 in 2016[11]. According to the 2016 Census, the population aged 0 to 24 years represents 27.8% of the total population, and the over 65 years represents 15% of the total population living in the County.

[10] WCCC. Waterford City & County Development Plan 2022-2028. 2022

[11] www.cso.ie

The main river flowing through Waterford is the River Suir which has a length of 183km and rises in Devil's Bit Mountain in Tipperary. The Rivers Bride and Blackwater are the other two main rivers flowing through Waterford. Waterford City is the largest urban centre situated within the Suir catchment area, which drains a total area of 3,610km².

There is circa 26,950 ha of forestry cover which is 14.5% of the total land area of the county. Across Waterford County, the total area of bogland is 905 ha and the total area of peatland is 3446 ha which represents percentage coverage of Waterford County of 0.5% and 1.86% for bogland and peatland respectively.

Main river: River Suir

Length: 183km

Waterford has a coastline of circa 100km which includes The Copper Coast Geopark which is 25km of rugged coastline. The coastline also includes seaside resorts of Tramore, Dunmore East & Ardmore The coastline also has a variety of ecosystems including tidal flats, rocky headlands, shallow blue flag beaches, tidal marshes, cliff faces, shallow bays and estuarine flats. A large percentage of land is arable, and a significant percentage is also used for farming. Waterford also has a regional airport, which is located 3km from Tramore at an elevation of 36m. There is also a shipping port located on the estuary within close proximity to Waterford City.

These characteristics of the County can reduce or exacerbate the impacts of climate hazard types and provides a better understanding as to which hazards are most damaging.

5 WORKSHOP

RPS facilitated a workshop with Waterford City & County Council on Monday 21st November 2022.

The workshop was productive in providing a platform to share understanding of current climate hazards across WCCC 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 WCCC 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 WCCC services were represented within the workshop:

- Community
- Roads and Transport
- Heritage
- Environment
- Water
- Planning
- Housing
- Human Resources
- I.T.
- Emergency services
- Coastal
- Finance
- Library Services
- Business

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 Waterford City & County Council, to create a bespoke but consistent CCRA output that meets the needs at a local authority level.

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 Waterford City & County Council and its administrative area, and
- Assessing the exposures and vulnerabilities of Waterford City & County Council and its administrative area to these hazards.

6.1 Climate Hazards Profile

In collaboration and consultation with WCCC, and with the collective input by the Eastern & Midlands CARO County Councils of Wexford, Kilkenny, 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.

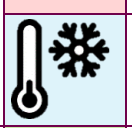
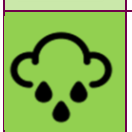
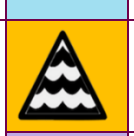
It is important to consider and identify, that many climate hazards are created or exacerbated by a pre-condition, e.g., a heavy rainfall event on saturated soils resulting in flooding. In addition, it is important to consider that the co-occurrence of multiple climate hazards can directly or indirectly 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 Waterford 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 Waterford. This hazard type classification was adapted from IPCC[12].

[12] "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 Waterford 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
Wind		Severe Windstorms
Snow and Ice		Heavy Snowfall
Coastal		Increase in Relative Sea Level
		Storm Surge
		Coastal Flood
		Coastal Erosion

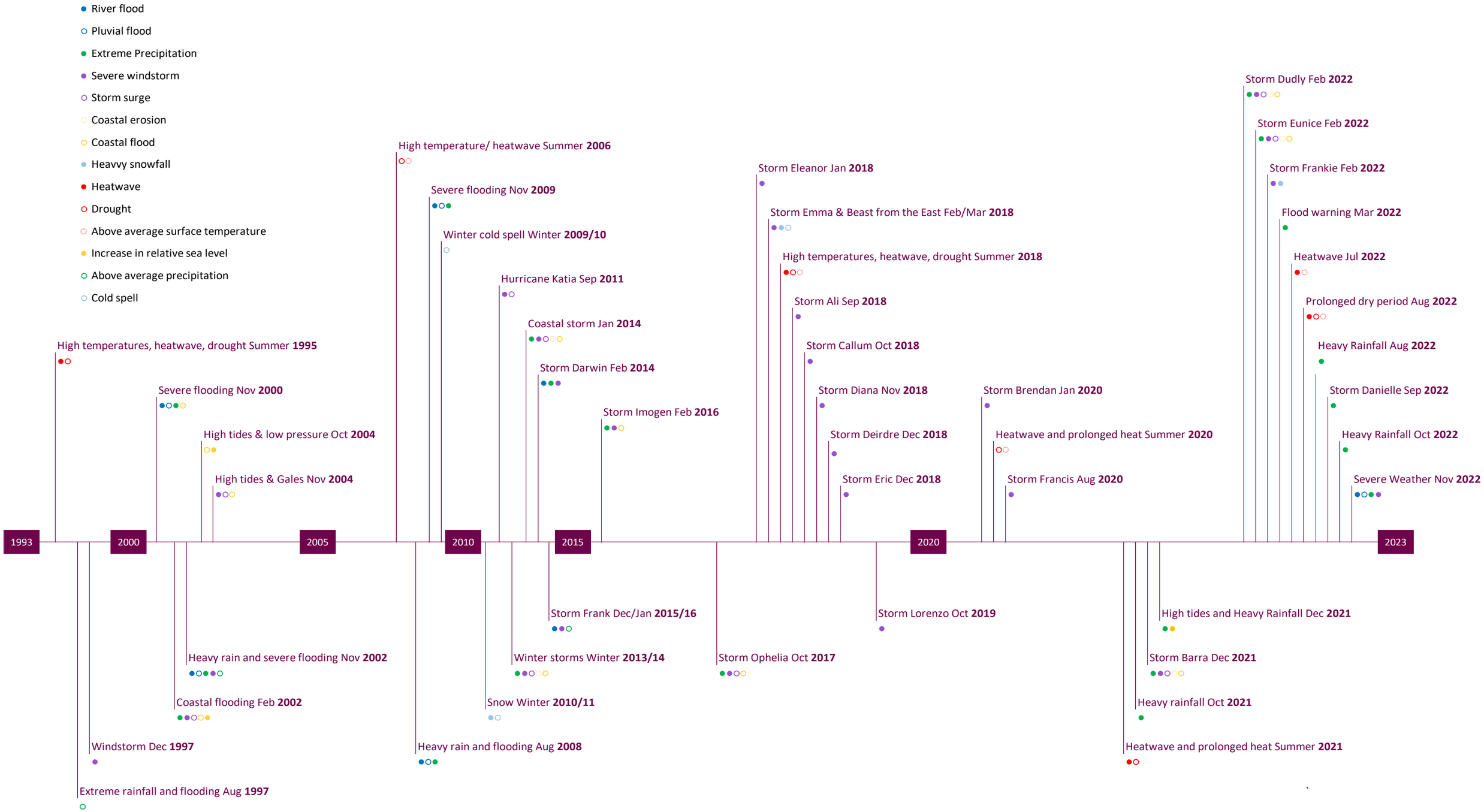


Figure 6-1: Climate Hazard Profile of County Waterford: Representative timeline of climate hazards illustrated to show type of hazard and frequency

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*[13] 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*[14], 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, WCCC developed a Severe Weather Plan for Flooding which sets out the strategy and protocols for responding to such events, highlighting the presence of flood risk[15].

6.2.1.1.1 River Flooding

River 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.

At least seven occurrences of significant river flooding in County Waterford 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 report works, water quality impacts, environmental contamination, stress on biodiversity and environmentally sensitive areas in additional to ongoing socio-economic implications and pressure on overworked emergency response staff over prolonged periods.

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. Nine locations in County Waterford were designated AFAs, these were:

Aglish, Ballyduff, Dungarvan & Environs, Dunmore East, Portlaw, Ringphuca, Tallow, Tramore & Environs, and Waterford[16].

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

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

[15] WCCC. Waterford City & County Council Major Emergency Plan. 2016

[16] www.floodinfo.ie

Flood barriers in Waterford

A Flood Risk Management Plan (FRMP) for the Suir River Basin, a FRMP for the Colligan – Mahon River Basin, and a FRMP for the Blackwater (Munster) River Basin were completed in 2018. The Plans set out the strategy, including a set of measures, for the cost effective and sustainable, long-term management of flood risk in the respective River Basins, including the areas where the flood risk has been determined as being potentially significant. The Plans includes feasible measures developed through a range of programmes or policy initiatives including: – 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[17].

In addition to the above FRMP, 615 properties in Waterford City were protected by a Flood Relief Scheme (FRS) in 2016 at an estimated cost of €26mn. An additional 13 properties are also due to be protected through the ongoing Ballyduff FRS. Outside of these larger schemes, minor mitigation works undertaken since 2010 include 18 no. projects at a combined cost of €1,211,334 across County Waterford.

November 2022

River water levels rose overnight - Flood Response Team required to monitor the water levels

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.

November 2009

Flooding around inner ring road Tramore road

The collated record of hazard events for Waterford identifies five 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.

[17] www.floodinfo.ie

6.2.1.1.3 Coastal Flooding

Coastal Flooding

Coastal flooding occurs when sea levels along the coast or in estuaries exceed neighbouring land levels or overcome coastal defences. Extreme wave conditions and surge effects can arise due to wind speed and direction and low-pressure systems which force water into estuaries and harbours. This event typically arises in tandem with storm surges and/or high sea levels.

Eleven events of coastal flooding are noted within the collated 30-year hazard event profile for the county. The potential coastal flooding risk to Irish coasts, in particular Waterford, is mapped in the South Coast Protection Strategy Studies[18]. These predictive flood maps show potential flood risk predominantly in or near coastal settlements. Primary areas identified with potential coastal flood risk include Waterford City, Tramore, and Dungarvan.

February 2020

Coastal flooding in the towns of Dungarvan and Tramore. WCCC clean-up crews deployed

6.2.1.2 Extreme Precipitation

Extreme Precipitation

Extreme precipitation events are periods of rainfall occurring at a higher frequency and intensity than normal, usually leading to flooding. There is a high risk of flooding due to the extreme rainfall. There is also the possibility of water bodies being contaminated and having increased turbidity, reducing the water quality. The extreme precipitation may also lead to the cancellation of any outdoor events. Ireland has been monitoring rain levels since the late 1700s with two monitoring stations and has reached just under 500 rain gauges to this day[19]. There are twenty instances of extreme precipitation events noted within the hazard events record, highlighting its regular occurrence.

November 2022

Deterioration of water quality due to high turbidity

[18] OPW. Irish Coastal Protection Strategy Study Phase 3 - South Coast. 2011

[19] 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*[20], windstorms are listed as one of the priority climate risks in Ireland.

The hazard events record shows a total of 26 severe windstorm events in County Waterford, the most regularly occurring event in the County.

February 2021

Gusts up to 130km/hr brought about fallen trees and blocked roads county wide, and major power outages

6.2.1.4 Storm Surge

Storm Surge

Storm surges are events where a storm, which is typically brought about by low pressures, produces strong winds that push the seawater onto shore. Infrastructure located in coastal areas are vulnerable to these surges. Similarly, to flooding events, critical infrastructure may be exposed due to the seawater being pushed onto shore, resulting in disrupted transport routes and an increase in clean-up, maintenance, and repair costs. The strong winds which carry the seawater also carries its own risks which are like that of severe windstorm events. The EPA Risk Assessment Report indicates that coastal infrastructure in Ireland is particularly vulnerable to storm surges and changes in storm frequency in many areas in Ireland[20].

Storm Brendan storm surges

November 2004

Passage East and Dungarvan affected. Tramore promenade closed and damage to bridges was noted

Nine storm surge events are noted in the hazard events record for Waterford in the past 30 years. The risk of storm surges is influenced by wind and tide levels, and an increase in relative sea level would increase the baseline risk of the event. Both Tramore and Ardmore are at risk of wave overtopping during storms, highlighting the vulnerability of these areas[21].

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

[21] OPW. Irish Coastal Protection Strategy Study Phase 3 - South Coast. 2011

6.2.1.5 Coastal Erosion

Coastal Erosion

Coastal erosion is the breaking down and carrying away of materials by the sea. Coastal erosion is often a gradual process where visible signs are not always noticeable but can also lead to vulnerable land to suddenly give way. Soft coasts are susceptible to high erosion rates which can lead to the destruction of infrastructure, such as roads and urban residential areas, and natural heritage that is in contact with the sea.

1980's Storm

Destructive storm which accelerated erosion rates, raising awareness of coastal erosion

The South Irish Coastal Protection Strategy Study showed that the primary identified area of potential coastal erosion risk is Tramore[22]. The mean annualised erosion rate of all areas along the pilot coastline where an erosion hazard was identified was approximately 0.3 metres. In the 1980's, a destructive storm which accelerated erosion rates led to a perceived need to seriously address the question of coastal erosion[23]. There are five records of coastal erosion in the last 30 years based on the hazard events record. These events contained slow onset erosion rather than immediate effects on the coastlines.

8 sites containing sand dune habitat systems were identified and reviewed along the Waterford Coastline[24]:

- 2 no. designated pNHA – Duncannon Sandhills and Dungarvan Harbour;
- 2 no. cSAC – Waterford Harbour and Tramore Dunes and Backstrand; and
- 4 no. undesignated sites.

Coastal heritage sites are also a significant concern, particularly the four promontory fort sites along the coasts of Waterford:

- The Woodstown promontory fort on the eastern side of Annestown Strand with the banks and ditches suffering from severe erosion today.
- The three promontory forts at Ballyvoyle Head in Islandhubbock, thehighest cliffs of the Copper Coast in County Waterford.
- The concentration of eight forts around Ballynarrid near Bunmahon. One fort in particular, Illaunabrick, is difficult to reach due to erosion and is almost a sea stack, while Templeobrick is a stack today.
- The larger promontory fort at Dunabratin Head along the Copper coast which has signs of erosion from the slumping of the cliff of the smaller promontory fort and narrow gullies between islets.

[22] OPW. Irish Coastal Protection Strategy Study Phase 3 - South Coast. 2011

[23] ECOPRO Project. Environmentally Friendly Coastal Protection - Code of Practice. 1996

[24] National Parks and Wildlife Service. Coastal Monitoring Project. 2009

6.2.1.6 Heavy Snowfall

Heavy Snowfall

Civil Defence during Storm Emma

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[25]. 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[26].

Three recorded heavy snowfall events in Waterford in the last 30 years were identified from the hazard events record. The last major heavy snowfall event recorded was in February/March 2108 during Storm Emma and the Beast from the East.

Feb/Mar 2018

Blizzard like conditions led to disruption to business, emergency services, power cuts, and transport networks

6.2.1.7 Heatwave

Heatwave


Results of soft tar

The working national definition of a heatwave is five consecutive of days or more with maximum temperature over 25 degrees Celsius[26]. 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 the location and type of historic wildfires in Ireland and gives a visual representation of what areas have experienced wildfires, highlighting the need to monitor heatwaves due to its influence on wildfires[27].

August 2022

Consistent temperatures above 25°C. Hot weather warnings were issued

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

[26] www.met.ie

[27] CCC, EPA, UCC, DOECC. Fire, Land & Atmospheric, Remote Sensing of Emissions (FLARES). 2021

There is also the potential for increased pressure on services and infrastructure in parts of Waterford City & Council as people from inland counties migrate to coastal villages and agglomerations. 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[28]. In the last 30 years, there has been evidence of at least six heatwave events experienced in Waterford based on the hazard events record.

6.2.1.8 Drought

Drought

August 2022

Water conservation notices were issued for "drought-prone" areas

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[28].

There were five records of droughts being experienced in Waterford in the last 30 years based on the hazard events record.

6.2.1.9 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.

