Rialtas na hÉireann
Government of Ireland

Technical Annex B

Climate Change Risk Assessment

Local Authority Climate Action Plan Guidelines

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1.0 Introduction

Adaptation is the approach for addressing the current and future risks posed by a changing climate. The aim of adaptation is to reduce the risks posed by climate change to our environment, society and economy and increase resilience. Adaptation also brings opportunity through green growth, innovation, jobs and ecosystem enhancement as well as improvements in areas such as water and air quality.

Assessing 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. For the purpose of assessing climate change, risk is composed of three inter-related components[1]:

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

Figure 1 is from the Intergovernmental Panel on Climate Change Assessment Report 5 Framework of Climate Risk. It 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.[2] Therefore, to understand the possible impacts of climate change, a climate change risk assessment is required.

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

[2] Note that the treatment of climate sensitive risk has been expanded on in IPCC AR6 WG 2, however the AR5 methodology of evaluating risk based on the Climate Hazard, Vulnerability and Exposure set out here is considered appropriate in this guidance. IPCC, 2022: AR6 WG2: Summary for Policymakers (Figure SPM1): [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the

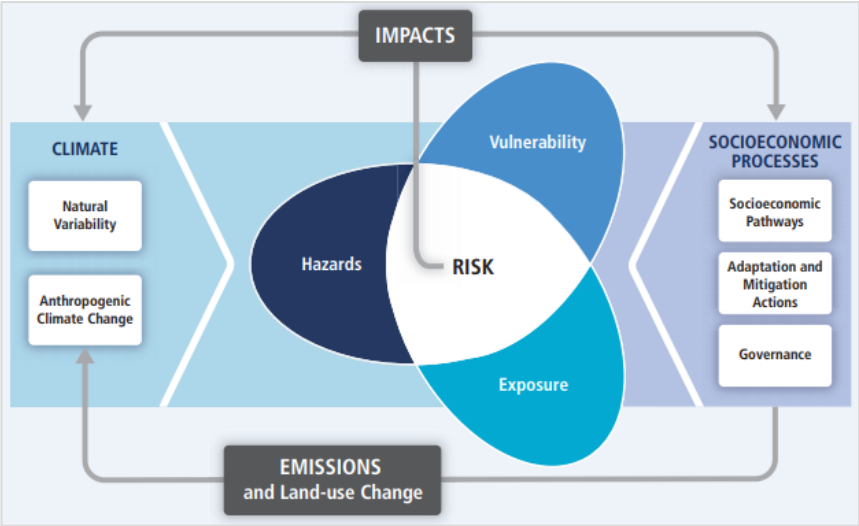

Figure 1: The Intergovernmental Panel on Climate Change Assessment Report 5 Framework of Climate Risk which shows how the three components of risk (hazards, exposure, and vulnerability) are connected to climate and socioeconomic processes[3].

Climate risk assessments provide a number of benefits:

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

Climate change risk assessments can be qualitative (Tier-1), semi-quantitative (Tier-2), to fully- quantitative (Tier-3), with each tier building on the previous and requiring an increasing

Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3-33, doi:10.1017/9781009325844.001.

[3] 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.

level of data, information and complexity to develop[4]. It is therefore recommended to begin the process of climate risk assessment using a qualitative (Tier-1) approach.

This Technical Annex provides guidance on how to undertake a qualitative (Tier-1) climate change risk assessment and has been developed on the basis of the existing local authority adaptation strategy guidelines[5], along with the '*Adaptation to climate change - Guidelines on vulnerability, impacts and risk assessment*' International Standard[6], guidance on the climate proofing of infrastructure[7], the National Risk Assessment of Impacts of Climate Change[8], and ongoing risk assessment research. In addition, the approach outlined within this Technical Annex builds upon the data and information produced within the previous local adaptation strategies.

Figure 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 spreadsheet has been developed to assist local authorities undertake and record their risk assessment analysis.

Figure 2: An overview of the stages of the Climate Change Risk Assessment.

[4] Stephen Flood et al., *National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action*, Report 346 (EPA Research, 2020).
[5] DCCAE, "Local Authority Adaptation Strategy Development Guidelines," 2018.
[6] ISO, "Adaptation to Climate Change - Guidelines on Vulnerability, Impacts and Risk Assessment (14091)."
[7] European Commission, "Technical Guidance on the Climate Proofing of Infrastructure in the Period 2021-2027," 2021.
[8] Flood et al., *National Risk Assessment of Impacts of Climate Change: Bridging the Gap to Adaptation Action*.

2.0 Assessing Current Climate Risks and Impacts

Understanding current climate impacts is critical to developing an understanding of future climate risks. Assessing current climate impacts involves:

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

2.1. Develop a Profile of Climate Hazards

In collaboration and consultation with all departments within the local authority, the Climate Action Team (CAT) should identify and develop a timeline of climate hazards that have been of significance to the local authority in the past. Climate hazards include extreme weather events and periods of climate variability, for example:

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

Table 1 provides an overview and typology of potential climate hazards that may have affected your area while Figure 3 provides a representative example and illustration of a profile of the climate hazards over time.

Table 1: The types of climate hazards that occur (or could occur) in Ireland. Adapted from IPCC[9].

Type	Climate Hazards
Heat and Cold	Above average surface temperature
	Below average surface temperature
	Heatwave
	Heatwave and drought
	Cold spell
	Frost
Wet and Dry	Above average precipitation
	Below average precipitation
	Extreme precipitation
	River flood
	Pluvial flood
	Groundwater flood
	Landslide
	Aridity
	Hydrological drought
	Agricultural and ecological drought
Wind	Above average mean wind speed
	Below average wind speed
	Severe windstorm
	Sand and dust storm
Snow and Ice	Heavy snowfall
	Hail
	Snow avalanche
Coastal	Increase in Relative Sea Level
	Storm Surge
	Coastal flood
	Coastal erosion
	Marine heatwave
	Ocean acidity
Other	Air pollution weather
	Lightning Storm

[9] "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*, ed. V. Masson-Delmotte et al. (Cambridge University Press, Cambridge, 2021), https://www.ipcc.ch/report/ar6/wg1/.

