



Meath County Council

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# CLIMATE CHANGE RISK ASSESSMENT





**Meath County Council**

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# **CLIMATE CHANGE RISK ASSESSMENT**

**TYPE OF DOCUMENT (VERSION) PUBLIC**

**PROJECT NO. 70031770  
MEATH COUNTY COUNCIL- CLIMATE CHANGE ADAPTATION STRATEGY**




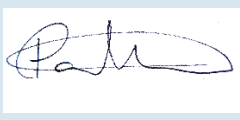
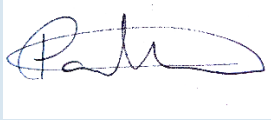
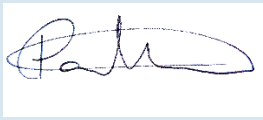

**DATE: MAY 2018**

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# QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2
Date	09/03/18	04/04/18	18/04/18
Prepared by	Katharine Thorogood	Katharine Thorogood	Katharine Thorogood
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Project number	70031770	70031770	70031770

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# EXECUTIVE SUMMARY

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## INTRODUCTION

This report presents an assessment of the potential impacts of climate change upon activities occurring within, and under the jurisdiction of, Meath County Council. It provides a forward look into the consequences of projected shifts in climate behaviour on 11 key service areas within the county. As our climate changes and extreme weather events, such as storms and heatwaves, become more frequent (and possibly severe), there is an increasing need to consider how our climate is expected to change, so that we can build resilience to the challenges that the future might bring. Indeed, even if all man-made greenhouse gas (GHG) emissions ceased immediately, the influence of those GHG's which have been previously emitted into the atmosphere will still generate significant, long-term impacts. As an example, such changes are expected to include changing rainfall patterns, rising sea levels and an increased frequency and intensity of extreme events, such as storms and heatwaves. To help Meath County Council become Future Ready<sup>1</sup>, it is important to start to develop a strategy that will enable services, communities and infrastructure to adapt to these future challenges.

The methodology that has been developed and applied, quantifies and ranks the severity of impact that a particular climate risk might have. This assessment may then be used to inform long-term planning and prioritisation, including proactive engagement with other authoritative bodies who support the operation and management of some of these services, such as the Office of Public Works (OPW) and Irish Water. Ultimately, this will enable the council to take a leading role in adapting to the impacts of climate change, both in terms of the services that they are responsible for but also as part of (inter)national efforts to build resilience to climate change and extreme weather events through Climate Action (one of the 17 Sustainable Development Goals or SDGs).

## METHODOLOGY

The risk assessment looked at the potential impacts occurring from the following projected changes in climate within the county:

- Warmer summers and warmer winters
- More frequent heatwaves
- Increased likelihood and severity of droughts
- Increased occurrences of flooding
- More extreme rainfall events
- Sea level rise
- Increased rate of coastal erosion
- Increased wind speeds/more frequent and severe storms
- Storm surge

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<sup>1</sup> Future Ready is WSP's program to see the future more clearly, and to work with clients to design for this future as well as for today's needs <https://www.wsp.com/en-GL/who-we-are/future-ready>.



Risk was calculated for 11 of the key sectors, over which Meath County Council exercise at least some level of operational control or influence, including: transport, planning and land use, waste, water resource management, agriculture, built environment, ecosystems and biodiversity, coastal and marine and the emergency services. The risk assessment analysed both the short-term (2020s) and medium-term (2050s) risks to the county, relative to the anticipated changes in climate noted above.

Risk was quantified using the following equation:

$$\text{Consequence} \times \text{Likelihood} = \text{Future Risk}$$

wherein “consequence” is the level of harm or damage caused by an event and likelihood is the probability of the event occurring.

### RISK ASSESSMENT

The assessment highlighted a number of high-scoring climate risks, where the council should look to prioritise action in both the short- and medium-term. The scores were classified as follows:

- Low risk: 1 – 6
- Medium risk: 7 - 14
- High risk: 15 – 25

The top three scoring risks in each sector are summarised in the table below.