July 2022

Temperatures in the 25-30°C range for the month

In the last 30 years, there were five events in the hazard events record which suggest above average surface temperatures were noticed. These prolonged extreme temperatures resulted in fire safety warnings being issued by the Fire Department and the Department of Agriculture. 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[28]. There is also the potential for increased pressure on services and infrastructure in parts of Waterford City & County as people from inland counties migrate to coastal villages and agglomerations.

[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 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. Low lying regions along the coast are at risk of an increase in frequency of hazards such as storm surges and coastal flooding as higher sea levels reduce the height needed to cause these hazards. Critical infrastructure located in these low-lying regions will be subject to increased risk to coastal flooding, coastal erosion, and storm surges. Studies from the *National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action*[29] also indicate that sea level rise is amongst the highest priority climate risks on a national basis.

October 2004

During high water levels, winds caused flooding in Dungarvan, resulting in cars being washed away

There have been three occasions noted in the hazard events record where there has been a noticeable impact on infrastructure due to the increase in sea levels in the past 30 years. Conditions in October 2004 led to water levels being 1m above usual levels as a result of a low pressure in the area. Problems arose when the presence of winds caused flooding in Dungarvan, resulting in a rising main had been washed out along a Greenway. The main issue with this hazard is how it exacerbates the impacts and potential frequency of other coastal hazards such as storm surges and coastal flooding.

6.2.1.11 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. Above average precipitation can lead to more time spent indoors which can affect mental health. A decrease in active travel may also be present which leads to increased use of vehicles running on fossil fuels. Drainage systems may be at risk of reaching capacity as they would be designed for a lower level of precipitation. Observations from the *National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action*[29] 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.

Three events noted in the hazard events record indicate above average precipitation levels in Waterford in the last 30 years. The main issue when there is an increase in average precipitation levels is the increase in the risk of both pluvial and river flooding. Urban areas may not be designed to contain increased levels of rain and result in an increase in flood frequency.

January 2016

Wettest January on record, with 126% of monthly long term average rainfall

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

6.2.1.12 Cold Spell

Winter 2010/2011

Daytime averages below freezing

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[30].

The hazard events record indicates that on three occasions in the last 30 years, Waterford experienced cold spells events.

6.2.2 Frequency

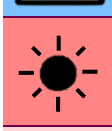
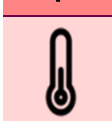
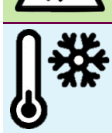
Through development of the Climate Hazards Profile, the frequency of climate hazard types affecting County Waterford becomes more apparent. Using the classification categories adopted from Annex B shown in **Table 6-2**, the frequency of existing climate hazard types can be grouped into 5 broad categories. These have then been applied to the hazard types historically affecting County Waterford. The recorded information indicated that Severe Windstorms often combined with Extreme Precipitation, are the most frequently occurring climate hazards for County Waterford.

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

[30] www.met.ie

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

	Hazard Type	Occurrences	Frequency
	Severe Windstorm	26	Very Frequent
	Extreme Precipitation	20	Very Frequent
	Coastal Flooding	11	Common
	Storm Surge	9	Common
	River Flooding	7	Common
	Heatwave	6	Common
	Pluvial Flooding	5	Common
	Drought	5	Common
	Above Average Surface Temperature	5	Common
	Coastal Erosion	5	Common
	Heavy Snowfall	3	Common
	Above Average Precipitation	3	Common
	Cold Spell	3	Common
	Increase in Relative Sea Level	3	Common

6.3 Overall Impact to the Local Authority

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 Waterford.

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.

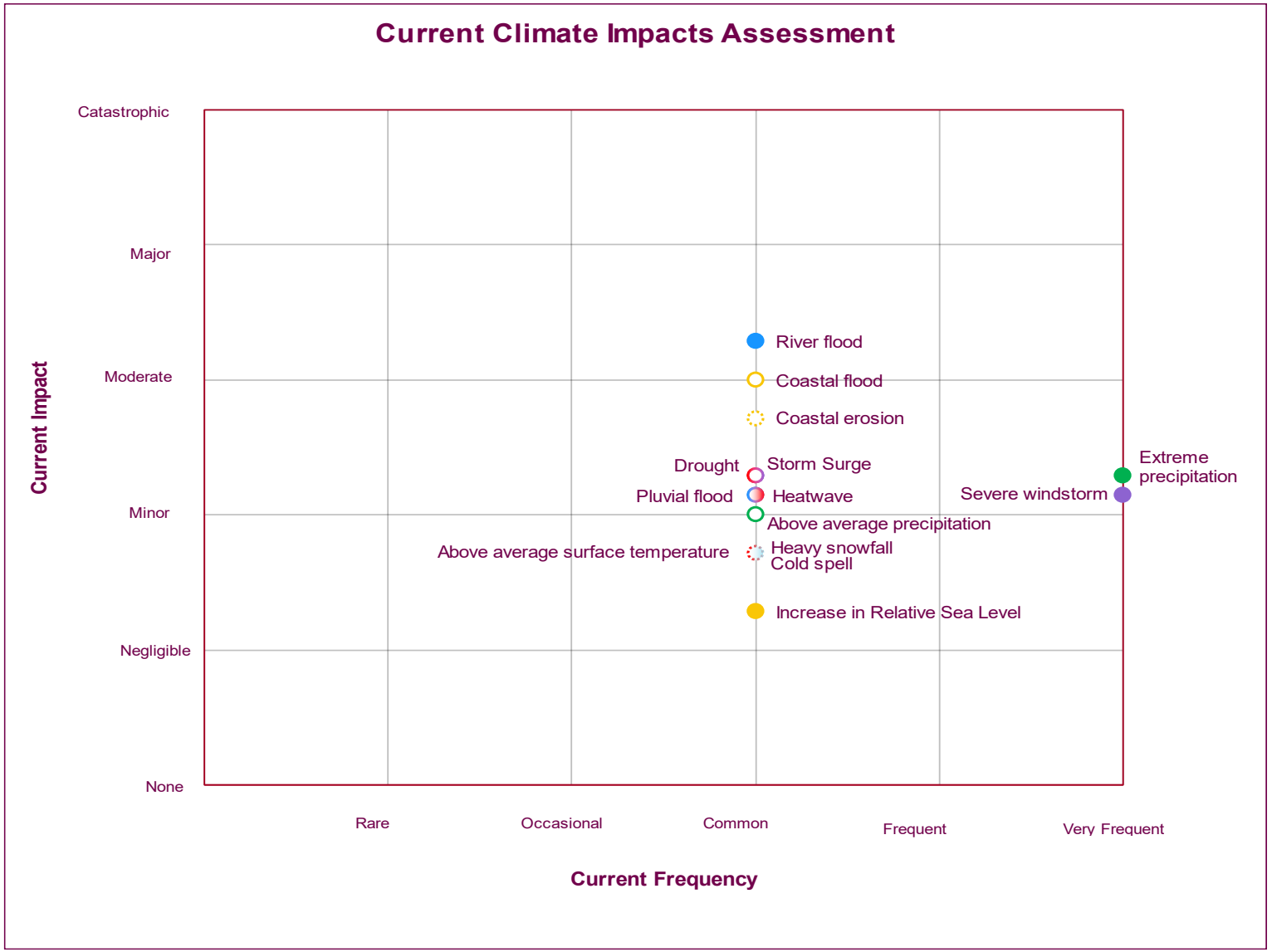


Figure 6-2: Current Climate Impacts Assessment for County Waterford

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 WCCC 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 Waterford City & 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 WCCC 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 WCCC. 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.

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

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

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 Waterford County Development Plan 2022-2028[34] and the Waterford Local Economic and Community Plan 2016-2022[35]. 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] WCCC. Waterford County Development Plan 2022-2028. 2022

[35] WCCC. Waterford Local Economic and Community Plan 2016-2022. 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 WCCC and taking into account the character of Waterford and its assets, risks associated with wildfires are likely to emerge in the years ahead.

The increasing risk of prolonged dry periods, above average temperatures and heatwaves is projected to lead to a continued reduction is soil moisture content leading to drier conditions and higher fuel loads. Notes collected during the workshop demonstrate the increase in observed risk by the Fire Services and the changing nature of this risk. UCC have established a monitoring and recording programme[36] to collate information about wildfires in Ireland and should support the collation of data and impacts as this risk is projected to emerge.

- Fires, Land and Atmospheric Remote Sensing of Emissions (FLARES) undertaken by UCC aims to develop systematic approaches to the acquisition and collation of a range of data on agricultural and uncontrolled wildland burning events from satellite datasets.
- The drying out of bogs is becoming more of a concern, as they are extremely difficult to extinguish if they catch fire. In addition, a large portion of the bogland in the county is designated as SAC and in some cases SPA.

These increased temperatures may also lead to increased problems with invasive species as the changing environment promotes their growth. Seasonal changes are a significant emerging risk to pollination, as pollinators are showing signs of becoming offset from the time for pollination.

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. 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.

[36] CCC, EPA, UCC, DOECC. Fire, Land & Atmospheric, Remote Sensing of Emissions (FLARES). 2021

7.6 Future Climate Impacts Assessment Summary

After producing the Future Impact Summary Matrix, the future climate impacts of hazards projected to impact Waterford'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.

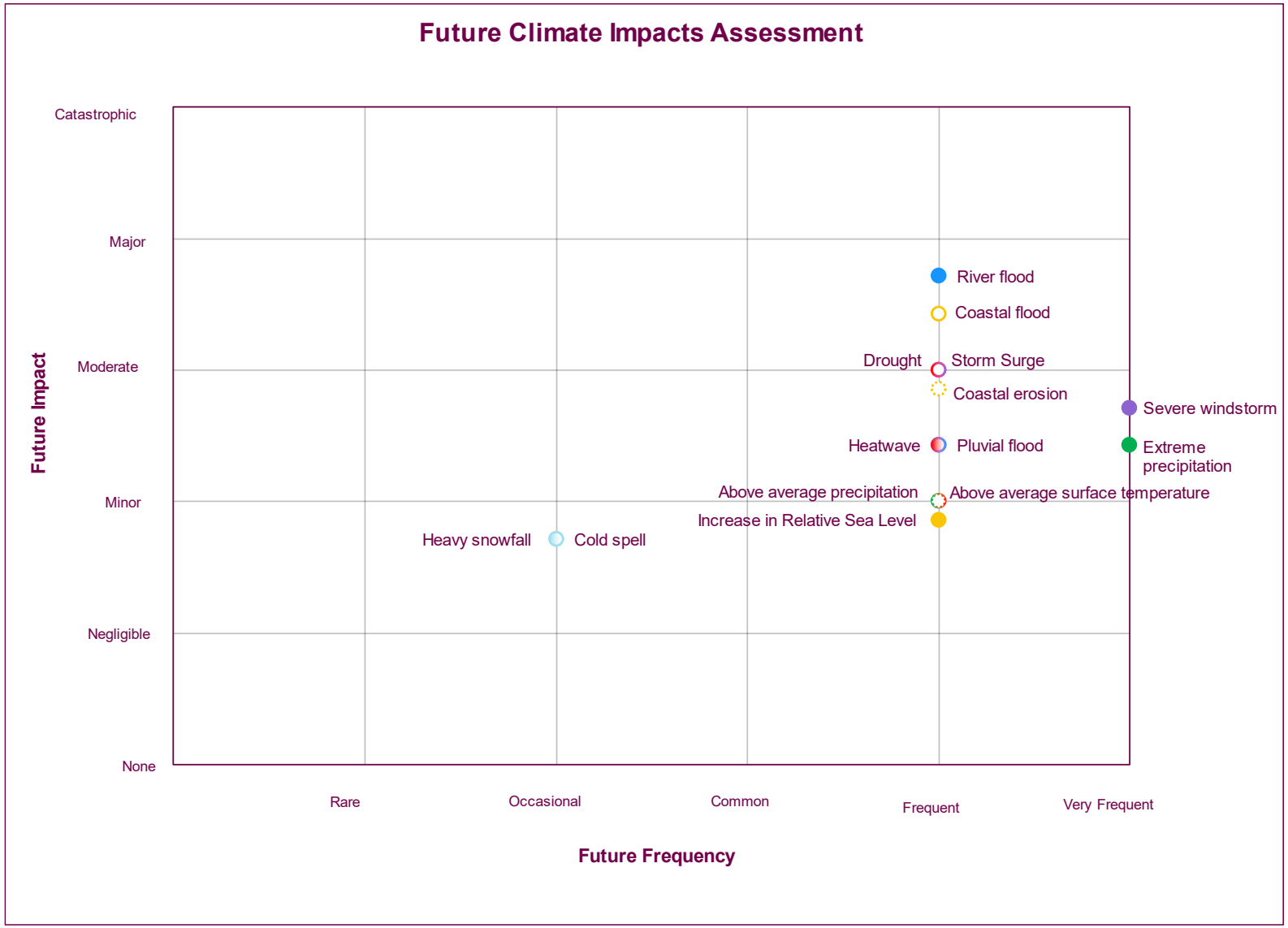


Figure 7-1: Future Climate Impacts Assessment for County Waterford

8 SUMMARY AND CONCLUSION

This CCRA Report summarises the steps undertaken to assess the climate change risks within WCCC. 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.

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

Key Climate Hazards identified for Waterford City & County:

River Flooding

Coastal Flooding

Coastal Erosion

Future projections of climate change indicate that Above Average Precipitation, Prolonged Cold Periods and Heavy Snowfall will remain relatively consistent with existing conditions. However, risk is predicted to increase for all other identified climate hazards, with River Flooding remaining the perceived highest risk to County Waterford.

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.
- The data gathering phase of this assessment identified that there is no systematic approach within Waterford City & County Council to record climate related observations and records in an indexed or easily accessible method. It is recommended that all Service Areas within the local authority adopt a consistent approach to recording service disruptions, mitigation or recovery measures implemented and associated costs for any areas within their remit, and that WCCC produce an annual summary report documenting all climate hazard impacts across all Service Areas.

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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 - Waterford County Council
Workshop date:	21 November 2022
Workshop location:	Waterford City & County Council Offices

Attendees

Name	Initials	Sector/Service
Jack Doyle	JD	IT
Niall Curtain	NC	Emergency Services
Raymond Maloney	RM	Environment
Graham Keeffe	GKee	Environment
Niall Kane	NK	Environment
Eoin Dullae	ED	Environment
Fergus Galvin	FG	Transport & Water
Bernadette Guest	BG	Heritage Officer & Planning
Liam Mc Guirk	LMG	Planning
Colum Flynn	CF	Water Services
James Murray	JM	Roads & Active Travel
Gavin Breen	GB	Facilities
Liam Fleming	LF	Environment
Grainne Kennedy	GK	Environment & Climate Action
Nicola Keating	NiK	Roads
Tim Cooke	TC	RPS
James Peters	JP	RPS
Aidan Ware	AW	RPS

Notes

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:

- Storm Emma (Beast from the East) Feb/March 2018 and the impacts experienced by the council services was discussed by the attendees:
    - Frozen water pipes and subsequent bursts in the water network was a significant issue which resulted in talking out supplies to significantly large areas. Same issue as brought up by Wexford that a big problem was older services and pipes being laid above the frost line freezing and bursting.
    - Access to treatment sites (both water & wastewater) was problematic this impacted on operators getting to site as well as delivery of chemicals and other consumables which put the quality of treatment at risk.
    - There was a large portion of roads that incurred damage and were blocked that caused communities to be cut off in particularly the rural communities and areas that took days to get out and clear roads and get supplies to them.
    - The mobilisation of emergency services and crews for long periods of time in order to respond to emergencies, clear roads, treat roads with slats, deliver supplies to vulnerable communities and people etc. was a struggle and put extreme pressure on resource. Relying on the same pool of people to work long hours under harsh conditions for long periods of time, burnout was a concern.
    - Health services were significantly affected, just getting critical and urgent care patients to health services was a challenge, but the added pressure of getting staff to work in the poor conditions was exacerbated the problem and stretched resources not to mention delivery of medication and medical supplies to patients in home care and getting health service staff to and from these locations.
    - Rural locations were very much cut off from health and emergency services.
    - There was an issue with immediate emergency response just could not get to people and took longer to get places as well as a long-term impact of getting to critical/long term care patients that were at home care or in remote health care facilities.
    - Getting deliveries to shops and re-stocking food supplies was a serious issue, shop shelves were empty for days on end as supply trucks could not get access to areas. Council were relied upon to get food and supplies into areas that could not be accesses by the normal delivery mechanisms.
    - There was widespread closures of non-essential business and closures of schools also. Only emergency services and critical services were in operation. Pre-COVID so people were not as prepared as they are now for remote working or learning.
    - There was gradual thaw so there was no significant impact on storm networks or due to surface run-off, however it could be a completely different story if there was a rapid rise in temperature and a quick thaw occurred as mention in the notes for Wexford.
    - Limited back-up power generation in WCC buildings as such they are extremely vulnerable to power outages.
    - The issue around the safety of the personnel being mobilised was raised similar to other counties. They are sensing their people out in more extreme weather conditions, more often and putting their health and safety at higher risk. Also, the people making the decisions to send these people out can suffer form serious stress and anxiety as well as remorse and more significant mental health issues if the worst was to happen.