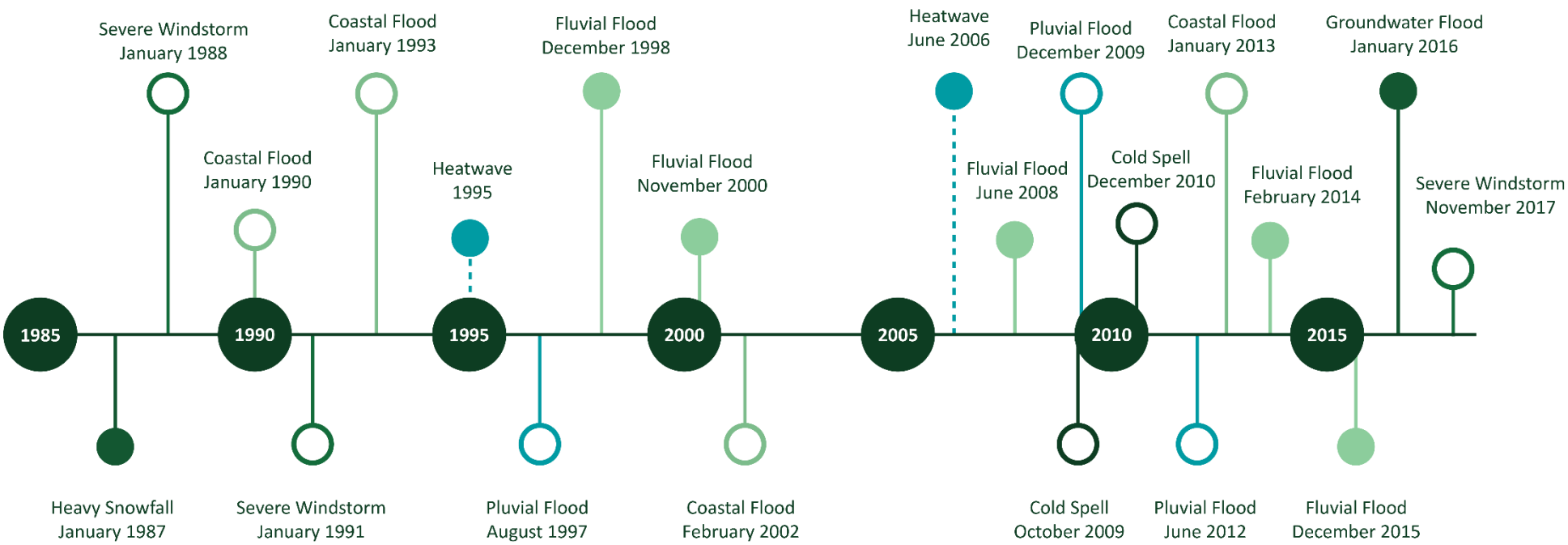

Figure 3: Profile of Climate Hazards: Representative timeline of extreme weather illustrated to show type of hazard and frequency of events.

2.2. Characterising Climate Hazards

Having developed and visually represented the profile of climate hazards to have previously affected your area, the next step is to develop an understanding of the frequency of the identified hazards and describe the meteorological or climatological conditions that comprised the hazard events.

2.2.1. Frequency

For each of the climate hazards identified for your area, indicate the frequency of occurrence of each. The frequency can be classified according to Table 2.

Table 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

2.2.2. Description

Having indicated the frequency of the hazard event, the next step is to provide a description of the meteorological and climatological conditions that comprised the event and the spatial areas affected.

- Meteorological and climatological conditions: 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 fluvial and coastal flooding, or a heavy rainfall event after a period of drought creating surface water flooding.
- Spatial areas affected: Identify the spatial areas affected and provide as much detail as possible including geographical or topographical characteristics and specific details associated with past hazards events e.g. low-lying areas, typical land uses, watercourses, proximity to city, towns, villages etc.

Table 3: An example of characterisation of a climate hazard.

Hazard Event:	Heatwave
Frequency of Occurrence:	Occasional
Description of the Hazard Event (Including relevant meteorological/climatological conditions, locations affected):	A sustained high pressure weather system resulted in six sequential days of high day and night air temperatures. Urban areas were particularly affected.

2.3. Characterising Exposure, Vulnerability, and Impacts of Current Climate Hazards

Having developed a local level profile of climate hazards, the next step is to identify the local-scale exposures and associated vulnerabilities to the hazard that result in impacts to the local authority.

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

1. The impacts of the hazard should be identified and described (Table 4, Hazard Impact and Impact Description column). When doing so, provide as much evidence as possible including examples of the impact under consideration and as much quantitative information as possible (e.g. number of houses flooded, kilometres of roads impacted). This information allows the impacts of each hazard to be identified.
2. For each of the identified climate impacts, detail the specific exposures, e.g. infrastructure, people, environment, biodiversity (Table 4, Exposure column). This information allows the types of exposures that are impacted by each hazard to be identified.
3. For each of the exposures, the associated physical, socioeconomic and environmental vulnerabilities to the impact are then assessed (Table 4, Vulnerability column). Table 5 describes the differences between these types of vulnerabilities in more detail. This information allows the factors that could exacerbate the impacts of each hazard to the exposed asset/persons to be identified.

Table 4: An example of an assessment of a hazard impact due to a heatwave event. A description of the hazard impact is given, the assets or persons that are exposed to the hazard impact, and an exploration of the vulnerabilities of the exposed asset that could exacerbate the hazard impact.

Hazard Impact	Impact Description (Including example and location if possible)	Exposure	Vulnerability	
			Type	Description
Hot and uncomfortable living/working conditions	High temperatures in offices and homes resulting in discomfort e.g. During the heatwave of June 2006	Social Housing	Physical	Lack of active cooling in homes
			Environmental	Located in high density urban areas/Limited access to green space
			Socioeconomic	Homes with elderly populations
		Private Housing	Physical	Lack of active cooling
			Environmental	Limited access to green space
			Socioeconomic	Elderly populations
		Outdoor Workers	Physical	Lack of access to water and sun protection
			Environmental	Limited access to green space
			Socioeconomic	Elderly, underlying conditions
		Care Homes	Physical	Lack of active cooling in homes
			Environmental	Located in high density urban areas/Limited access to green space
			Socioeconomic	Elderly population / underlying health conditions

Table 5: Description of the different vulnerability types that should be assessed in relation to each of the exposed assets/persons to a hazard impact.

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.

2.4. Assess the Impacts of Current Climate Risks

The impacts of climate risks will result in disruption to the delivery of services and functions by the local authority and these should be considered as part of the assessment. For example, during and after an extreme weather event or as a result of a period of climate variability: Were core services disrupted? Were economic costs incurred in order to maintain a requisite level of service to the community?

An indicative list of services for local authorities is provided through Table 6.

Table 6: An indicative list of Local Authority Service Areas (not exhaustive).

Local Authority Service Areas		
Archives	Finance	Leisure and Recreation
Arts & Culture	Governance & Administration	Libraries
Business & Economy	Heritage & Conservation	Planning & Building
Community	Housing	Roads & Transport
Emergency Services	Human Resources	Tourism
Environment	Information Technology	Water

For each of the impacts associated with a climate hazard, indicate the level of disruption for the delivery of services by the local authority. Table 7 provides a high-level means of assessing the level of impact to the authority [10]. This will provide an overview of the extent of each individual impact on the delivery of services.

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

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

Table 7: Description of the levels of impact due to description of Local Authority services.

2.5. Overall Impact to the Local Authority

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

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

Table 8 provides detail on the ranking system to support the impact assessment.

Table 8: 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)**	**Catastrophe (Score: 5)**
Asset Damage	Impact can be absorbed through normal activity	An adverse event that can be absorbed by taking business continuity action	A serious event that requires additional emergency business continuity actions	A critical event that requires extraordinary/emergency business continuity actions	Disaster with the potential to lead to shutdown or collapse or loss of assets/network
Health and Wellbeing	First aid case	Minor physical injury or mental health impact, medical treatment required	Serious physical or mental health impact, or lost work	Major or multiple injuries or mental health impact, permanent 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)	x % IRR < 2% of turnover	x % IRR 2-10% of turnover	x % IRR 10-25% of turnover	x % IRR 25-50% of turnover	x % IRR > 50% of turnover
Reputation	Localised, temporary impact on public opinion	Localised, short-term impact on public opinion	Local, long-term impact on public opinion with adverse local media coverage	National, short- term impact on public opinion; negative 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

2.6. Current Climate Impacts Assessment Summary

Having identified and assessed the range of hazards to have affected your local authority and the associated exposures, vulnerabilities, levels of service disruption and impacts, an assessment of the current climate impacts has been completed. On this basis, a summary of hazards currently impacting your Local Authority and the administrative area can be illustrated according to the current frequency and level of impact of the hazard, as illustrated in Figure 4. 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, Cultural Heritage and Cultural Premises.

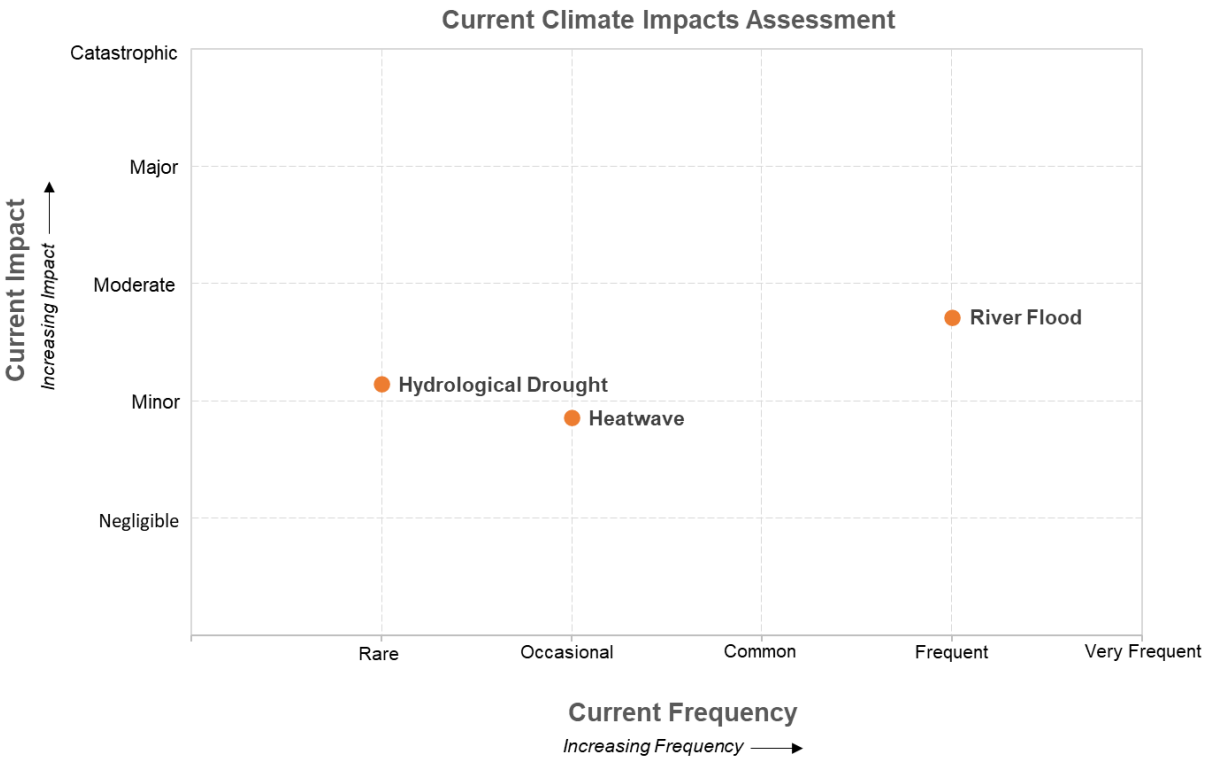

Figure 4: A hypothetical example of the Current Climate Impacts Assessment summary chart. Hazards that are closer to the top right occur more frequently and result in a large impact to local authority services and assets.