Notes

- It was noted that during storm Ophelia approx. 2,500 trees had to be cleared once the storm had passed.
- Mixed impacts during storm events due to road blockages and downed trees. Typically, it has a greater impact on rural communities and isolated industries which can be mostly affected due to limited routes to and from the areas. Whereas the major routes to larger rural areas and centres of industry typically have alternative routes if one or more routes get blocked. Typically, the major roadways are cleared first as more people are complaining and most people impacted, and it slowly works its way down to the more isolated areas and as such they can be cut off for longer.
- There is an increased risk to personnel during clean-up operations following storm events there often times can be hidden hazards to health & safety in an already dangerous environment. In addition, there is the risk to public safety, do-gooders trying to help in the clear up effort can often put themselves at significant risk that can result in injury or death putting further strain on emergency services.
- Long period of cold weather in 2009 (coldest spell since 1963 with 30 days of snow and ice in some places):
    - Only major roads could be adequately slated/ploughed resulting in more remote and rural areas being cut off for long periods until such time as the council crews could get out and clear the roads. Shortage of road salt exacerbated this issue.
    - All the issues of prolonged period of cold were experienced during this cold spell and one very large issue again was snow drifts not melting and increased resources having to be called upon from sub-contractors to clear these snow drifts resulting in increased costs.
    - WCC have a protocol in place to aid the homeless population during extreme weather events.
    - The national salt shortage experienced in 2009 was a big lesson learnt in terms of planning for harsh winters and requirments of salt and equipment to service major and minor road networks to prevent the same thing happening again.
- Coastal flooding is a significant hazard that Waterford are exposed to there is a lot of low-lying towns and cities along the coastline that are vulnerable to coastal flooding which can be significantly exacerbated by coastal surges.
    - There has been a number of flood relief schemes put in place over the years to mitigate against this hazard. These schemes are reliant storm pumps to over pump surface run off due to rainfall while the defences are engaged, heavy rainfall can put these pumps under pressure and if they fail the flood defences can prevent the flow of this water out and cause flooding.
    - Maintenance programme for these pumps is critical and must be kept on top of and kept up to date.
    - There is a flood defence warning system in place to enact the rection of the installed flood defences it is tried and tested at this stage and is almost an automatic response now and errors on the side of caution in order to mitigate risk.
- In October 2004 there was a significant storm surge that ended up causing flooding to buildings housing archives one of which was the Tax office.
- Storm Frank in 2015 the water levels in the River Suir reached record high levels and it was noted that there was persistent heavy rain for the previous 2 months and that significant intense rainfall during Storm Frank then exacerbated the problem and cause flooding.
- Prolonged rain periods can increase the risk of flooding to roads, the ground is saturated and rainfall has no where to go so runs off adjacent land and onto road surfaces and floods road, this is a particular problem for tertiary road (typically un designed with no drainage network, relying on drainage ditches or drainage to adjacent land or gravel drains).

Climate Hazard Breakdown:

For the second stage of the workshop TC brought the attendees through the different hazard classifications identified for the county and the attendees were invited to identify the hazards impacts, exposures and vulnerabilities.

Windstorms:

Notes

- It was agreed by consensus of the attendees that the frequency of this hazard event was increasing in recent times and should be categorised as Very Frequent.
- A big vulnerability to this hazard is quality of construction and ensuring things are built to correct standards and are designed to account for wind loading.
- It was noted that roof damage is the most common form of damage seen to physical assets and that older structures in particularly built heritage structures with older roofs and aging materials can be more vulnerable to windstorms.
- Storm Ophelia in 2017 caused significant damage due to the high winds and the clean-up effort lasted approx. 7-10days with a significant cost to the council.
- IT and water services noted that telemetry signals can be affected during high winds due to damage of ariels on outstations as well as loss of power to same.
- The very nature of derelict properties and lack of upkeep and degradation over time increase their vulnerability to the impacts of windstorms.
- Seasonality plays a very large role in the impacts windstorms have on damage to trees and vegetation, winter storms the effect on larger trees and vegetation can be alleviated due to the less foliage while the opposite is true for spring/summer where the full foliage results in a sail effect increasing the impact of the wind on trees and vegetation.
- The loss of power during windstorms is a significant impact and can result in loss of communications between services and to mobilised crews similar to Wexford.
- Emergency services operate on the TETRA system so have some reliance to this in addition there call out system to take emergency calls has battery backups that can last for 24-48hrs in the case of power outages.
- There is back-up power generation in place in the building where the emergency response team is housed as well as in some of the fire stations.
- When it was queried about WTP & WWTP and their vulnerability to power outages and windstorms it was noted that this is an IW problem as they are responsible for these sites.
- In terms of closures of roads and bridges during high winds there are none that are put in place however there are warnings in place for high sided vehicles on some roads and bridges. There are alternative routes available in these instances however there is a risk that these may be blocked due to other impacts of the storm event such as downed trees, flooding etc.

Pluvial Flooding:

- There is a significant impact on quality of water bodies which can affect potable water abstractions with turbidity in the abstracted water being the main issue and the plants unable to treat for the level of turbidity in the abstracted water.
- Silt run-off from construction sites and infrastructure projects can have a significant impact on water bodies.
- The there is a vulnerability in relation to pluvial flooding coinciding with possible coastal or fluvial flooding with reliance on storm pumps and the capacity of the existing storm network. This is particularly true for areas with flood defences in place where the flood defences to protect from the coastal and/or fluvial flooding can prevent the pluvial run-off from getting out and causes flooding.
- There can be a significant impact on beaches and bathing water quality due to surface water run-off as well as increased floes through storm water overflows/outfalls (some of which can be from combined systems).
- A vulnerability of pluvial flooding is the management and maintenance of storm management systems, the example given was that some of the SUDs drainage systems can become ineffective if not maintained correctly and can exacerbate the issue is some a cases.
- The increased storm flows through combined networks can have a significant impact on the storm management systems in place at WWTP and result in significant overflows of untreated effluent directly to the environment.

Notes

- There has been historical land slides and bog bursts within the county with some landslides blocking roads for days at a time given how long it can take to clear them safely.
- The Harvest festival was cancelled in the past due to pluvial flooding.

River Flooding:

- Damage to intakes of WTP, similar issues that were raised by Wexford.
- Emergency Services can be over extended as they have to respond to non-emergency events such as over pumping of water, rescuing cars that tried to drive through flood waters etc, this puts pressure on responding to the baseload and actual emergencies and can reduce response time which can cost lives.
- The surcharging of MH's during river flooding can be a common occurrence and the lids can be removed, the fact that an open manhole is in the road or footpath can be hidden by flood waters and poses a significant risk to health & safety of the public, emergency services and council crews.
- There is a huge H&S risk as a result of "Flood Tourism" with people putting themselves in danger and then needing to be rescued putting emergency services in unnecessary danger. People have been known to go out kayaking or canoeing during river flooding and poses a huge risk as well as those just coming out to look at the flood defences up and in action.
- If flood defences are breached/overcome the flooding event tends to be catastrophic with significant impacts as the perception is that the area is protected. TC mentioned that the risk of this happening should be designed into flood defences and mitigated as much as possible.
- A discussion was had about flood defences only being as good as the warning system in place as well as the method of deployment (manual or automatic) and everything being put in place correctly. One section of a flood gate missing could make the whole defence system useless. The flood defences in place in Waterford County rely on people going out and deploying the systems which is a vulnerability. Having a good maintenance plan in place is critical as well as good protocols in place for deploying flood defence systems.
- There is an issue with potable water supply for treatment plants to smaller water supply zones that do not have adequate 24hr emergency storage so any impact on water supply to these areas can be very significant as there is no storage.
- River flooding can cause issues with bathing water quality in rivers and at beaches.
- A comment was made that the impact on the elderly population of flooding events can be much more severe as they may lose a home or material possessions, they have had all their lives and it can take longer for them to recover and subsequent flood warnings and events can severely impact their mental health as they become anxious and concerned due to past events.
- WCC can often be the first-place people go to for assistance following displacement during flooding events and seen as the last chance saloon when people have exhausted all other avenues.
- Insurance is becoming a very large issue in more recent times as once an area floods insurance companies will be slow to provide flooding insurance.
- There is a reliance on council services to help with the clean up effort after flooding events and this is not just for areas they are responsible for they aid in the clean up of private properties and businesses also, all hands to the wheel effort.
- The civil defence are called out in almost all flooding events in order to get people safely out of flooded houses/areas.
- The impact on local businesses can be significant due to property damage, loss of stock (exacerbated by power outages for perishables that need to be refrigerated/frozen), long term closures for repairs etc.

Coastal Flooding:

- Coastal flooding can wash sand, silt and debris into the storm network, causing blockages and exacerbating the flooding as well as potential downstream impacts at WWTP on combined networks.
- It can cause the dumping of significant amounts of debris and rubbish (plastics in particular) into the flooded areas.

Notes

- There are some coastal flood defences in place across the county, but more can be done as a lot of low-lying coastal towns, Dungarvan was mentioned as being particularly vulnerable.
- Coastal flooding has a significant impact on tourism, leisure and recreation given that Waterford is a coastal county with significant amounts of coastal amenities and coastal tourism.
- The county has 9 SACs and 6 SPAs with a large portion of these being located along the coats line and that are impacted by coastal flooding.
- The county also has a large number of coastal walkaways that can be damaged during these flood events as well as requiring to be closed for H&S reasons which can have a negative impact on the community as tourism.
- Heritage sites and structures along the coastline can be at particular risk to coastal flooding, it was noted that erosion of the coastline and cliff erosion is what is putting these at most risk.
- There was study done that mapped coastal and island heritage and archaeology sites vs flood mapping to determine the potential risk of climate change on them. *https://www.gsi.ie/en-ie/programmes-and-projects/marine-and-coastal-unit/projects/Pages/CHERISH.aspx*
- Habitats in the coastal environment is significantly impacted by coastal flooding and the seasonality of the event can increase or decrease the impacts.

Sea Level Rise:

- Heritage and archaeological sites along the coastline are at risk, similarly SPA & SACs.
- Loss of coastal amenitiy areas.
- The higher sea levels can result in more saltwater getting in the ground water which can end up infiltration the storm network or getting into potable water supplies and the increases salinity can have a detrimental effect on the life span of infrastructure particularly mechanical equipment. This can be a particular problem in WTP & WWTP where increased salinity can disrupt the treatment processes.
- Raising of water tables due to sea level rise could also impact on the effectiveness of landfill leachate treatment systems as well as impacting on the leachate collection systems.
- The increase in sea levels will have a knock-on impact on the levels of other water bodies also which poses a risk to available free board to structures that will reduce over time increasing the risk of damage to the structures or blockages preventing water from passing through etc.

Storm Surge:

- There was an instance in the past were a storm surge resulted in buried services being lifted out of the ground (large diameter rising main). In addition, services that are passing through bridges and other structures that are susceptible to damage from storm surges can end up being severely damaged during storm events.
- Coastal walkways and cliff walks are exposed to damage from storm surges and increased land erosion caused by same. Public realm areas at threat along the coast must be closed.
- “Storm Tourism” was brought up again and the issues this brings with public safety and mobilisation of emergency services for avoidable call outs.
- There can be a big issue with people going out surfing in storm surges again putting themselves and emergency services at risk and putting additional stress on emergency services base load.
- Damage across the board to marinas, docks, harbours and coastal infrastructure on a whole.

Cold Spell:

- Buildings constructed during the Boom years are causing issues due to the poor quality of construction resulting in poor instillation, inefficient heating, pipes bursting etc.
- Emergency water supplies for emergency services can be affected.
- Freezing of roads and footpaths van cause heaving of the subbase and surface this is a particular issue for non-designed roads (typically tertiary roads), the longer cold spells increases the risk of pot holes forming.

Notes

- Prolonged cold spells can have an impact on major road infrastructure projects as the same crews working on these must be diverted for treatment of roads with salt and clearing of snow/ice build up etc which impacts on the day-to-day works. Similarly annual maintenance programmes can be delayed due to diversion of resources as well as temperatures being too low for completing surfacing or laying sub-bases etc.
- The prolonged periods of salting of roads can have an environmental impact increasing the salinity in adjacent soils as well as in the surface water run-off which makes its way into the surrounding environment.

Heavy Snowfall:

- There are increased pressures on Emergency Services due to people putting themselves at unnecessary risk. Council road crews can be under severe pressure to clear roads and assist emergency services.
- The training and upkeep of training for people to be suitably qualified to operate the machinery and equipment needed in these vents is critical, no point in having all the equipment but nobody trained too use it.
- The equipment available to the council for clearing snow is only sufficient to a point, once the snowfall hits a certain level the ploughs at their disposal just can't cope and they can do nothing but wait and typically need the assistance of larger machinery that they have to sub-contract in to clear the snow.

Above Average Temp:

- Prolonged warm spells can impact roads annual maintenance programmes due to diversion of resources temperatures being too high for completing surfacing or laying sub-bases etc.
- Can lead to soil cracking which has significant impact on soil stability and can be of particular concern along coastlines and exacerbate coastal erosion/cliff collapse.
- Water safety is impacted, typically hot spells lead to increased use of bathing waters and increases in deaths and injuries.
- Same issue raised as in Wexford. Huge stresses on infrastructure for getting people to the sunny southeast to make the most of the good weather, especially when it can be relied upon and planned. All the problems that come with an influx of people to areas outside of the day-to-day population become an impact and puts severe stresses on services that the council provide across the board.
- Higher surface temperatures can result in increased wear an tear of roads surfaces in particularly on bitumen based surfaces and surface dressed roads.
- There can be limited shaded areas available to the public which has an impact of their health and wellbeing as well as an impact on the environment and biodiversity.
- Heat stress to trees can result in them becoming weaker and more prone to branches falling of or trees falling and all the impacts this entails.
- Similar concerns raised around water demand and supply, demand increases in hotter weather while sources may be under stress at the same time, all the same concerns that were raised by Wexford.

Heatwaves:

- Stresses from influx of people for outside the normal population and all that this entail, same as what was pointed out above for above average temps.
- There is a significant increase to the risk of fires due to a combination of dried out conditions and increased activity of people lighting campfires, BBQ's, increased use of forest areas etc.
- It was noted that the effect of dry spells and heatwaves can have a delayed impact on the occurrence significant fires, as farmers are waiting to burn off until the dry spell is over, this subsequently leads to larger stockpiles and areas to be burned off as they build up and then result in a larger amount of "controlled" burn offs by farmers becoming out of control.
- The Fire services mentioned they think that going forward the incidences of wildfires and forest fires are going to increase and are already exploring the use of controlled burns or pre-burns to mitigate against these.

Notes

- Predominantly the wildfires seen in Waterford have been gorse fires, but the general consensus is that there will be an increased incidence of forest fires as we get longer periods of intense head and dry spells.
- The drying out of bogs is also becoming more of a concern as if these take fire they are almost impossible to put out. Added impact is that a large portion of the bogland in the county is designated as an SAC's and in some cases also SPA's so destruction of natural environment is a big issue.
- Increased incidences of fires will have a direct impact on air quality.
- The immediate destruction of natural habitat and its impact on biodiversity etc can be significant but additionally in the aftermath the impacts on pollutants entering the environment increases significantly.
- A valid comment was made in relation trying to adapt coastal areas to increased pressures during hot weather, do nothing and you risk having congested roads and blocked roads that can have a wide range of impacts the worst of all is the blocking emergency services V's provision of larger infrastructure more parking which then is then impacting on the coastal environment due to change of land use!

Drought:

- There have been restrictions on night-time water supplies in order to replenish storage overnight, this can have significant impact on some industries that have high night-time flows.
- There is an impact on pollinators and animal movements in general, droughts typically associated with higher than average temps and puts the relationship between flora and fauna out of sync.
- There can be a loss of green areas, parks are not as attractive to people, and it takes a lot of time and money to repair them and put them back into their original condition. This has a monetary impact as well as reputational impact on the council.

Extreme Precipitation:

- Inundation of storm networks, gullies and gutter systema that just were not deigned to cope with the intense rainfall events we are experiencing this can result in very localised flooding that cant be warned in advance.
- There is a very big issue with an increase in turbidity in water bodies and this directly impacts the quality of potable water supply when it impacts on abstraction for treatment facilities.
- Extreme precipitation and the resultant surface run-off and surface flow along roads etc can have significant impacts on infrastructure and land banks due to the scouring effect it can have.

Above Average Precipitation:

- Saturated ground is more unstable which can lead to increased instability of soils and increases the risk of trees coming down.
- Saturated ground is more unstable which can lead to increased risk of land slides
- De-stabilisation of coastal areas in particular cliff faces can be increased by above average precipitation.
- There is the health and well being aspect of people being inside for longer periods and the effect this has on their mental and physical health.
- The increased storm flows through combined networks can have a significant impact on the storm management systems in place at WWTP and result in significant overflows of untreated effluent directly to the environment.
- There can be effect on tourism and business across the board as people are not out and about as much.
- Active travel can be disproportionally affected as cyclists and walkers are more exposed to the elements and will be more inclined to take the bus or use a car.
- Air quality can be impacted during these periods also.

Notes

Post workshop notes:

October 2004 in Dungarvan where an extremely low pressure storm passed over with a South Easterly wind that kept the tide levels artificially high in the harbour. The extreme low pressure caused an increase of c.1m on the high water level that day that caused severe flooding in Dungarvan and in terms of council assets, the staff car park flooded to a height of 1.2m and cars literally floated, the same car park also house our archives and there was a large loss of files, the ground floor of the Motor Tax Building flooded causing extensive damage and a new twin 350mm rising main was washed out along the Greenway and cost €1m to replace. Luckily it hadn't yet been commissioned or the environmental impact would have been significant.

24th December 1997 a storm with hurricane force gusts over southern coastal counties. Highest wind speeds since at least Jan 1974. Lots of trees down and power outages for over 135,000 homes on Christmas Day and 15,000 homes were still without electricity by 27th December, including some in Waterford. All flights and sailings on 24th were cancelled.

When it comes to risks, there were a few extra things that may be issues:

- Heavy rainfall causing flash flooding on roads
- Landslides

One point that was raised at the workshop was loss of electrical supply. However, I feel that the fallout from this is more serious than most people realise. If we lose power all of our buildings, bar the 2 fire stations with generators, will be required to shut down immediately. We have emergency lighting in buildings that will kick in with the loss of power, but the regulations (IS3217 6.2) do not permit the use of emergency lighting to allow normal operations to be continued in the building.

Apart from not being able to use the buildings we will be seriously hampered regarding the information systems we can access.

- Loss of power to the Civic Offices means we lose all our networks, staff working remotely will not be able to log in to any systems. Telemetry for our water and wastewater pumps and pump stations comes into the Civic Offices, loss of this information for more than 12 hours would lead to a boil water notice on all water supply schemes west of Lemybrien. It was mentioned in the workshop that there is 40 minutes back up on the UPS but I think we are looking at longer outages than that. The servers can be kept up with additional battery supply but the staff who will be required to enter the building to check on the servers will need to be kept safe as well (lighting from entrance door to work area and welfare facilities, fire alarm etc).
- Loss of power to City Hall means we lose our Major emergency HQ, city CCTV network and staff in city buildings will not be able to log onto the network.
- Menapia has a number of dishes that connect the remote city buildings back to the networks through City Hall. These are all powered through the building

Appendix C Hazard Events Record

Hazard Events Record - County Waterford				Hazard Type													
Year	Date	Event	Summary	River flood	Pluvial flood	Extreme precipitation	Severe windstorm	Storm Surge	Coastal Erosion	Coastal flood	Heavy snowfall	Heatwave	Drought	Above average surface temperature	Increase in Relative Sea Level	Above average precipitation	Cold spell
2022	2nd-4th November	Severe Weather	Orange status warning for heavy rain accompanied by high winds. Water levels rose considerably overnight which required the Flood response Team in Waterford to monitor the situation.	■	■	■	■										
	18th - 28th October	Heavy Rainfall	Following heavy rainfall overnight, a number of roads were closed with debris left behind.			■											
	4th - 7th September	Storm Danielle and Heavy Rainfall Event	Poor raw water quality at rivers serving towns leading to supply risk. Water quality deterioration, pH impacted.			■											
	15th August	Heavy Rainfall				■											
	August	Prolonged Dry period	Extreme and prolonged heat in excess of 25°C over a period of 5 days or more. Status Orange weather warning. Consistent daily temperatures in excess of 25°C, extreme heat, intense UV, wildfires, drought conditions Heat stress warning issued, water conservation notices issued for "drought-prone" areas, wildfire warnings issued, hot weather advice warnings deployed on Council social media channels									■	■	■			
	July	Heatwave	Prolonged extreme heat of 25-30°C. Extreme and prolonged temperatures, fire safety warnings issued by Fire Department and Department of Agriculture									■		■			
	March	Flood warning	Met Eireann National Orange flood Warning. SWAT meeting held. 43mm rain recorded at Mayglass rainfall station. Heavy rainfall event caused a deterioration in water quality that escalated over a number of days resulting in major supply outages due to difficulties with water supply affecting 22000 people.			■											
	20th February	Storm Franklin	High winds, rain, sleet and snow. Status orange, downgraded to yellow after a period of time. Storm Force 10. Sustained 102 km/h (55 kt) at Mace Head, Co Galway around 8pm, Gusts of 139km/h at Mace Head. Colder temperatures impacting routes in rural areas, high winds in coastal areas.				■				■						
	17th/18th February	Storm Eunice	Extreme, severe, damaging gusts, heavy rainfall, flooding in coastal areas accompanied by spot flooding in other parts of the county. Status red weather warning Violent Storm Force 11 Sustained 106 km/h (57 kt) at Roches Point, Co Cork around 8am, Gusts of 137km/h recorded at Roche's Point at 08:38am, roads blocked across the city and county. High number of trees felled across the county due to wind speeds, multiple reports of structural damage - slates blown off buildings on Merchant's Quay, Dungarvan and Tramore severely impacted by wind and coastal flooding. Council offices closed until 12pm. WCCC cleanup crews deployed.			■	■	■	■	■							
	15th/16th February	Storm Dudley	Status orange Wind warning Moderate winds with heavy rainfall, coastal areas particularly vulnerable to these conditions. Strong, sustained gale of 80km/h recorded at Malin Head. Gusts of 109km/h recorded at Mace Head. High and sustained winds across the city and county. Falling leaves and debris resulting in hazardous driving conditions. Windows and doors secured in Council buildings.			■	■	■	■	■							
2021	December	High tides and heavy rainfall	Flood warnings issued due to high tides and heavy rain			■									■		
	6th/7th December	Storm Barra	South-easterly winds, mean speeds of 65 to 80 km/h with severe or damaging gusts of 100 to 130 km/h, with localised stronger winds likely, severe gusts on coasts. Due to a combination of high waves, storm surge and high tide, coastal flooding occurred. Multiple roads blocked by fallen trees, localised flooding, power outages, coastal flooding. Violent storm force 11 winds recorded at 104km/h at Mace Head, Co. Galway. 31mm of daily rainfall recorded at Newport, Co. Mayo. 135km/h gust recorded at Sherkin Island, Co. Cork. City and county-wide exposure with coastal areas such as Tramore, Dungarvan and Passage East significantly impacted. Low-lying roads impacted by flooding. Tramore promenade closed. Coastal car parks flooded. Structural damage to bridges in county, public buildings and schools closed for the day. Poor drainage systems, socially-isolated individuals, the elderly, secondary transport routes, emergency services being overwhelmed.			■	■	■	■	■							
	28th October	Heavy Rainfall	91mm of rain over 4 days.			■											
	Summer	Heatwave & prolonged Dry period	loss of water supplies in private wells. Some supply interruptions due to high demand.									■	■				
2020	August	Storm Francis					■										
	Summer	Heatwave & prolonged Dry period	Hosepipe ban issued										■	■			
	Jan	Storm Brendan	All areas on alert				■										
2019	2nd October	Storm Lorenzo	All areas on alert				■										
2018	Dec	Storm Eric	All areas on alert				■										
	Dec	Storm Deirdre	All areas on alert				■										

Hazard Events Record - County Waterford				Hazard Type														
Year	Date	Event	Summary	River flood	Pluvial flood	Extreme precipitation	Severe windstorm	Storm Surge	Coastal Erosion	Coastal flood	Heavy snowfall	Heatwave	Drought	Above average surface temperature	Increase in Relative Sea Level	Above average precipitation	Cold spell
	Nov	Storm Diana	All areas on alert				■										
	October	Storm Callum	All areas on alert				■										
	September	Storm Ali	Orange Wind Warning - gale-force winds of up to 120km/h, stormy conditions				■										
	Summer	High Temperatures, Heatwave & drought	High Temperatures, Heatwave and drought - disruption to water supply, issues with road maintenance etc. highest June Temperature in Ireland in more than 40 years.									■	■	■			
	February/ March	Storm Emma & Beast from the East	Blizzard / Heavy Snowfall / widespread heavy snow drifting. Disruption to business, emergency services, power cuts etc. South east hit severely. Frozen pipes impacted supply. Multiple power outages. Difficulty with access to sites. This caused widespread disruptions to road, rail and air travel. It also resulted in the majority of businesses and schools being closed. Roof collapse in National Heritage Park due to snow loading.				■				■						■
	Jan	Storm Eleanor	All areas on Alert				■										
2017	16th October	Storm Ophelia (Ex-Hurricane Ophelia)	Red warning - gale force winds, heavy rain and storm surges along some coasts (flooding). Disruption to business, power cuts etc.			■	■	■		■							
2016	8th February	Storm Imogen	Extreme winds causing widespread damage. Extremely high waves and wins of up to 140km/hr. Storm brought down trees and debris throughout Waterford.			■	■			■							
2015/2016	Dec/Jan	Storm Frank	Wettest January on record - 126% of monthly long-term average Heavy Rain and Flooding.	■			■									■	
2014	11th/12th February	Storm Darwin	Red Warning for strong winds - classified a 1 in 20-year event. Wind speed 80-90km/h with Gusts 130-170km/h. Flooding of houses in Poleberry.	■		■	■										
2014	7th January	Coastal storm	Storm tides struck causing localised spot flooding in coastal and rural areas including Poleberry.			■	■	■	■	■							
2013/14	Winter	Winter Storms	A combination of strong winds, tidal surges and low pressure conspired to cause widespread damage and flooding during the latter half of December 2013 and into the middle of February 2014. Serious coastal damage and widespread, persistent flooding.			■	■	■	■	■							
2011	September	Hurricane Katia	Met Eireann, issued an extreme weather warning amid predictions of storm gusts of up to 128 kph.				■	■									
2010/2011	Winter	Snow	Extensive snowfalls and extremely low temperatures with daytime averages being below freezing.								■						■
2009/10	Winter	Winter Cold Spell	Coldest winter in almost 50 years (Met Eireann) with extreme low temperature recorded at Johnstown castle of -3.7oC Lowest temperatures on record in Dublin Airport (-8.4 degrees C) and Casemont Aerodrome (-9.1 degrees C) Important factors are the duration of the cold weather, how cold it was. This particular cold spell was notable for being the earliest spell of significant duration (started in November). It was also notable for the sustained extreme low temperatures. Damage to roads caused by frost heave, most notably Ballycashin Road.														■
2009	November	Severe flooding	Flooding around inner ring road Tramore road in the city with a number of businesses affected.	■	■	■											
2008	August	Heavy rain and flooding	Heavy rain and extensive flooding	■	■	■											
2006	Summer	High Temperature / Heat Wave	Warmest summer since record breaking 1996. Temp 31°C at casement Aerodrome on 19th July 2006 (may have been exceeded by 2018)									■		■			
2004	November	High Tides & South easterly Gales	River Suir banks burst due to rising tide. Sandbags had to be provided. Damages to surrounding premises.				■	■		■							
2004	October	High Tides and low pressure cell	Extremely low pressure storm passed over with a South Easterly wind that kept the tide levels artificially high in the harbour. The extreme low pressure caused an increase of c.1m on the high water level that day that caused severe flooding in Dungarvan and in terms of council assets, the staff car park flooded to a height of 1.2m and cars literally floated, the same car park also house our archives and there was a large loss of files, the ground floor of the Motor Tax Building flooded causing extensive damage and a new twin 350mm rising main was washed out along the Greenway and cost €1m to replace. Luckily it hadn't yet been commissioned or the environmental impact would have been significant.							■				■			
2002	14th November	Heavy rain and severe flooding	Severe flooding in eastern areas. Wettest month on record at Casemont Aerodrome. Flooding in Mullinavat.	■	■	■	■									■	
2002	1st February	Coastal Flooding	Eastern and southern coasts - highest tide in 80 years.			■	■	■		■					■		
2000	5th November	Severe Flooding	70-98mm rainfall in Waterford. Localised flooding in rural areas	■	■	■				■							
1997	24th December	Windstorm	A storm with hurricane force gusts over southern coastal counties. Highest wind speeds since at least Jan 1974. Lots of trees down and power outages for over 135,000 homes on Christmas Day and 15,000 homes were still without electricity by 27th December, including some in Waterford. All flights and sailings on 24th were cancelled.				■										
1997	3rd – 7th August	Extreme rainfall and Flooding	Persistent rainfall in South East 3rd – 7th August.													■	
1995	Summer	High Temperatures, Heatwave & drought	Warmest Summer on record. Mean temperatures over 2 degrees C above normal. Temp rises to 30 degrees C over a number of consecutive days. 31.1degrees reported in Athy, Co. Kildare for June 29th									■	■				
1986	August	Hurricane Charley	Strong winds and rain, worst flooding in 100 years. Damage to trees and buildings, and loss of life.	■	■	■	■	■	■	■							