3.0 Assessing Future Climate Risks and Impacts

Understanding how climate change risks are likely to evolve in the future is crucial in order 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 in changes in the hazard, exposure, and vulnerability components of risk.

3.1. 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 into the future, it is important to examine available climate projection information 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.

Standardised climate projections and supporting climate products are continually being updated through Ireland's National Framework for Climate Services (NFCS). This latest summarised information, appropriate for assessing climate hazards, is available through the Climate Ireland online platform. Local authority support for climate services is available by contacting enquiries@met.ie.

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, indicate the projected frequency of each of the identified climate hazards. For example, for a given local authority, heatwaves have been identified as occurring on an occasional basis. The climate change projections in Nolan and Flanagan[10] indicate that heatwaves are expected to occur more frequent by mid-

century. Accordingly, the local authority can expect to be dealing with an increase in the occurrence of heatwaves and its associated impacts on a more frequent basis. It is also important that the evidence base for the projected frequency is provided and the plan should cite the source of information, the time horizon of the projection, i.e. what is the future time-period being considered, the emission scenario under consideration, the projected change value and any other relevant information.

Table 9: Example of the future changes in climate hazards expected due to climate change.

Hazard No.	Hazard Type	Current Frequency	Projected Frequency	Evidence-base
Hazard 1	Extreme Heat	Occasional	Frequent	Nolan and Flanagan (2020) indicate an increase in the number of heatwave days.
Hazard 2	Hydrological Drought	Occasional	Frequent	Nolan and Flanagan (2020) indicate that there will be a decrease in rainfall during the summer months which will increase the likelihood of drought conditions.
Hazard 3	River Flooding	Frequent	Very Frequent	Nolan and Flanagan (2020) indicate there will be an increase in Wet and Very Wet days in the future which will likely increase the frequency of flood events.

3.2. Future Changes in Exposure and Vulnerability

Climate risks may develop or increase in the future because of the change of frequency and intensity of climate hazards. However, changes in exposure and vulnerability will also affect future climate risks. For example, Ireland's population is projected to increase to between 5.58 and 6.69 million people by 2051. Within this, a substantial rise in older populations (aged 65 years and older) is expected to increase from 13.3% of the population in 2016 to between 23.9% and 27.4% by 2051[11]. This will likely result in a higher level of vulnerability to climate hazards such as heatwaves and associated impacts (heat-related illness), plus increased number of properties which will have to be constructed in suitable locations that comply with national and regional planning policies.

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

[11] CSO, Population and Labour Force Projections 2017 - 2051, https://www.cso.ie/en/releasesandpublications/ep/p-plfp/populationandlabourforceprojections2017-2051/, 2018

Plan etc.) should be examined to assess potential changes in levels of exposure and vulnerability. For some impacts, there may be little existing information to support future impact and vulnerability assessment. This should be noted as part of assessment and may form a priority for investigation or research. An example of the future impact assessment is shown in Table 10.

Table 10: An example of the future impact assessment upon health and wellbeing for three hazards and the rational for the projected change.

Hazard No.	Hazard Type	Current Health and Wellbeing Impact	Projected Change	Rationale (hypothetical examples)
Hazard 1	Heatwave	Minor	Moderate	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability
Hazard 2	Hydrological Drought	Major	Major	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 catastrophic future impact
Hazard 3	River Flood	Moderate	Catastrophe	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability

3.3. Uncertainty

In assessing future climate risks, there will be 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. There are ways of reducing uncertainty, for example, using a range of data and information sources. However, there will still be varying degrees of uncertainty present when assessing future changes. Therefore, when selecting evidence to inform the climate risk assessment, information related to the uncertainty of projected changes in climate hazards, exposure, and vulnerability should be noted as part of Assessment of Future Climate Impacts stage within the Rationale column. This information should include the reason for the uncertainty, i.e. the missing/unknown data/information that leads to the uncertainty.

3.4. Emerging Hazards and Climate Change Risks

At this stage of the assessment, it is important that new or emerging climate change risks are considered. 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. Figure 5 shows some hypothetical examples of an increasing and decreasing current climate risk, and an emerging risk over time.

Climate change will also offer opportunities and it is important to also identify these. For example, projected increases in annual average temperature will make Ireland a more attractive tourism destination. However, it should also be noted that projected decreases in levels of summer rainfall and an increasing tourist population will put increased pressure on available water resources.

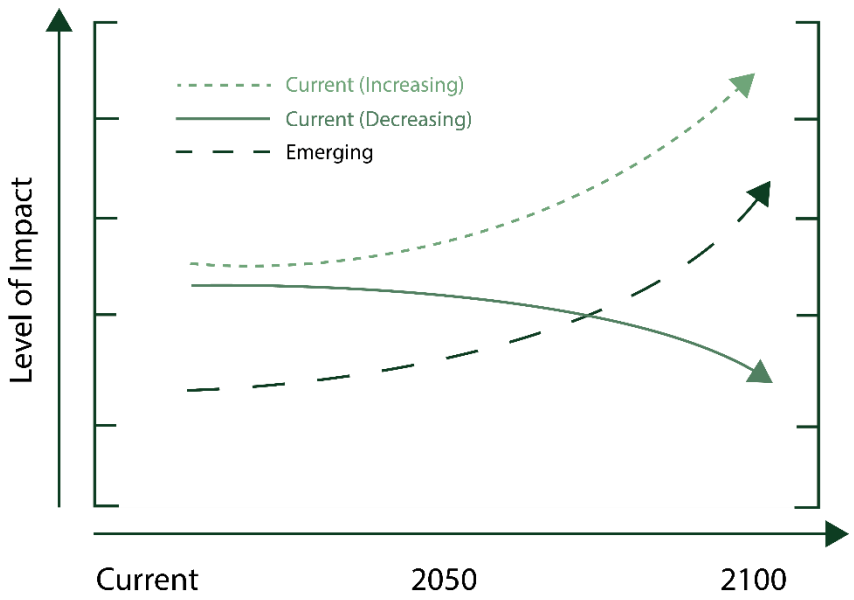

Figure 5: Conceptual diagram of projected future changes in levels of impacts.