Hazard Events Record - County Waterford				Hazard Type													
Year	Date	Event	Summary	River flood	Pluvial flood	Extreme precipitation	Severe windstorm	Storm Surge	Coastal Erosion	Coastal flood	Heavy snowfall	Heatwave	Drought	Above average surface temperature	Increase in Relative Sea Level	Above average precipitation	Cold spell
1976	Summer	Heat wave	On June 29th, 1976, a weather station in Boora, Co Offaly, recorded a temperature of 32.5 degrees. This heat wave occurred at the end of the driest period in 150years. This period began in October 1974.									■	■	■			
1973	November - December	Rain / Flood	This deluge of rain lead to extensive flooding in the south region with a max of 195.1mm being the highest amount recorded over the four days.	■	■	■											
1962/1963	Winter	Cold	The coldest winter on record in Ireland and the UK since records began.														■
1961	16th September	Hurricane Debbie	The most powerful cyclone on record to strike Ireland in September, and possibly the only tropical cyclone on record to ever strike Britain and Ireland while still tropical.				■	■									
1954	December	Combination event	Rainfall was 50% above the normal levels for the last quarter of the year resulting in the sinking and running a ground of several ships on Irish coasts in what was described as "mountainous seas". On Dec 9th a railway bridge was destroyed by flood waters which then created a "dam". There was also widespread power outages and further disruptions caused by severe snowfalls.	■				■			■					■	
1947	January - March	Combination event	The severe conditions disrupted communications and transport facilities for several weeks.				■				■						■
1933	23rd February	Snow	Widespread snowfalls with strong winds lead to drifts up to 3m.								■						
1927	28th October	Storm	A storm which had an extremely low pressure of 976hPa claimed 45 lives of the west coast.				■	■									
1917	1st April	Snowfall	Many places were cut off for several days. Snow lay to a depth of 1.3 m with drifts of 3m.								■						
1917	January - February	Combination event	Rain, sleet & snow accompanied a S.E gale. Melted snow had a depth of 52mm rainfall. Drifts of 3m reported. Large portion of rail traffic was disrupted. Low temperatures prevented snow thawing.				■				■						■
1909/1910	Winter	Snowfall	The snowfall in Jan was very severe with several counties covered with up to 33cm for several days.								■						■
1908	April	Snowfall	Extremely heavy snowfall observed.								■						
1903	26th/ 27th February	Storm	Many thousands of trees were uprooted countrywide. There was also extensive damage to large amount of buildings and infrastructure.				■										
1895	February	Snowfall	Extremely heavy snowfalls observed.								■						
1891/1892	Winter	Snowfalls	Greatest snowfalls recorded since 1855. Serious disruption in late Feb to rail traffic.								■						
1887	Summer	Heat wave	The highest temperature ever recorded in Ireland was 33.3°C on June 26th 1887.									■					
1886	7th-10th April	Blizzard	A "great" blizzard with snow depths of up to 60cm.								■						
1881	January	Snowfalls	“Remarkable” snowfalls recorded throughout this month.								■						
1873	2nd February	Snowfall	Extremely heavy snowfall resulted in circa 120cm of snow falling in a short period.								■						
1869	5th February	Tidal Flooding	Most of the lower lying regions of Waterford City were submerged due to extreme flooding.							■							
1867	25th January	Freeze	The River Suir flowing through Waterford City completely froze over. The Railway Steamboat was used to keep large ice flows impacting the bridge. On the same day the New Ross bridge was swept away by ice flows.														■
1853	14th February	Snowstorm	A severe snowstorm hit Ireland which resulted in the Queen Victoria sinking in the Irish Sea claiming 55 lives.				■				■						
1839	6th Jan	Wind	The Night of the Big Wind was a massive hurricane that swept over Ireland on the night of January 6, 1839.				■										
1807	19th-20th February	Blizzard	Severe blizzard swept across Ireland which resulted in several deaths and the wrecking of two transport ships on the Irish Sea.				■				■						

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	Coastal	
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	None	None	Minor	None	Minor	None	Negligible	Minor	None	None	None	None	None	None	None	0.58
			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	None	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	None	None	None	0.32
			Environmental	Proximity to rivers																			
			Socioeconomic	-																			
		Railway	Physical	-	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	None	0.21
			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	None	0.37
			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	None	0.16
			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	Moderate	0.58
			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	None	0.21
			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	None	0.16
			Environmental	-																			
			Socioeconomic	-																			
		Harbour	Physical	Ground level relative to surrounding area	None	None	Moderate	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Moderate	None	Moderate	0.74
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area																			
			Socioeconomic	-																			
		Land use suitability	Physical	Adequacy pf drainage network	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	Moderate	None	None	None	None	0.21
			Environmental	Proximity to rivers																			
			Socioeconomic	-																			
		Power supply	Physical	Fixed or manual flood defences Flooded outfalls Structural loading Backup generator availability	Minor	Minor	Moderate	Minor	Moderate	Minor	Minor	Minor	Minor	Minor	Minor	Major	Minor	Minor	Minor	Moderate	Minor	Moderate	Minor	2.32
			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 Pearl Mussels are vulnerable Forestry silt	None	None	None	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.26
			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	None	0.37
			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	None	0.63
			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	None	0.47
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to rivers																			
			Socioeconomic	-																			
		General public	Physical	-	None	None	None	None	None	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	None	0.21
			Environmental	Road congestion																			
			Socioeconomic	Exposure to warnings/ alerts																			
		Emergency responders	Physical	-	None	None	Minor	None	Moderate	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.32
			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	Coastal	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	None	0.53
			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	Major	None	0.53
			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	None	0.42
			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	None	0.53
			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	None	0.42
			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	None	0.37
			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	None	0.42
			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	None	0.47
			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	None	0.16
			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	None	0.42
			Environmental	Proximity to rivers																				
			Socioeconomic	-																				

Hazard Event:	**Extreme Precipitation**
Frequency of Occurrence:	Very 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	Coastal	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	None	None	Minor	None	Minor	None	Negligible	Minor	None	None	None	None	None	Moderate	None	0.74
			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 - possible flash floods	None	None	None	None	None	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	None	None	None	0.32
			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	None	None	0.37
			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	None	0.16
			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	None	None	None	None	None	Minor	None	Moderate	0.47
			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	None	0.16
			Environmental	-																			
			Socioeconomic	-																			
		Harbour	Physical	Presence of coastal defences	None	None	Moderate	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Moderate	None	Moderate	0.74
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area																			
			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	None	0.32
			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	None	0.21
			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	None	0.21
			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	None	0.58
			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	None	0.53
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																			
			Socioeconomic	-																			
		General public	Physical	-	None	Negligible	Minor	Minor	Minor	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	None	0.58
			Environmental	Road congestion																			
			Socioeconomic	Exposure to warnings/ alerts																			
		Emergency responders	Physical	-	None	None	Moderate	Minor	Moderate	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.47
			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	None	0.42
			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	None	0.37
			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)																			
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	None	0.37
			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	Coastal	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	None	0.47
			Environmental	Available cover Proximity to urban environments Adequacy of drainage systems																				
			Socioeconomic	Population age Population constitution																				
		Council staff	Physical	-	None	None	Minor	None	Minor	None	Negligible	Negligible	None	None	None	None	None	Minor	None	None	None	None	None	0.42
			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	None	0.37
			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 which can lead to landslides	Saturated cliffs	Physical	Soil properties	None	None	None	Minor	None	Moderate	Negligible	None	None	None	None	None	Negligible	None	Negligible	None	Negligible	None	Moderate	0.63
			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	None	None	Negligible	None	Minor	None	None	None	None	None	None	None	None	None	None	0.16
			Environmental	-																				
			Socioeconomic	-																				
		Road network	Physical	Use of material Built Heritage	None	None	Negligible	None	None	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	None	0.26
			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	None	0.16
			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	None	0.42
			Environmental	Proximity to urban areas																				
			Socioeconomic	-																				

Hazard Event:	**Severe Windstorm**
Frequency of Occurrence:	Very Frequent
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																			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	Coastal	
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	None	None	Minor	None	Moderate	Minor	Negligible	None	None	Minor	Negligible	None	Negligible	None	None	0.95
			Environmental	Proximity to vegetation Wind tunnels in urban environments Proximity to coastal environments																				
			Socioeconomic	-																				
		Bridges	Physical	Use of material Built Heritage Structural loading	None	None	None	None	None	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	None	None	None	0.32
			Environmental	Proximity to coastal environments																				
			Socioeconomic	-																				
		Housing	Physical	Use of material Built Heritage Structural loading Building heights	None	None	None	Minor	Minor	None	Minor	None	None	Minor	None	None	None	None	None	None	None	None	None	None	0.42
			Environmental	Proximity to vegetation Wind tunnels in urban environments Proximity to coastal environments																				
			Socioeconomic	-																				
		Commerce	Physical	-	Negligible	None	Moderate	None	None	None	Negligible	Negligible	None	None	None	Negligible	None	Negligible	None	None	Moderate	None	None	0.58
			Environmental	Proximity to vegetation Wind tunnels in urban environments																				
			Socioeconomic	Nature of business																				
		Telemetry	Physical	-	None	None	Moderate	Moderate	Moderate	None	Negligible	Negligible	None	None	Negligible	Moderate	Minor	Negligible	None	Minor	Minor	Minor	Moderate	1.42
			Environmental	Proximity to vegetation																				
			Socioeconomic	-																				
		Harbour	Physical	-	None	None	Moderate	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Moderate	None	Moderate	0.74
			Environmental	Level of exposure to wind																				
			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	None	0.21
			Environmental	Proximity to vegetation																				
			Socioeconomic	-																				
		Amenities	Physical	Equipment security Available shelter	None	Minor	None	Minor	None	None	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	None	0.58
			Environmental	Level of exposure to wind																				
			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	None	0.32
			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	None	None	Negligible	None	Minor	Minor	None	None	None	Minor	Negligible	None	Negligible	None	None	0.79
			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	None	0.53
			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	None	0.63
			Environmental	Proximity to vegetation Wind tunnels in urban environments																				
			Socioeconomic	-																				
		Derelict buildings	Physical	Use of material Built Heritage	None	None	None	Minor	Minor	None	Negligible	None	None	None	None	None	None	None	Minor	None	None	None	None	0.37
			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	None	0.21
			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	None	0.37
			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	None	None	0.53
			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	None	None	0.53
			Environmental	Available shelter Wind tunnels in urban environments																				
			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	None	0.37
			Environmental	Available shelter Wind tunnels in urban environments																				
			Socioeconomic	Population age Population constitution																				

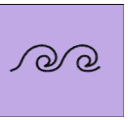
Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																				
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Coastal	Impact Score
Land erosion	Loss of land leading to increased pressure on dune systems in coastal areas	Dunes	Physical Environmental Socioeconomic	Soil properties Erosion mitigation measures Level of exposure to wind -	None	None	None	Minor	None	Moderate	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	None	0.47
Reduced water quality	Saline intrusion of waters leading to contaminated drinking water	Water treatment plants	Physical Environmental Socioeconomic	- Proximity to coastal environments -	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	None	0.21
Power supply cuts	Damage to powerlines leading to loss of power to urban and regional centres	Commerce	Physical Environmental Socioeconomic	Presence of overhead lines Backup generator availability Proximity to vegetation -	Negligible	None	Moderate	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	Moderate	None	None	0.42
		LA buildings	Physical Environmental Socioeconomic	Presence of overhead lines Backup generator availability Proximity to vegetation -	Negligible	Negligible	Moderate	Minor	Moderate	Negligible	Negligible	Negligible	Moderate	Minor	Minor	Minor	Negligible	Minor	Minor	Negligible	Moderate	Negligible	Negligible	1.74
		Housing	Physical Environmental Socioeconomic	Presence of overhead lines Backup generator availability Proximity to vegetation Population age Population constitution	None	None	None	Minor	Minor	None	Negligible	None	None	Minor	None	None	None	None	None	None	None	None	None	None	0.37
		Hospital/Health Centres	Physical Environmental Socioeconomic	Presence of overhead lines Backup generator availability Proximity to vegetation -	Negligible	None	None	Minor	Moderate	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	None	0.37
		Communication/ servers	Physical Environmental Socioeconomic	Presence of overhead lines Backup generator availability Proximity to vegetation -	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Major	Minor	Minor	Minor	Moderate	Moderate	Minor	Minor	2.21
		Water and wastewater treatment plants	Physical Environmental Socioeconomic	Presence of overhead lines Backup generator availability Emergency supply storage Overflow from wastewater systems due to power outage Proximity to vegetation -	None	None	None	None	Moderate	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	None	0.37
Falling trees/ branches	Wind destroying trees and carrying material leading to a variety of disruption to services	Outdoor workers	Physical Environmental Socioeconomic	Personal Protective Equipment Influenced by time of year Proximity to/ volume of vegetation Available cover Population age Population constitution	None	Negligible	Moderate	Minor	Minor	None	Negligible	None	None	None	Minor	None	None	None	None	None	None	None	None	None	0.58
		Emergency services	Physical Environmental Socioeconomic	Personal Protective Equipment Influenced by time of year Proximity to/ volume of vegetation Available shelter Population age Population constitution	None	Negligible	Moderate	Minor	Minor	None	Negligible	None	None	None	Minor	None	None	None	None	None	None	None	None	None	0.58
		Parks	Physical Environmental Socioeconomic	Soil properties Influenced by time of year Proximity to/ volume of vegetation -	None	None	None	Minor	None	Moderate	Negligible	None	None	None	None	None	Minor	None	None	None	Moderate	None	None	0.58
		Transport infrastructure including roads, rail, and pathways	Physical Environmental Socioeconomic	Use of material Built Heritage Influenced by time of year Proximity to/ volume of vegetation Remote working Alternate transport methods Reliance on TII for alerts on National roads	None	None	None	Minor	Minor	None	Negligible	None	None	None	None	None	Negligible	None	Negligible	Moderate	Minor	None	None	0.63
		Water and wastewater treatment plants	Physical Environmental Socioeconomic	Debris management measures Influenced by time of year Proximity to/ volume of vegetation Extended workload and overtime leading to burnout and availability of monitoring staff	None	None	None	None	Minor	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	None	0.32
Cancellation/ postponing of cultural events	Adverse weather disrupting ability to hold a cultural event	Cultural events	Physical Environmental Socioeconomic	Available shelter Level of exposure to wind -	None	Moderate	Negligible	Minor	None	None	Negligible	None	None	None	None	None	None	None	None	None	Minor	None	None	0.47

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	Coastal	
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	None	None	Minor	None	Minor	None	Negligible	Moderate	None	None	None	None	None	None	None	0.63
			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	None	None	Negligible	None	Minor	None	None	None	None	None	None	Moderate	None	None	None	0.32
			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	None	0.37
			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	None	0.16
			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	Moderate	0.58
			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	None	0.16
			Environmental	Proximity to vegetation																				
			Socioeconomic	-																				
		Harbour	Physical	Presence of coastal defences	None	None	Moderate	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Moderate	None	Moderate	0.74
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area																				
			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	None	0.21
			Environmental	Proximity to urban environment																				
			Socioeconomic	-																				
		Power supply	Physical	Fixed or manual flood defences Flooded outfalls Structural loading Backup generators	Minor	Negligible	Moderate	Minor	Minor	Negligible	Minor	Minor	Minor	Minor	Minor	Moderate	Minor	Minor	Minor	Moderate	Minor	Moderate	Minor	2.11
			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	None	0.26
			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	None	0.63
			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	None	0.47
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to urban environment																				
			Socioeconomic	-																				
		General public	Physical	-	None	None	None	None	None	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	None	0.21
			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	None	0.37
			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	None	0.53
			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	None	Major	None	0.47
			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)																				
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	None	0.42
			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	Coastal	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	None	0.53
			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	None	0.42
			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	None	0.37
			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	None	0.42
			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	None	0.47
			Environmental	Proximity to urban environment																			
			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	None	0.16
			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	None	0.42
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			