3.5. Overall Future Impact on the Local Authority

On this basis and for each hazard and for each of the impact categories (Asset Damage, Health and Wellbeing, Environment, Social, Cultural Heritage, Financial and Reputational), the projected level of impact should be estimated and the rationale for this provided. This future impact assessment should account for projected changes in hazard, exposure and vulnerability and should assume that no additional adaptation actions are taken to offset future impacts.

3.6. Future Climate Impacts Assessment Summary

Future changes in hazards, exposure, and vulnerability have been appraised allowing an analysis of future impacts. On this basis, a summary of hazards impacting your local authority and the administrative area in the future can be illustrated according to the future frequency and future level of impact of the hazard, as illustrated in Figure 4. The level of future impact is calculated as the average level of impact across the impact categories listed in section 2.5.

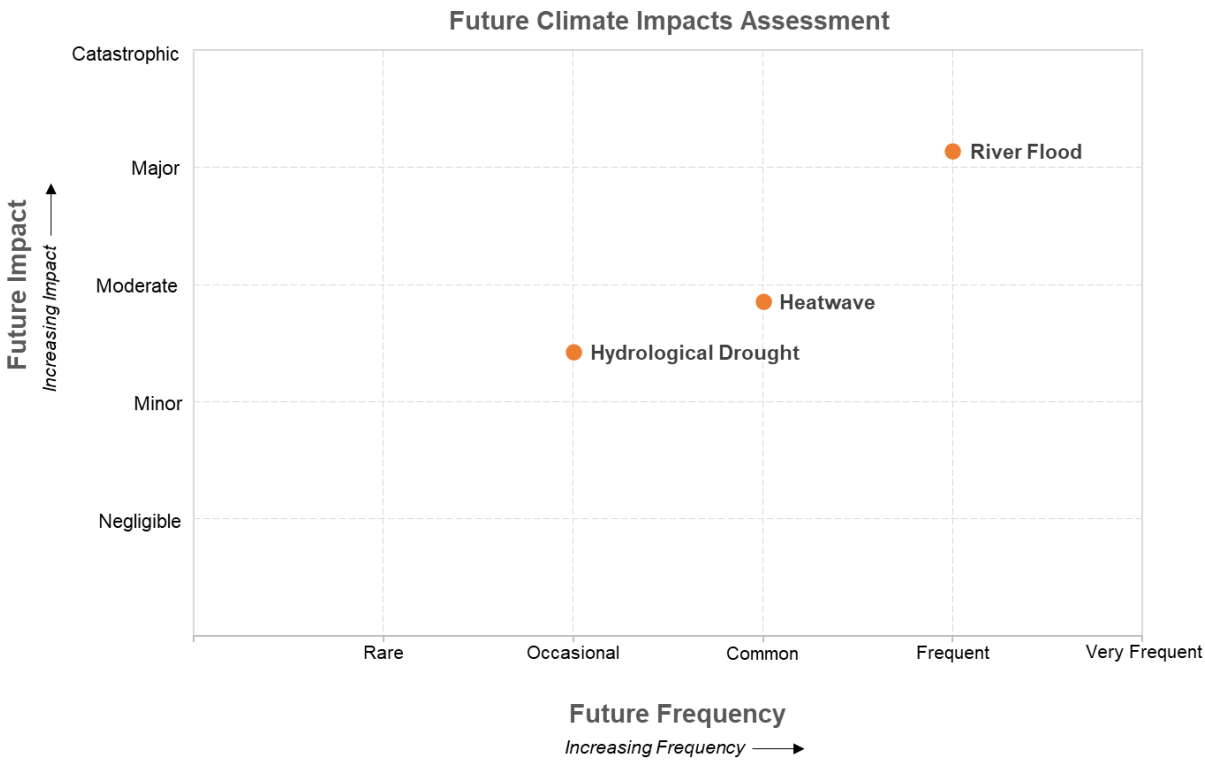

Figure 6: A hypothetical example of the Future Climate Impacts Assessment summary chart. Hazards that closer to the top right will occur more frequently and result in a large impact to local authority services and assets.

4.0 Summary and Conclusion

This technical guide supports local authorities in the collation of a range of information to develop an evidence-based approach to climate risk assessment. By assessing the current climate impacts and future climate risks, local authorities will develop a comprehensive understanding of the hazards, exposures, and vulnerabilities associated with climate change within their local authority and the broader administrative area.

The climate change risk assessment 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.

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Appendix A
Example of the Climate Risk Assessment Spreadsheet

Hazard:	Heatwave
Frequency of Occurrence:	Occasional
Description of the Hazard Event (Including relevant meteorological/climatological conditions, locations effected):	A sustained high pressure weather system resulted six sequential days of high air temperatures. Urban areas were particularly affected.

			Vulnerability		Service Areas: Level of Disruption																		
Hazard Impact	**Impact Description/Example and location**	**Exposure**	**Type**	**Description**	**Archives**	**Arts and Culture**	**Business and Economy**	**Community**	**Emergency Services**	**Environment**	**Finance**	**Governance and Administration**	**Heritage and Conservation**	**Housing**	**Human Resources**	**Information Technology**	**Leisure and Recreation**	**Libraries**	**Planning and Building**	**Roads and Transport**	**Tourism**	**Water**	**Impact Score**
Hot and uncomfortable living/working conditions	High temperatures in offices and homes reusulting in discomfort E.g. During the heatwave of …..	Social Housing	Physical	- Lack of active cooling in Homes	None	None	None	Negligible	Moderate	Catastrophic	None	None	None	None	None	None	None	None	None	None	None	None	0.5
			Environmental	- Located in high density urban areas/Limited access to green space																			
			Socioeconomic	- Homes with Elderly Populations																			
		Private Housing	Physical	- Lack of active cooling	Minor	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	0.1
			Environmental	- Limited access to green space																			
			Socio-economic	- Elderly Populations																			
		Outdoor Workers	Physical	- Lack of access to Water and Sun screen	None	None	None	None	None	None	None	None	None	None	Moderate	None	None	None	None	None	None	None	0.2
			Environmental	- Limited access to green space																			
			Socioeconomic	- Elderly, underlying conditions																			
		Care Homes	Physical	- Lack of active cooling in homes	None	None	None	None	None	None	None	None	None	None	Major	None	None	None	None	None	None	None	0.2
			Environmental	- Located in high density urban areas/Limited access to green space																			
			Socioeconomic	- Elderlying poopulation / underlying health conditions																			
Pressure on Recreational Areas	High temperatures resulting in increased use of recreational areas and pressure on assoicated infrastructure	Beaches	Physical	- Beaches within easy access to urban areas / Beaches with limited services (road, refuse)	None	None	None	None	None	Minor	None	None	None	None	None	None	None	None	None	None	None	None	0.1
			Environmental	- Beaches with dunes systems																			
			Socioeconomic	-																			
		Parks	Physical	- Parks within easy access to urban areas	None	None	None	None	None	Minor	None	None	None	None	None	None	None	None	None	None	None	None	0.1
			Environmental	-																			
			Socio-economic	-																			
Heat Stress on Buidlings/Infrastructure	High temperatures resulting in damage to road surfaces	Roads	Physical	- Vulnerable substrate	None	None	None	None	None	None	None	None	None	None	None	None	None	None	None	Moderate	None	None	0.2
			Environmental	- Located in areas of high solar radiation																			
			Socioeconomic	-																			

Overall Impact Assessment:	
Asset Damage	Moderate
Health and Wellbeing	Minor
Environment	Minor
Social	Minor
Cultural Heritage	Negligible
Financial	Minor
Reputational	Negligible
Overall Impact	Minor

Figure 7: Hypothetical example of a heatwave hazard and its impact level of local authority service areas.

Hazard:	Hydrological Drought
Frequency of Occurrence:	Rare
Description of the Hazard Event (Including relevant meteorological/climatological conditions, locations effected):	A period of three months with minimal precipitation resulted in very low water levels in rivers, lakes, and groundwater.

			Vulnerability		Service Areas: Level of Disruption																		
Hazard Impact	**Impact Description/Example and location**	**Exposure**	**Type**	**Description**	**Archives**	**Arts and Culture**	**Business and Economy**	**Community**	**Emergency Services**	**Environment**	**Finance**	**Governance and Administration**	**Heritage and Conservation**	**Housing**	**Human Resources**	**Information Technology**	**Leisure and Recreation**	**Libraries**	**Planning and Building**	**Roads and Transport**	**Tourism**	**Water**	**Impact Score**
Reduced water availability	Lack of water for drinking	Social Housing Tenents	Physical	-	None	None	None	None	Moderate	None	None	None	None	None	None	None	None	None	None	None	None	Major	0.4
			Environmental	-																			
			Socioeconomic	Homes with Elderly Populations that require support to access emergency water supplies																			
		Public	Physical	- Homes supplied by private water supply - Rural properties	None	None	None	None	Moderate	None	None	None	None	None	None	None	None	None	None	None	None	Major	0.4
			Environmental																				
			Socioeconomic	Those with no access to a vehicle to obtain emergeny water supplies																			
Deterioration of Recreational Areas/Public Planting	Reduced water availabiltiy will prevent public areas with planting to be maintained.	Parks	Physical	Parks within easy access to urban areas	None	None	None	None	None	Moderate	None	None	Moderate	None	None	None	Minor	None	None	None	Minor	Minor	0.7
			Environmental	Urban parks with reduced access to natural water sources																			
			Socioeconomic	-																			

Overall Impact Assessment:	
Asset Damage	Negligible
Health and Wellbeing	Major
Environment	Moderate
Social	Negligible
Cultural Heritage	Minor
Financial	Minor
Reputational	Minor
Overall Impact	Minor

Figure 8: Hypothetical example of a hydrological hazard and its impact level of local authority service areas.

Hazard:	River Flood
Frequency of Occurrence:	Frequent
Description of the Hazard Event (Including relevant meteorological/climatological conditions, locations effected):	A period of wet weather resulted in saturated soils. A very heavy rainfall event created significant of surface run off which entered the river system rapidly, resulting in several rivers exceeding their bank capacity.

			Vulnerability		Service Areas: Level of Disruption																		
Hazard Impact	**Impact Description/Example and location**	**Exposure**	**Type**	**Description**	**Archives**	**Arts and Culture**	**Business and Economy**	**Community**	**Emergency Services**	**Environment**	**Finance**	**Governance and Administration**	**Heritage and Conservation**	**Housing**	**Human Resources**	**Information Technology**	**Leisure and Recreation**	**Libraries**	**Planning and Building**	**Roads and Transport**	**Tourism**	**Water**	**Impact Score**
Flood Damage to Buildings	Flood water entering building causes damage to structure and services, e.g. electricity, flooring, furniture	Social Housing	Physical	- Properties with only a single groundfloor storey	None	None	None	Minor	None	None	None	None	None	Moderate	None	None	None	None	None	None	None	None	0.3
			Environmental	- Properties situated in areas with high levels of impervious surfaces																			
			Socioeconomic	- Properties with elderley residents - Properties with residents in poor health																			
		Private Property	Physical	- Properties with only a single groundfloor storey	None	None	None	Minor	None	None	None	None	None	None	None	None	None	None	None	None	None	None	0.1
			Environmental	- Properties situated in areas with high levels of impervious surfaces																			
			Socioeconomic	- Properties with elderley residents - Properties with residents in poor health																			
		Local Authority Offices	Physical	- Buildings without temporary flood defences	Minor	None	None	None	None	None	None	None	Negligible	None	None	Minor	Minor	Minor	None	None	None	None	0.5
			Environmental	- Properties situated in areas with high levels of impervious surfaces																			
			Socioeconomic	-																			
Reduced water quality	Untreated sewage entering the water system	Water Bodies (e.g. lakes, rivers)	Physical	- Bodies of water with low volumes - Bodies of water with multiple inputs from sewage overflow systems	None	None	None	None	None	Moderate	None	None	None	None	None	None	Minor	None	None	None	Minor	Moderate	0.6
			Environmental	- Bodies of water close to urban areas																			
			Socioeconomic	-																			
Unuseable Roads	Flooded roads will become inaccessible during a flood event and potentially after flood waters have receded due to debris on the roads	Road network	Physical	- Roads with elevations that allow pooling of water - Roads with insufficient/blocked drainage	None	None	Moderate	None	Minor	None	None	None	None	None	None	None	None	None	None	Major	Minor	None	0.6
			Environmental	-																			
			Socioeconomic	-																			