Hazard Event:	**Storm Surge**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Strong winds, high tides, and low pressures resulting in widespread coastal damage. Coastal areas particularly 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	Coastal	
Damage to infrastructure	Damage to infrastructure and built heritage due to high tide levels and strong winds	LA buildings	Physical	Use of material Built Heritage Coastal defences Structural loading	Negligible	None	Moderate	Minor	None	None	Minor	None	Minor	Minor	Negligible	None	None	Minor	Negligible	None	Negligible	None	Minor	1.00
			Environmental	Ground elevation relative to sea level Proximity to coastal environment																				
			Socioeconomic	-																				
		Harbour	Physical	Use of material Built Heritage Coastal flood defences Structural loading Navigation aids	None	None	Moderate	Minor	None	None	Minor	None	Minor	None	None	None	Moderate	None	None	None	Moderate	None	Moderate	0.95
			Environmental	Elevation relative to sea level																				
			Socioeconomic	Cancelation of ferries																				
		Telemetry	Physical	-	None	None	Moderate	Moderate	Moderate	None	Minor	Negligible	None	None	Negligible	Moderate	Minor	Negligible	None	Minor	Moderate	Minor	Moderate	1.53
			Environmental	Proximity to vegetation																				
			Socioeconomic	-																				
		Commerce	Physical	Storage of stock/ equipment	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.05
			Environmental	Proximity to coastal environment																				
			Socioeconomic	-																				
		Power supply	Physical	Structural loading Backup generators	Minor	Negligible	Moderate	Minor	Minor	Negligible	Minor	Minor	Minor	Minor	Minor	Moderate	Minor	Minor	Minor	Moderate	Minor	Moderate	Minor	2.11
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to rivers																				
			Socioeconomic	-																				
Damage to Amenities	Erosional processes deteriorate amenities located on the coast	Caravan Parks	Physical	Soil characteristics Presence of coastal defences	None	None	None	Minor	None	None	Minor	None	None	Minor	Negligible	None	Moderate	None	Negligible	None	None	None	None	0.58
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Tourist Amenity Areas	Physical	Presence of coastal defences	None	Minor	None	Minor	None	None	Minor	None	None	None	Negligible	None	Moderate	None	None	Moderate	Moderate	None	None	0.84
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Walkways and trails	Physical	-	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Minor	None	None	0.37
			Environmental	Ground elevation and gradient relative to sea level Proximity to rivers																				
			Socioeconomic	-																				
		Access to bathing waters	Physical	Soil characteristics Presence of coastal defences	None	None	None	Minor	None	Negligible	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	Minor	0.63
			Environmental	-																				
			Socioeconomic	-																				
Damage to environment	Erosion due to wind and exposure to seawater	SAC/SPA/natural habitats	Physical	Water turbidity Combined foul and surface system	None	None	None	Negligible	None	Major	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	Moderate	0.79
			Environmental	Ground elevation relative to sea level Proximity to coastal environment																				
			Socioeconomic	-																				
		Coastline/Dunes	Physical	Soil/material properties Heritage Erosion mitigation measures	None	None	None	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.26
			Environmental	Level of exposure to wind Elevation relative to sea level																				
			Socioeconomic	-																				
Reduced water quality	Sea water or debris entering water systems. Boil water notices issued in some cases	Water bodies	Physical	Water turbidity Combined foul and surface system	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	None	0.37
			Environmental	Ground elevation relative to sea level Proximity to coastal environment																				
			Socioeconomic	-																				
		Water supply distribution	Physical	-	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	None	None	None	None	Minor	Moderate	None	0.42
			Environmental	Ground elevation relative to sea level Proximity to coastal environment																				
			Socioeconomic	Extended workload and overtime leading to burnout and availability of monitoring staff Responsibility (Irish Water)																				
Loose debris	Debris picked up by wind causing damage to infrastructure and population	LA buildings	Physical	Use of material Built Heritage	Negligible	None	Moderate	Minor	None	None	Negligible	None	Minor	Minor	None	None	None	Minor	Negligible	None	Negligible	None	Minor	0.89
			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	None	0.53
			Environmental	Proximity to vegetation Wind tunnels in urban environments																				
			Socioeconomic	-																				
		Construction sites	Physical	Use of material Security of materials	Negligible	None	Moderate	Minor	None	None	Negligible	None	None	Minor	None	None	None	None	Moderate	None	None	None	None	0.63
			Environmental	Proximity to vegetation Wind tunnels in urban environments																				
			Socioeconomic	-																				
		Derelict buildings	Physical	Use of material Built Heritage	None	None	None	Minor	Minor	None	Negligible	None	Minor	None	None	None	None	None	Minor	None	None	None	None	0.47
			Environmental	Proximity to vegetation Wind tunnels in urban environments																				
			Socioeconomic	-																				
		People	Physical	-	None	Negligible	Minor	Minor	Major	None	Negligible	None	None	None	Minor	None	Negligible	None	None	None	Minor	None	None	0.79
			Environmental	Proximity to coastal environment Available shelter																				
			Socioeconomic	Human desire to watch the event from an unsafe location Population age Population constitution Homeless Exposure to warnings/ alerts																				

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	Coastal	Impact Score
Submersion of infrastructure	Disruption to infrastructure due to sea water rising above infrastructure	Harbour	Physical	Elevation of harbour infrastructure	None	None	Moderate	None	None	None	Minor	Minor	Minor	None	None	None	None	None	None	None	None	None	Moderate	0.63
			Environmental	-																				
			Socioeconomic	-																				
		Buildings	Physical	-	Moderate	None	Minor	None	None	None	Minor	None	None	Minor	None	Moderate	None	None	None	None	None	None	Minor	0.74
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Transport infrastructure	Physical		None	None	None	None	Negligible	None	Minor	None	None	None	None	None	None	None	None	Moderate	None	None	None	0.32
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
Health and Safety risks	Drowning/ presence of submerged hazards leading to injury or death	People	Physical	-	None	Negligible	Minor	Minor	Minor	None	Negligible	None	None	None	Minor	None	Negligible	None	None	None	Minor	None	None	0.68
			Environmental	Proximity to urban environment																				
			Socioeconomic	Human desire to watch the event from an unsafe location Population age Population constitution Homeless Exposure to warnings/ alerts																				

Hazard Event:	**Coastal Erosion**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Damage to coastal environment due to coastal erosional processes. Loss of land, slow deterioration of coastal infrastructure.

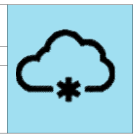
Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																			Impact Score
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Coastal	
Damage to infrastructure	Erosional processes cause structural damage to infrastructure, compromising its integrity	LA Buildings	Physical	Use of material Built Heritage Presence of coastal defences	Minor	None	Minor	None	None	None	Minor	None	Minor	None	None	None	None	None	None	None	None	None	Minor	0.53
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Harbours	Physical	Presence of coastal defences	None	None	Moderate	None	Minor	None	Minor	None	Minor	None	None	None	Moderate	None	None	Moderate	Minor	None	Moderate	1.05
			Environmental	-																				
			Socioeconomic	-																				
		Housing	Physical	Use of material Built Heritage Presence of coastal defences	None	None	None	Minor	Minor	None	Minor	None	None	Minor	None	None	None	None	Negligible	Moderate	None	None	None	0.63
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Roads	Physical	Presence of coastal defences	None	None	Minor	None	Minor	None	Minor	Negligible	None	None	None	None	None	None	None	Moderate	Minor	None	None	0.63
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Temporary structures (e.g., lifeguard huts/ temporary bridges)	Physical	Integrity of structure	None	None	Negligible	Negligible	None	None	Negligible	None	None	None	None	None	None	None	None	Negligible	None	None	Minor	0.32
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Coastal defences	Physical	Type of defence	None	None	None	None	None	None	Minor	None	None	None	None	None	None	None	None	None	None	None	Major	0.32
			Environmental	-																				
			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	Moderate	0.58
			Environmental	Proximity to sea																				
			Socioeconomic	-																				
		Railway	Physical	Presence of coastal defences	None	None	Minor	None	None	None	Minor	None	None	None	None	None	None	None	None	Moderate	Negligible	None	None	0.42
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
Damage to Amenities	Erosional processes deteriorate amenities located on the coast	Caravan Parks	Physical	Soil characteristics Presence of coastal defences	None	None	None	Minor	None	None	Minor	None	None	Minor	Negligible	None	Moderate	None	Negligible	None	None	None	None	0.58
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Tourist Amenity Areas	Physical	Presence of coastal defences	None	Minor	None	Minor	None	None	Minor	None	None	None	Negligible	None	Moderate	None	None	None	Moderate	None	None	0.68
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Walkways and trails	Physical	-	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Minor	None	None	0.37
			Environmental	Ground elevation and gradient relative to sea level Proximity to rivers																				
			Socioeconomic	-																				
		Access to bathing waters	Physical	Soil characteristics Presence of coastal defences	None	None	None	Minor	None	Negligible	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	Minor	0.63
			Environmental	-																				
			Socioeconomic	-																				
Damage to built heritage	Erosional processes compromise built heritage	Promontory forts	Physical	Presence of coastal defences	None	None	Negligible	Minor	None	None	Negligible	None	Major	None	None	None	Moderate	None	None	None	Moderate	None	None	0.74
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
Reduced land use	Erosional processes reduce the overall landmass	Agricultural land	Physical	Soil characteristics Presence of coastal defences	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	None	None	Minor	None	None	None	None	0.26
			Environmental	Proximity to coastline																				
			Socioeconomic	Type of farming																				
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	None	0.42
			Environmental	Proximity to coastal environment																				
			Socioeconomic	Human desire to watch the event from an unsafe location Population age Population constitution Exposure to warnings/ alerts																				
Damage to environment	Erosional processes destroy the environment and natural heritage	Dune habitat systems	Physical	Heritage Presence of coastal defences	None	None	None	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.26
			Environmental	Proximity to coastline Time of year																				
			Socioeconomic	-																				
		Beaches	Physical	Soil characteristics Presence of coastal defences	None	None	Negligible	Minor	None	Moderate	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	Moderate	0.84
			Environmental	Influenced by tidal conditions There are 8 erosion risk zones identified for Waterford's coastlines																				
			Socioeconomic	-																				
		SAC/SPA/natural habitats	Physical	Presence of coastal defences	None	None	None	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.26
			Environmental	-																				
			Socioeconomic	-																				
		Soft cliffs and coastlines	Physical	Soil properties Presence of coastal defences	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	Moderate	None	None	None	Minor	None	Moderate	0.63
			Environmental	Influenced by tidal conditions There are 8 erosion risk zones identified for Waterford's coastlines																				
			Socioeconomic	-																				

Hazard Event:	**Coastal Flood**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	High sea levels, pressures, and strong winds cause flooding along the coasts. Coastal areas particularly 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	Coastal	
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	None	None	Minor	None	Negligible	None	Negligible	Moderate	None	None	None	None	None	None	None	0.58
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to coastal environment																			
			Socioeconomic	-																			
		Roads & Bridges	Physical	Use of material Built Heritage Structural loading	None	None	None	None	None	None	Negligible	None	Negligible	None	None	None	None	None	None	Minor	None	None	None	0.21
			Environmental	-																			
			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	None	0.37
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to coastal 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	None	0.16
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to coastal environment																			
			Socioeconomic	-																			
		Harbour	Physical	Presence of coastal defences	None	None	Moderate	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Moderate	None	Moderate	0.74
			Environmental	Impermeability of surface																			
			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	None	0.16
			Environmental	Proximity to coastline																			
			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	None	0.21
			Environmental	Proximity to coastline																			
			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	Moderate	0.58
			Environmental	Proximity to urban environment																			
			Socioeconomic	-																			
		Monuments and Historic Towns	Physical	Use of material Built Heritage Structural loading	None	None	None	None	None	None	Minor	None	Moderate	None	None	None	None	None	None	None	Minor	None	None	0.37
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to coastal 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	None	0.63
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to coastal 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	None	0.47
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to coastal environment																			
			Socioeconomic	-																			
		General public	Physical	-	None	None	None	None	None	None	Negligible	None	None	None	None	None	Negligible	None	None	None	Minor	None	None	0.21
			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	None	0.37
			Environmental	Road congestion																			
			Socioeconomic	Reliance on TII for alerts on National roads Extended workload and overtime leading to burnout and availability of monitoring staff																			
Damage to environment	Loss of biodiversity	SAC/SPA/natural habitats	Physical	Presence of coastal defences	None	None	None	None	None	Major	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.26
			Environmental	-																			
			Socioeconomic	-																			
		Beaches	Physical	Presence of coastal defences Soil characteristics Presence of coastal defences	None	None	Negligible	Minor	None	Moderate	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	Moderate	0.84
			Environmental	Influenced by tidal conditions There are 8 erosion risk zones identified for Waterford's coastlines																			
			Socioeconomic	-																			
Damage to coastal amenities	Flooding deteriorates the amenities located on the coast	Walkways and trails	Physical	-	None	None	None	Minor	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	Minor	None	None	0.37
			Environmental	Ground elevation and gradient relative to sea level Proximity to rivers																			
			Socioeconomic	-																			
		Access to bathing waters	Physical	Soil characteristics Presence of coastal defences	None	None	None	Minor	None	Negligible	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	Minor	0.63
			Environmental	-																			
			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	Coastal	Impact Score
Reduced water quality	Sea water, debris, or leachate from surface run off 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	None	0.53
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to coastal environment																				
			Socioeconomic	-																				
		Water supply distribution	Physical	-	None	None	Negligible	Negligible	None	None	Negligible	None	None	Negligible	Negligible	None	None	None	None	None	None	Major	None	0.47
			Environmental	Impermeability of surface Ground elevation and gradient relative to surrounding area Proximity to coastal environment																				
			Socioeconomic	Extended workload and overtime leading to burnout and availability of monitoring staff Resoonsibility (Irish Water)																				
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	None	0.53
			Environmental	Proximity to coastal 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	None	0.42
			Environmental	Proximity to coastal 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	None	0.37
			Environmental	Proximity to coastal 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	None	0.42
			Environmental	Proximity to coastal 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	None	0.47
			Environmental	Proximity to coastal environment																				
			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	None	0.16
			Environmental	Proximity to coastal 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	None	0.42
			Environmental	Proximity to coastal environment																				
			Socioeconomic	-																				

Hazard Event:	**Heavy Snowfall**
Frequency of Occurrence:	Common
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.