Overall Impact Assessment:	
Asset Damage	Major
Health and Wellbeing	Moderate
Environment	Moderate
Social	Minor
Cultural Heritage	Minor
Financial	Moderate
Reputational	Minor
Overall Impact	Moderate

Figure 9: Hypothetical example of a river flood hazard and its impact level of local authority service areas.

Hazard No.	Hazard Type	Current Frequency	Current Frequency (Score)	Assets	Health and Wellbeing	Environment	Social	Cultural Heritage	Financial	Reputational	Current Impact
Hazard 1	Heatwave	Occasional	2	Moderate	Minor	Minor	Minor	Negligible	Minor	Negligible	1.57
Hazard 2	Hydrological Drought	Rare	1	Negligible	Major	Moderate	Negligible	Minor	Minor	Minor	1.86
Hazard 3	River Flood	Frequent	4	Major	Moderate	Moderate	Minor	Minor	Moderate	Minor	2.71

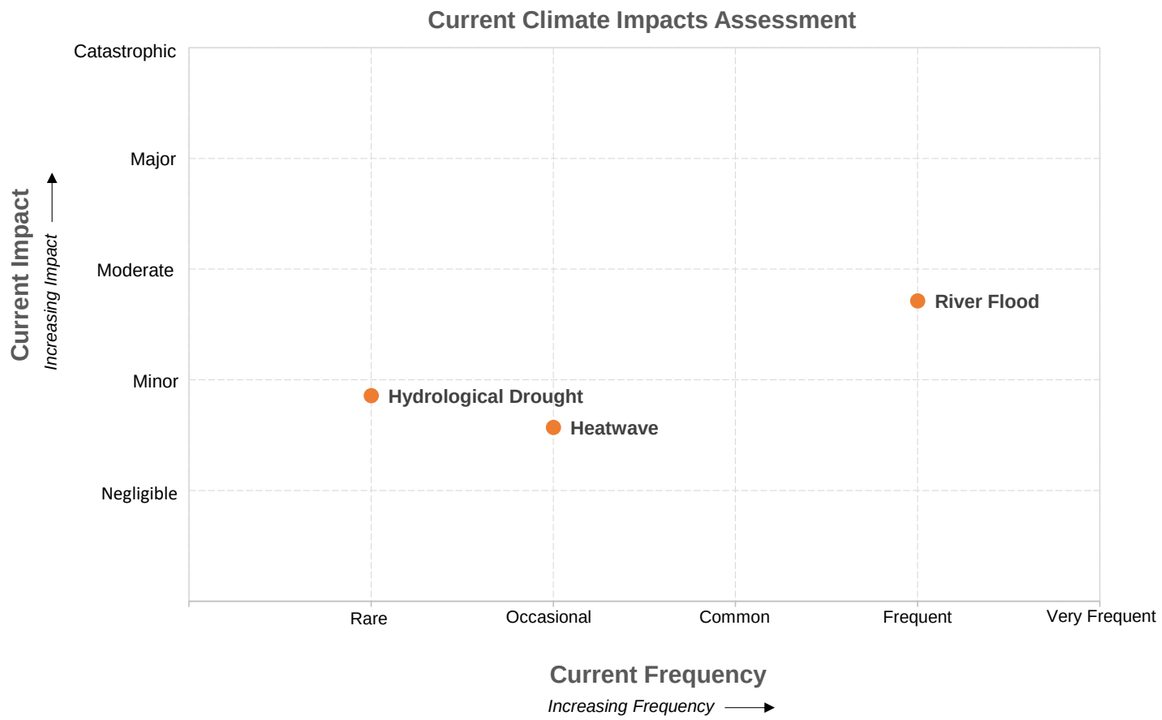

Figure 10: Hypothetical example of a summary of the current climate impacts for three hazards

Assessment of Future Climate Hazards

Hazard No.	Hazard Type	Current Frequency	Projected Frequency	Evidence-base
Hazard 1	Heatwave	Occasional	Frequent	Nolan and Flanagan (2020) indicate an increase in the number of heatwave days
Hazard 2	Hydrological Drought	Rare	Occasional	Nolan and Flanagan (2020) indicate that there will be a decrease in rainfall during the summer months increase the likelihood of drought conditions.
Hazard 3	River Flood	Frequent	Very Frequent	Nolan and Flanagan (2020) indicate there will be an increase in Wet and Very Wet days in the future which will likely increase the frequency of flood events.

Assessment of Future Climate Impacts

Hazard No.	Hazard Type	Current Asset Damage	Projected Asset Damage	Rationale (hypothetical examples)
Hazard 1	Heatwave	Moderate	Moderate	Densification of urban areas will potentially increase exposure and vulnerability however, not enough to make this a catastrophic future impact
Hazard 2	Hydrological Drought	Negligible	Negligible	No changes in the assets affected by hydrological doubt expected.
Hazard 3	River Flood	Major	Catastrophe	Densification of urban areas will potentially increase exposure and vulnerability

Hazard No.	Hazard Type	Current Health and Wellbeing Impact	Projected Change	Rationale (hypothetical examples)
Hazard 1	Heatwave	Minor	Moderate	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability
Hazard 2	Hydrological Drought	Major	Major	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 catastrophic future impact
Hazard 3	River Flood	Moderate	Catastrophe	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability

Hazard No.	Hazard Type	Current Environment Impact	Projected Change	Rationale (hypothetical examples)
Hazard 1	Heatwave	Minor	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.
Hazard 2	Hydrological 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.
Hazard 3	River Flood	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.