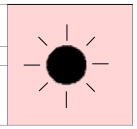
Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		Impact Score
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Coastal	
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	None	None	Minor	Negligible	Minor	None	None	None	None	Minor	None	None	Minor	None	Minor	0.89
			Environmental	Ground elevation relative to sea level																				
			Socioeconomic	-																				
		Housing	Physical	Use of material Built Heritage Structural loading Time to thaw	None	None	None	Minor	Minor	None	Minor	None	None	Minor	None	None	None	None	None	None	None	None	None	0.42
			Environmental	Ground elevation relative to sea level																				
			Socioeconomic	-																				
		Bridges	Physical	Use of material Built Heritage Structural loading Time to thaw	None	None	Negligible	None	Negligible	None	Negligible	None	Negligible	None	None	None	None	None	None	Moderate	None	None	None	0.37
			Environmental	Ground elevation relative to sea level																				
			Socioeconomic	-																				
		Power supply	Physical	Presence of overhead lines Time to thaw	Minor	Negligible	Moderate	Minor	Minor	Negligible	Minor	Minor	Minor	Minor	Minor	Moderate	Minor	Minor	Minor	Moderate	Minor	Moderate	Minor	2.74
			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	None	
			Environmental	Ground elevation relative to sea level																				
			Socioeconomic	-																				
		Telemetry	Physical	Structural loading Backup generators Time to thaw	Minor	Negligible	Moderate	Minor	Minor	Negligible	Minor	Minor	Minor	Minor	Minor	Moderate	Minor	Minor	Minor	Moderate	Minor	Moderate	Minor	2.11
			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	Minor	0.42
			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	None	1.00
			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	None	None	Negligible	Negligible	None	None	None	None	Negligible	Minor	None	None	Minor	None	Minor	0.68
			Environmental	Ground elevation relative to sea level																				
			Socioeconomic	-																				
		Harbour	Physical	Access to vessels at piers & harbours compromised/unsafe Time to thaw	None	None	Minor	None	None	None	Negligible	None	None	None	None	None	Minor	None	None	None	None	None	Major	0.47
			Environmental	-																				
			Socioeconomic	-																				
		Amenities	Physical	Time to thaw	None	None	None	Moderate	None	None	Negligible	None	None	None	Negligible	None	Minor	Moderate	None	None	Minor	None	None	0.63
			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	None	Negligible	Major	None	0.63
			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	None	0.37
			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	None	0.42
			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	None	0.53
			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	None	0.42
			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	None	0.21
			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	None	0.16
			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	None	0.21
			Environmental	-																				
			Socioeconomic	Population age Population constitution																				
Frostbite	Exposure to snow can lead to frostbite	People	Physical	-	None	None	Minor	Minor	Moderate	None	Negligible	None	None	None	Minor	None	Minor	None	None	None	Minor	None	None	0.74
			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		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	Coastal	
Hot and uncomfortable working conditions	High temperatures in homes and office causing discomfort	Outdoor workers	Physical	-	None	None	Moderate	None	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	0.47
			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	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	0.47
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water/ cooling apparatus																			
			Socioeconomic	Population age Population constitution																			
Heat stroke	High heat can lead to heat stroke if careless	People	Physical	-	None	None	Negligible	Minor	Moderate	None	Negligible	None	None	None	Moderate	None	Negligible	None	None	None	Minor	Major	None	0.89
			Environmental	Limited access to green areas/ areas of shade Inadequate access to water and sun screen																			
			Socioeconomic	Population age Population constitution Homeless																			
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 dives of strav flame	None	None	None	None	Moderate	None	Negligible	None	None	None	None	None	Negligible	None	None	None	None	None	None	0.26
			Environmental	Proximity to fire Exposure to fire																			
			Socioeconomic	Population age Population constitution																			
		Environment	Physical	-	None	None	None	None	Moderate	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.37
			Environmental	Proximity to fire Upland areas, gorse areas, and sand dunes typically affected Areas of conservation Biodiversity present																			
			Socioeconomic	-																			
		LA Buildings	Physical	Structural integrity Fire proofing of buildings Built Heritage	Negligible	None	Minor	None	Moderate	None	Negligible	None	Minor	None	None	None	None	Minor	None	None	None	None	None	0.58
			Environmental	Proximity to fire																			
			Socioeconomic	-																			
		Housing	Physical	Structural integrity Fire proofing of buildings Built Heritage	None	None	None	Minor	Moderate	None	Negligible	None	None	Minor	None	None	None	None	None	None	None	None	None	0.42
			Environmental	Proximity to fire																			
			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	None	0.16
			Environmental	Water source location																			
			Socioeconomic	Tvpe 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	None	0.16
			Environmental	-																			
			Socioeconomic	-																			
Pressure on recreational areas	High temperatures promotes the use of recreational facilities and puts pressure on existing infrastructure and lifeguard/ coastal/ emergency rescue services	Beaches/ Green areas	Physical	Access to recreational areas Capacty Beach services in place	None	None	Negligible	Minor	Moderate	Minor	Negligible	None	None	None	None	None	Moderate	None	None	Minor	Moderate	Moderate	Moderate	1.21
			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	None	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	None	0.21
			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	None	0.26
			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	None	0.26
			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	None	0.37
			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	None	0.21
			Environmental	Located within areas of high solar radiation																			
			Socioeconomic	-																			

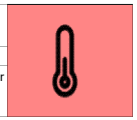
Hazard Impact	Impact Description:	Exposure	Vulnerability		Service Areas: Level of Disruption																		
			Type	Description	Archives	Arts and Culture	Business and Economy	Community	Emergency Services	Environment	Finance	Governance and Administration	Built Heritage and Conservation	Housing	Human Resources	Information Technology	Leisure and Recreation	Libraries and Museums	Planning and Building	Roads and Transport	Tourism	Water Services	Coastal	Impact Score
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	None	Moderate	Negligible	None	None	None	Minor	None	Moderate	None	None	None	Moderate	Major	None	0.84
			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	None	0.95
			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	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Major	None	0.26
			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	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.21
			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																		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	Coastal	
Hot and uncomfortable working conditions	High temperatures in homes and office causing discomfort	Outdoor workers	Physical	-	None	None	Moderate	None	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	0.47
			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	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	0.47
			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	Beaches/ Green areas	Physical	Access to recreational areas Capacity Beach services in place	None	None	Negligible	Minor	Minor	Minor	Negligible	None	None	None	None	None	Major	None	None	Minor	Major	Moderate	Moderate	1.26
			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	None	0.16
			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	None	0.16
			Environmental	-																			
			Socioeconomic	-																			
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	None	0.26
			Environmental	Proximity to fire Exposure to fire																			
			Socioeconomic	Population age Population constitution																			
		Environment	Physical	-	None	None	None	None	Moderate	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.37
			Environmental	Proximity to fire Upland areas, gorse areas, and sand dunes typically affected Areas of conservation Biodiversity present																			
			Socioeconomic	-																			
		LA Buildings	Physical	Structural integrity Fire proofing of buildings Built Heritage	Negligible	None	Minor	None	Moderate	None	Negligible	None	Minor	None	None	None	None	Minor	None	None	None	None	None	0.58
			Environmental	Proximity to fire																			
			Socioeconomic	-																			
		Housing	Physical	Structural integrity Fire proofing of buildings Built Heritage	None	None	None	Minor	Moderate	None	Negligible	None	None	Minor	None	None	None	None	None	None	None	None	None	0.42
			Environmental	Proximity to fire																			
			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	None	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	None	0.21
			Environmental	Available shade cover Proximity to urban environment																			
			Socioeconomic	-																			
		Buildings	Physical	Material properties Built Heritage	None	None	None	None	None	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	None	0.26
			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	None	Moderate	Negligible	None	None	None	Minor	None	Moderate	None	None	None	Moderate	Major	None	0.84
			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	Minor	1.05
			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	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Major	None	0.26
			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	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.21
			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 particularly 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	Coastal	
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	None	0.21
			Environmental	Influenced by time of year																				
			Socioeconomic	Invasive Alien Plant Species protocols in place to reduce the spread of invasive 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	None	0.21
			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	None	0.21
			Environmental																					
			Socioeconomic	-																				
Hot and uncomfortable working conditions	High temperatures in homes and office causing discomfort	Dwellings	Physical	Inadequate cooling mechanisms	None	None	None	Minor	None	None	Negligible	None	None	Minor	None	None	None	None	None	None	None	Minor	None	0.37
			Environmental	Proximity to high density urban areas																				
			Socioeconomic	-																				
		Outdoor workers	Physical	-	None	None	Moderate	None	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	0.47
			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	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	0.47
			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	None	0.26
			Environmental	Proximity to fire Exposure to fire																				
			Socioeconomic	Population age Population constitution																				
		Environment	Physical	-	None	None	None	None	Moderate	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.37
			Environmental	Proximity to fire Upland areas, gorse areas, and sand dunes typically affected Areas of conservation Biodiversity present																				
			Socioeconomic	-																				
		LA Buildings	Physical	Structural integrity Fire proofing of buildings Built Heritage	Negligible	None	Minor	None	Moderate	None	Negligible	None	Minor	None	None	None	None	Minor	None	None	None	None	None	0.58
			Environmental	Proximity to fire																				
			Socioeconomic	-																				
		Housing	Physical	Structural integrity Fire proofing of buildings Built Heritage	None	None	None	Minor	Moderate	None	Negligible	None	None	Minor	None	None	None	None	None	None	None	None	None	None	0.42
			Environmental	Proximity to fire																				
			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	None	0.16
			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	None	0.16
			Environmental	-																				
			Socioeconomic	-																				
Pressure on recreational areas	High temperatures promotes the use of recreational facilities and puts pressure on existing infrastructure	Beaches/ Green areas	Physical	Access to recreational areas Capacity Beach services in place	None	None	Negligible	Minor	Minor	Minor	Negligible	None	None	None	None	None	Moderate	None	None	Minor	Moderate	Moderate	Moderate	1.16
			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	None	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	None	0.21
			Environmental	Available shade cover Proximity to urban environment																				
			Socioeconomic	-																				
		Buildings	Physical	Material properties Built Heritage	None	None	None	None	None	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	None	0.26
			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	None	Moderate	Negligible	None	None	None	Minor	None	Moderate	None	None	None	Moderate	Moderate	None	0.79
			Environmental	Presence of shade Located within areas of high solar radiation																				
			Socioeconomic	-																				
		Water supply plants	Physical	Backup water supply	None	None	Moderate	None	None	None	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	Moderate	None	0.68
			Environmental	Presence of shade Located within areas of high solar radiation																				
			Socioeconomic	Resoonsibility (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	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Moderate	None	0.21
			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	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.21
			Environmental	Influenced by time of year Proximity to water bodies																				
			Socioeconomic	-																				

Hazard Event:	**Increase in Relative Sea Level**
Frequency of Occurrence:	Common
Description of the Hazard Event: (Including relevant meteorological / climatological conditions and locations affected)	Low lying regions are submerged. Water vessels are displaced onto land. Surfaces directly exposed to harsh sea water. Satellite observations indicate that sea level around Ireland has risen by approximately 2-3mm per year since the early 1990s.

Hazard Impact	Impact Description:	Vulnerability			Service Areas: Level of Disruption																			
		Exposure	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	Coastal	Impact Score
Damage to environment	Erosion due to direct exposure to seawater	Coastlines/beaches	Physical	Soil composition	None	None	None	Minor	None	Minor	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	Moderate	0.74
			Environmental	-																				
			Socioeconomic	Trade off between keeping coastlines and beaches or replace with coastal defences																				
		SAC/SPA/natural habitats	Physical	Soil composition	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	Negligible	None	Minor	0.37
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Land/cliffsides	Physical	Soil properties	None	None	None	None	Moderate	Moderate	Negligible	None	None	None	None	None	None	None	Negligible	None	None	None	Minor	0.53
			Environmental	Ground elevation and gradient relative to surrounding area Proximity to urban environment																				
			Socioeconomic	-																				
Early retirement of coastal defence works	Rising sea levels/ overtopping may leave certain flood defence works ineffective	Coastal areas	Physical	Type of coastal defences in place - capacity for adaptation	None	None	Minor	Minor	None	Minor	Negligible	None	Minor	None	None	None	None	None	None	Minor	None	None	Moderate	0.74
			Environmental	Influenced by tidal conditions																				
			Socioeconomic	Trade off between keeping coastlines and beaches or replace with coastal defences																				
Reduced water quality	Salt water entering water systems	Water bodies	Physical	Low volume water bodies Aquifer capacity	None	None	Minor	Negligible	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	Major	None	0.42
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
		Water supply plants	Physical	Capacity to treat water with high salinity	None	None	Minor	Negligible	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	Major	None	0.42
			Environmental	Proximity to coastline																				
			Socioeconomic	-																				
Submersion of infrastructure	Disruption to infrastructure due to sea water rising above infrastructure	Harbour	Physical	Piers and harbours not capable of providing safe launching and berthing	None	None	Moderate	None	None	None	Minor	Minor	None	None	None	None	None	None	None	None	None	None	Moderate	0.53
			Environmental	-																				
			Socioeconomic	Enhancement in the design of coastal defences required to include for Sea Level Rise which is significantly increasing the cost of projects																				
		LA Buildings	Physical	-	Moderate	None	Minor	None	None	None	Minor	None	Minor	None	None	Moderate	None	None	None	None	None	None	None	0.63
			Environmental	Proximity to coastline																				
			Socioeconomic	Enhancement in the design of coastal defences required to include for Sea Level Rise which is significantly increasing the cost of projects																				
		Housing	Physical	-	None	None	None	Moderate	Minor	None	Minor	None	Minor	Moderate	None	None	None	None	None	None	None	None	None	0.63
			Environmental	Proximity to coastline																				
			Socioeconomic	Enhancement in the design of coastal defences required to include for Sea Level Rise which is significantly increasing the cost of projects																				
		Amenities	Physical	-	None	Minor	None	Minor	None	None	Negligible	None	None	None	None	None	Moderate	None	None	None	Moderate	None	None	0.58
			Environmental	Proximity to coastline																				
			Socioeconomic	Enhancement in the design of coastal defences required to include for Sea Level Rise which is significantly increasing the cost of projects																				
		Transport infrastructure	Physical	-	None	None	None	None	Minor	None	Minor	None	None	None	None	None	None	None	None	Moderate	None	None	None	0.37
			Environmental	Proximity to coastline																				
			Socioeconomic	Enhancement in the design of coastal defences required to include for Sea Level Rise which is significantly increasing the cost of projects																				

Hazard Event:	**Above Average Precipitation**
Frequency of Occurrence:	Common
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																		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	Coastal	
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	None	0.42
			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	None	0.32
			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)																			
Land erosion	Rainfall causing ground saturation, weakening ground strength which could lead to landslides	Land/cliffsides	Physical	Soil properties	None	None	None	None	Moderate	Moderate	Negligible	None	None	None	None	None	Negligible	None	Negligible	None	Negligible	None	Negligible	0.58
			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	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	None	None	0.47
			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	None	0.63
			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	None	None	Negligible	None	Minor	None	None	None	None	None	None	None	None	None	None	0.16
			Environmental	-																			
			Socioeconomic	-																			
		Road network	Physical	Use of material Built Heritage	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	Negligible	None	None	None	0.11
			Environmental	-																			
			Socioeconomic	-																			
		Housing	Physical	Use of material Built Heritage	None	None	None	None	None	None	Negligible	None	None	Negligible	None	None	None	None	None	None	None	None	None	0.11
			Environmental	-																			
			Socioeconomic	-																			

Hazard Event:	**Cold Spell**
Frequency of Occurrence:	Common
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: 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	Coastal	Impact Score
Cold and uncomfortable working conditions	Low temperatures in homes and office causing discomfort	Outdoor workers	Physical	-	None	None	Moderate	None	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	0.47
			Environmental	Limited access to heating apparatus/ shelter																				
			Socioeconomic	Population age Population constitution																				
		Indoor workers	Physical	-	None	None	Moderate	None	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	0.47
			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	Major	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	Major	None	0.79
			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	None	None	Negligible	None	None	None	None	None	None	None	None	Moderate	None	None	None	0.21
			Environmental	Proximity to urban environment																				
			Socioeconomic	-																				
		LA Buildings	Physical	Material properties Built Heritage	None	None	Minor	None	None	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	None	0.37
			Environmental	Proximity to urban environment																				
			Socioeconomic	-																				
		Harbour	Physical	Access to vessels at piers & harbours compromised/unsafe	None	None	None	None	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	None	Minor	0.16
			Environmental	-																				
			Socioeconomic	-																				
		Housing	Physical	Material properties Built Heritage	None	None	None	None	Minor	None	Negligible	None	Minor	Minor	None	None	None	None	None	None	None	None	None	0.37
			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	None	0.89
			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	None	0.95
			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	None	None	Negligible	None	None	None	None	None	None	None	None	None	None	Major	None	0.26
			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	None	None	None	None	None	None	None	None	None	None	None	None	None	0.16
			Environmental																					
			Socioeconomic	-																				
More time spent indoors	Cold temperatures dissuades people from going outdoors	Mental health	Physical	-	None	None	Minor	Moderate	None	None	Negligible	None	None	None	Moderate	None	None	None	None	None	None	None	None	0.47
			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	None	0.16
			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	0.21
			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 sensitivity to cold	None	None	None	None	None	Moderate	Negligible	None	None	None	None	None	None	None	None	None	None	None	None	0.21
			Environmental	Prolonged road salting affecting salinity of surrounding ground Influenced by time of year																				
			Socioeconomic	-																				
		Agricultural land	Physical	-	None	None	Negligible	Minor	Minor	Minor	Negligible	None	None	None	None	None	Major	None	None	Minor	Major	Moderate	Moderate	1.26
			Environmental	Prolonged road salting affecting salinity of surrounding ground Influenced by time of year																				
			Socioeconomic	-																				