Hazard No.	Hazard Type	Current Social Impact	Projected Change	Rationale (hypothetical examples)
Hazard 1	Heatwave	Minor	Moderate	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability
Hazard 2	Hydrological Drought	Negligible	Negligible	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 catastrophic future impact
Hazard 3	River Flood	Minor	Moderate	Changing demographics with an increasing elderly population and densification of urban areas will potentially increase exposure and vulnerability

Hazard No.	Hazard Type	Current Cultural Heritage Impact	Projected Change	Rationale (hypothetical examples)
Hazard 1	Heatwave	Negligible	Moderate	Areas of cultural heritage may see increase visitors during these events and therefore increase pressure on these assets may result
Hazard 2	Hydrological Drought	Minor	Minor	Hydrological droughts do not impact the majority of cultural heritage assets so a significant increase in overall impact is not envisaged.
Hazard 3	River Flood	Minor	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, and an increase in the overall impact is expected.

Hazard No.	Hazard Type	Current Financial Impact	Projected Change	Rationale (hypothetical examples)
Hazard 1	Heatwave	Minor	Minor	Although there is potential for an increasing impact from this hazard, the assets impacted are not necessarily the responsibility of the local authority. However, the indirect consequences of these impacts are unknown which could lead to an increase in financial burden for the local authority.
Hazard 2	Hydrological Drought	Minor	Minor	Although there is potential for an increasing impact from this hazard, the assets impacted are not necessarily the responsibility of the local authority. However, the indirect consequences of these impacts are unknown which could lead to an increase in financial burden for the local authority.
Hazard 3	River Flood	Moderate	Major	The increase in impact across a range of areas of the local authority mean that this could lead to an increasing financial burden on the local authroity

Hazard No.	Hazard Type	Current Reputational Impact	Projected Change	Rationale (hypothetical examples)
Hazard 1	Heatwave	Negligible	Minor	The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives.
Hazard 2	Hydrological Drought	Minor	Moderate	The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives.
Hazard 3	River Flood	Minor	Major	The local authority has a role in addressing these issues, and could therefore suffer reputational damage from local, national, and international perspectives.

Figure 11: Hypothetical example of the assessment of the future changes in hazard, exposure, vulnerability**,** and impact for three hazards.

Hazard No.	Hazard Type	Projected Change in Frequency of Hazard	Projected Change in Frequency of Hazard (Score)	Asset	Health and Wellbeing	Environment	Social	Cultural Heritage	Financial	Reputational	Projected Impact
Hazard 1	Heatwave	Frequent	3	Moderate	Moderate	Major	Moderate	Moderate	Minor	Minor	2.9
Hazard 2	Hydrological Drought	Occasional	2	Negligible	Major	Major	Negligible	Minor	Minor	Moderate	2.1
Hazard 3	River Flood	Very Frequent	4	Catastrophe	Catastrophe	Major	Moderate	Major	Major	Major	4.1

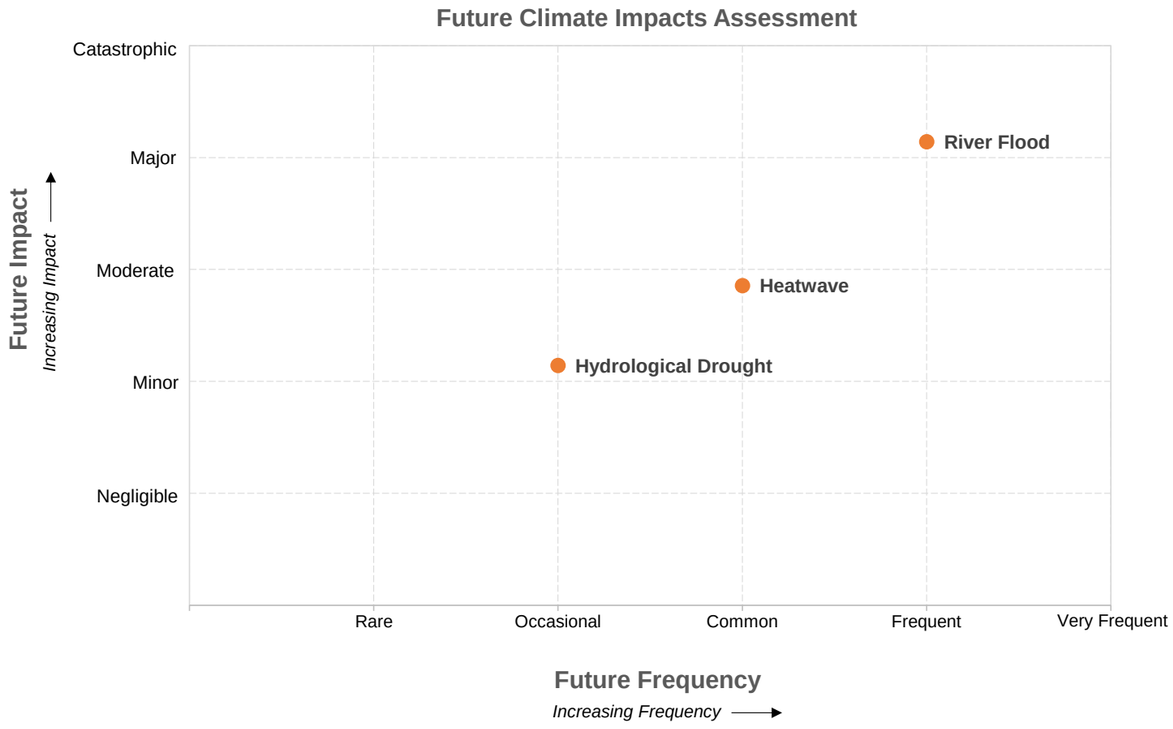

Figure 12: Hypothetical example of a summary of the future climate impacts for three hazards.

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