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
	Coastal flood	Common	3	Major	Moderate	Moderate	Moderate	Minor	Moderate	Moderate	3.00
	Coastal erosion	Common	3	Major	Minor	Major	Minor	Minor	Minor	Moderate	2.71
	Extreme precipitation	Very Frequent	5	Moderate	Minor	Minor	Minor	Minor	Minor	Moderate	2.29
	Storm Surge	Common	3	Moderate	Moderate	Moderate	Minor	Minor	Negligible	Minor	2.29
	Drought	Common	3	Minor	Moderate	Moderate	Moderate	Minor	Minor	Negligible	2.29
	Severe windstorm	Very Frequent	5	Minor	Moderate	Moderate	Minor	Negligible	Negligible	Moderate	2.14
	Pluvial flood	Common	3	Moderate	Minor	Minor	Minor	Negligible	Moderate	Minor	2.14
	Heatwave	Common	3	Minor	Moderate	Moderate	Minor	Negligible	Negligible	Moderate	2.14
	Above average precipitation	Common	3	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	Common	3	Minor	Minor	Negligible	Minor	Minor	Negligible	Minor	1.71
	Heavy snowfall	Common	3	Minor	Minor	Minor	Negligible	Minor	Negligible	Minor	1.71
	Increase in Relative Sea Level	Common	3	Negligible	Negligible	Minor	Negligible	Negligible	Negligible	Minor	1.29

Appendix F Assessment of Future Climate Hazards and Impacts

Assessment 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	Common	Frequent	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	Very 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	Very Frequent	Very 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		Storm Surge	Common	Frequent	Expected surge levels for events of a 20 to 30 year return period are likely to increase by up to 9cm by 2100 (The Impact of Climate Change on Storm Surge over Irish Waters). Increasing wave heights have been observed over the last 70 years in the North Atlantic with typical winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks (Status of Ireland's Climate, EPA). There is however a projected decrease in the amount of smaller storms but an increase in the amount of extreme storms (www.climateireland.ie).
7		Coastal erosion	Common	Frequent	Climate projections (www.climateireland.ie) indicate a decrease in mean and extreme wave heights but an increase in the magnitude and intensity of storm wave heights which will likely increase the frequency of coastal erosion. There is also indication that the ocean acidity will likely increase. In addition, 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), leading to increased levels of coastal erosion.
8		Coastal flood	Common	Frequent	Climate projections (www.climateireland.ie) indicate an increase in sea levels and an increase in the magnitude and intensity of storm wave weights which will likely lead to more coastal flood events. In addition, 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), leading to increased levels of coastal flooding.
9		Increase in Relative Sea Level	Common	Frequent	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).
10		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).
11		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).
12		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).
13		Cold spell	Common	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).
14		Heavy snowfall	Common	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.

Assessment 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 Waterford 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. Adaptation 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 (Waterford 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 (Waterford 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 (Waterford 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		Storm Surge	Moderate	Major	Climate actions in coastal areas include ensuring new developments in coastal areas are climate proofed and resilient to all elements of climate change (Waterford CDP). However, the goal to promote densification of urban areas will potentially increase the impact of storm surges. Increasing wave heights have been observed over the last 70 years in the North Atlantic with typical winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks (Status of Ireland's Climate, EPA).
7		Coastal erosion	Major	Major	Objectives set out in the Waterford CDP outline a goal of ensuring vulnerable developments are directed away from areas at risk in particular to coastal areas at risk of erosion and do not exacerbate erosion risk. However, existing infrastructure located along coastlines are currently at high risk of being abandoned due to erosion. The projected increase in the magnitude and intensity of storm wave heights will likely increase the impacts of coastal erosion (Climate Ireland). There is also an indication that the ocean acidity will likely increase.
8		Coastal flood	Major	Major	Climate actions include avoiding vulnerable development in areas under threat from coastal flooding, An increase in sea levels and an increase in the magnitude and intensity of storm wave heights are expected (Climate Ireland), leading to more severe coastal floods.
9		Increase in Relative Sea Level	Negligible	Minor	New developments are under guidance to be placed away from areas at risk of damage due to sea level rise, i.e., low lying regions (Waterford CDP). However, 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) and if this trend continues, the impact on assets will likely increase as low lying infrastructure already located along the coastline are likely to be submerged if no action is taken.
10		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 accommodate this, but there will also be an increase in the impact of heatwaves due to more compacted urban areas (Waterford CDP).
11		Drought	Minor	Moderate	Average surface temperature are expected 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.
12		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 accommodate hotter summers without compromising resilience to other climate changes, but densification of urban areas will potentially increase the solar radiation of urban areas (Waterford CDP).
13		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.
14		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 Waterford 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 Waterford 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 (Waterford LECP). Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved.
6		Storm Surge	Moderate	Major	Changing demographics with an increase in elderly population and densification of urban areas will potentially increase exposure and vulnerability (Waterford LECP). Increasing wave heights have been observed over the last 70 years in the North Atlantic with typical winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks (Status of Ireland's Climate, EPA).
7		Coastal erosion	Minor	Minor	Objectives set out in the Waterford CDP outline a goal of ensuring vulnerable developments are directed away from areas at risk in particular to coastal areas at risk of erosion. Vulnerabilities are unlikely to change. The projected increase in the magnitude and intensity of storm wave heights will likely increase the impacts of coastal erosion (Climate Ireland). There is also indication that the ocean acidity will likely increase.
8		Coastal flood	Moderate	Moderate	Objectives set out in the Waterford CDP outline a goal of ensuring vulnerable developments are directed away from areas at risk in particular to coastal areas at risk of flooding. An increase in sea levels and an increase in the magnitude and intensity of storm wave heights are expected (Climate Ireland), leading to more severe coastal floods.
9		Increase in Relative Sea Level	Negligible	Minor	Changing demographics with an increase in elderly population and densification of urban areas will potentially increase exposure and vulnerability (Waterford LECP). 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). If this trend continues, there will likely be an impact on mental health as the fear of abandonment of properties will rise along with the risks associated with storm surges/coastal erosion/flooding.
10		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 (Waterford CDP).
11		Drought	Moderate	Major	Changing demographics with an increase in elderly population and densification of urban areas will potentially increase exposure and vulnerability (Waterford LECP). Average surface temperature are expected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).
12		Above average surface temperature	Negligible	Negligible	Average surface air temperatures across all seasons are expected to increase (Climate Ireland). Adaptation goals for County Waterford 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 (Waterford CDP).
13		Cold spell	Minor	Minor	Increase in vulnerable population, e.g., elderly population, may increase the possible impacts (Waterford 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.
14		Heavy snowfall	Minor	Minor	The increasing elderly population increases the possible impacts of heavy snowfalls (Waterford 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	Major	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 (Waterford 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 (Waterford 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 (Waterford 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 (Waterford 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 (Waterford CDP).
6		Storm Surge	Moderate	Major	Increasing wave heights have been observed over the last 70 years in the North Atlantic with typical winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks (Status of Ireland's Climate, EPA). Goals are in place to enhance the biodiversity and ecosystems (Waterford CDP).
7		Coastal erosion	Major	Major	The projected increase in the magnitude and intensity of storm wave heights will likely increase the impacts of coastal erosion (Climate Ireland). There is also indication that the ocean acidity will likely increase. The Council will continue to work with GSI and the OPW to ensure that risks posed by coastal erosion are carefully managed so as to protect coastal habitats (Waterford CDP).
8		Coastal flood	Moderate	Major	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 (Waterford CDP). An increase in sea levels and an increase in the magnitude and intensity of storm wave heights are expected (Climate Ireland), leading to more severe coastal floods.
9		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). This may increase the growth of marine habitats in near shallow waters, but reduce habitats which live on the coastlines.
10		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.
11		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 expected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).
12		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.
13		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.
14		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 (Waterford 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 (Waterford 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 (Waterford 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 (Waterford 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 (Waterford 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		Storm Surge	Minor	Minor	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability (Waterford LECP). Increasing wave heights have been observed over the last 70 years in the North Atlantic with typical winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks (Status of Ireland's Climate, EPA).
7		Coastal erosion	Minor	Minor	Actions to avoid locating vulnerable developments in areas at risk of coastal erosion are envisaged (Waterford CDP). The projected increase in the magnitude and intensity of storm wave heights will likely increase the impacts of coastal erosion (Climate Ireland). There is also indication that the ocean acidity will likely increase.
8		Coastal flood	Moderate	Moderate	Actions to avoid locating vulnerable developments in areas at risk of flooding are envisaged (Waterford CDP). An increase in sea levels and an increase in the magnitude and intensity of storm wave heights are expected (Climate Ireland), leading to more severe coastal floods.
9		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, no social impacts are expected to increase.
10		Heatwave	Minor	Minor	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability (Waterford LECP). Average surface air temperatures are expected to increase across all seasons which will likely increase the intensity of heatwaves (Climate Ireland).
11		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 expected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).
12		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.
13		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.
14		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 (Waterford 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 (Waterford 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 financial 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 (Waterford CDP). Current predictions indicate an increase in the intensity of windstorms (Climate Ireland), increasing the impacts involved.
6		Storm Surge	Minor	Moderate	The increase in impact across a range of areas of the local authority could lead to an increasing financial burden on the local authority (Waterford CDP). Increasing wave heights have been observed over the last 70 years in the North Atlantic with typical winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks (Status of Ireland's Climate, EPA).
7		Coastal erosion	Minor	Moderate	The increase in impact across a range of areas of the local authority could lead to an increasing financial burden on the local authority (Waterford CDP). However, the indirect consequences of these impacts are unknown which could lead to an increase in financial burden for the local authority. The projected increase in the magnitude and intensity of storm wave heights will likely increase the impacts of coastal erosion (Climate Ireland). There is also indication that the ocean acidity will likely increase.
8		Coastal flood	Minor	Moderate	The increase in impact across a range of areas of the local authority could lead to an increasing financial burden on the local authority (Waterford CDP). An increase in sea levels and an increase in the magnitude and intensity of storm wave heights are expected (Climate Ireland), leading to more severe coastal floods.
9		Increase in Relative Sea Level	Negligible	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) and if this trend continues, the impact on finances will likely increase.
10		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 (Waterford CDP).
11		Drought	Minor	Moderate	Average surface temperature are expected 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.
12		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.
13		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.
14		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

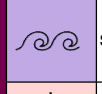
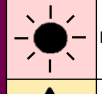
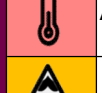
Hazard No.	Hazard Type		Current Reputational Impact	Projected Change	Rationale
1		River flood	Moderate	Moderate	There is a likely increase in river flows across most of the country leading to an increase in severity of flooding (Climate Ireland). The local authority has a role in addressing these issues, 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	Moderate	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		Storm Surge	Negligible	Negligible	Increasing wave heights have been observed over the last 70 years in the North Atlantic with typical winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks (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.
7		Coastal erosion	Minor	Negligible	The projected increase in the magnitude and intensity of storm wave heights will likely increase the impacts of coastal erosion (Climate Ireland). There is also indication that the ocean acidity will likely increase. 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.
8		Coastal flood	Moderate	Moderate	An increase in sea levels and an increase in the magnitude and intensity of storm wave heights are expected (Climate Ireland), leading to more severe coastal floods. 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		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) and if this trend continues, the impact on reputation will likely increase. 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.
10		Heatwave	Negligible	Minor	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.
11		Drought	Minor	Moderate	Average surface temperature are expected 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.
12		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.
13		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.
14		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 (Waterford 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 (Waterford 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 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	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		Storm Surge	Minor	Moderate	Storm surges are damaging to cultural assets located on the coasts and prevent the provision of cultural trails along the coast (Waterford LECP). Increasing wave heights have been observed over the last 70 years in the North Atlantic with typical winter season trends of increases up to 20 cm per decade, along with a northward displacement of storm tracks (Status of Ireland's Climate, EPA).
7		Coastal erosion	Moderate	Major	Coastal erosion is a risk to the promontory forts present on the coasts of Waterford. The projected increase in the magnitude and intensity of storm wave heights will likely increase the impacts of coastal erosion (Climate Ireland). There is also indication that the ocean acidity will likely increase.
8		Coastal flood	Moderate	Major	There could be an increase in the number of cultural heritage assets exposed to coastal flooding due to an increase in severity and frequency of flooding events, and an increase in the overall impact is expected. An increase in sea levels and an increase in the magnitude and intensity of storm wave heights are expected (Climate Ireland), leading to more severe coastal floods. The objective is to continue to work alongside OPW to carry out flood relief schemes and maintain existing defences (Waterford CDP).
9		Increase in Relative Sea Level	Minor	Moderate	Increased sea levels may increase the risk to cultural heritage on the coast, e.g., promontory forts, and lead to closure or the submersion of these assets. 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) and if this trend continues, the impact on cultural heritage will likely increase.
10		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).
11		Drought	Negligible	Negligible	Droughts do not impact the majority of cultural heritage assets so a significant increase in overall impact is not envisaged (Waterford CDP). Average surface temperature are expected in increase, as well as a decrease in the levels of summer rainfall (Status of Ireland's Climate, EPA).
12		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).
13		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.
14		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	Major	Moderate	Major	Moderate	Major	3.71
	Coastal flood	Frequent	4	Major	Moderate	Major	Moderate	Moderate	Moderate	Major	3.43
	Storm Surge	Frequent	4	Major	Major	Major	Minor	Moderate	Negligible	Moderate	3.00
	Drought	Frequent	4	Moderate	Major	Major	Moderate	Moderate	Moderate	Negligible	3.00
	Coastal erosion	Frequent	4	Major	Minor	Major	Minor	Moderate	Negligible	Major	2.86
	Severe windstorm	Very Frequent	5	Moderate	Major	Major	Minor	Minor	Negligible	Moderate	2.71
	Extreme precipitation	Very Frequent	5	Moderate	Minor	Moderate	Minor	Minor	Minor	Moderate	2.43
	Pluvial flood	Frequent	4	Moderate	Minor	Moderate	Minor	Minor	Minor	Moderate	2.43
	Heatwave	Frequent	4	Minor	Moderate	Major	Minor	Negligible	Minor	Moderate	2.43
	Above average precipitation	Frequent	4	Moderate	Minor	Minor	Minor	Negligible	Negligible	Moderate	2.00
	Above average surface temperature	Frequent	4	Negligible	Negligible	Catastrophic	Minor	Negligible	Negligible	Moderate	2.00
	Increase in Relative Sea Level	Frequent	4	Minor	Minor	Minor	Negligible	Minor	Negligible	Moderate	1.86
	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