RISK AND CONSEQUENCE	RISK SCORE	
	2020s	2050s
<b>TRANSPORT</b>		
Increase in the number of <b>flooding</b> events causing road closures, affecting both private and public transport. This is anticipated to impact business and industry with knock-on effects to the local and wider economy.	9	12
<b>Sea level rise</b> and increased prevalence of <b>storm surge events</b> will lead to an increased risk of flooding to coastal road and rail infrastructure, causing delays, disruption and overcrowding.	6	16
Warmer summers and more frequent <b>heatwaves</b> increase the risk of damage to asphalt roads and pavements, including buckling of the surface and issues with resurfacing. It may also cause reduced visibility and operational disruption (i.e. from fires).	9	15
<b>BUILT ENVIRONMENT</b>		
Increased risk of household water disruptions during periods of <b>drought</b> . This may lead to a decrease in water quality which can cause health and wellbeing concerns.	9	16
<b>Flooding</b> will result in an increased risk of flood damage, damp and mould to residential, commercial and industrial buildings. Flooded communities may require rebuilding and temporary or permanent relocation. Additionally, <b>sea level rise</b> will create a compounded level of risk for buildings in the coastal zone.	9	12
<b>Warmer summers</b> and increased occurrences of <b>heatwaves</b> will increase overheating risk within both new and existing homes.	6	15
<b>ENERGY</b>		
During <b>heatwaves</b> , there may be surges in energy demand to meet cooling requirements.	9	12
As a result of <b>sea level rise</b> and associated increase in frequency and magnitude of storm surges, energy infrastructure will be a greater risk from <b>flooding</b> and some may need to be relocated	6	16

RISK AND CONSEQUENCE	RISK SCORE	
	2020s	2050s
Increases in <b>wind speed</b> and <b>storminess</b> disruption and/or damage to energy infrastructure and supply.	6	12
<b>WASTE</b>		
<b>Warmer summers</b> may increase prevalence of vermin and odour from waste, and waste may (or therefore) require more frequent collection.	9	12
Increased occurrences of <b>flooding</b> may result in a greater possibility of sewerage overflowing, which may also contaminate fresh water supplies.	9	12
<b>Flooding</b> and exposure of historic coastal landfill sites causing ground and surface water pollution	8	16
<b>WATER RESOURCE MANAGEMENT</b>		
<b>Flooding</b> may increase the risk of flood waters infiltrating and contaminating fresh drinking water supply	8	16
<b>Extreme rainfall</b> events may exacerbate water quality risks, particularly if timing coincides with fertilisation of agricultural land.	9	12
During <b>drought</b> events there will be increased pressure on Meath's abstraction points, and the county may be unable to match demand sufficiently. As a result there is potential for hosepipe bans and agriculture/industry bans/restrictions?.	12	20
<b>AGRICULTURE</b>		
<b>Drought</b> will lead to higher irrigation requirements, particularly for high value and specialist crops.	9	12
<b>Warmer and wetter winters</b> , and <b>warmer summers</b> may increase the prevalence of pests and diseases for both crops and livestock.	6	9
<b>Flooding</b> during harvest may restrict ability to harvest crop at the necessary time. This will increase the risk of crop loss, may result in delays in product availability and lead to higher food prices.	6	12
<b>PLANNING AND LAND USE</b>		
<b>Warmer summers</b> and more frequent <b>heatwaves</b> may increase the risk of buildings overheating, particularly for new homes meeting strict energy efficiency regulations.	6	15
<b>Flood</b> risk may further reduce availability of suitable development land and may require development in more flood prone areas.	6	9
As a result of <b>sea level rise</b> , coastal developments are at an increased risk of exacerbated <b>flooding</b> and damage from erosion/land sliding. This may limit availability of suitable land for development in the popular coastal area.	6	12
<b>ECOSYSTEMS AND BIODIVERSITY</b>		
<b>Flooding</b> will result in an increased risk of damage and loss of habitats during flood events.	9	9
<b>Warmer summers</b> and <b>warmer and wetter winters</b> may increase the prevalence of invasive species, both existing and new.	9	9
<b>Drought</b> may increase the risk of loss of some water sensitive species, including some trees and wetland species.	6	12
<b>COASTAL AND MARINE</b>		

RISK AND CONSEQUENCE	RISK SCORE	
	2020s	2050s
Ecosystems in the coastal zone, and the services and the functions they provide, are at a high risk of loss and damage during <b>flood</b> events and <b>storm surges</b> . Those located in sand dunes are particularly vulnerable.	6	12
Increased frequency and intensity of <b>storm surges</b> , in combination with <b>sea level rise</b> will increase erosion rates in the already limited coastline. This will restrict both the housing and recreational activities in the area.	6	12
During <b>droughts</b> , increased drainage of, and damage to, wetland habitats and water courses may occur. This can lead to a decline of and damage to the species they support.	6	9
<b>EMERGENCY SERVICES</b>		
Increase risk of <b>flooding</b> will create a higher demand for rescue services, which may exceed capacity.	8	16
During <b>extreme rainfall</b> and <b>storm events</b> , road damage and blockage could significantly reduce access for emergency vehicles.	9	12
Increased occurrence of <b>heatwaves</b> will increase heat related illnesses, including heatstroke and dehydration.	9	15
<b>TOURISM</b>		
<b>Sea level rise, storm surges</b> and associated <b>flooding</b> may result in loss and/or damage of coastal attractions. This is particularly so for more vulnerable, small businesses which are clustered here.	6	12
<b>Flooding</b> and <b>storms</b> may lead to damage and/or closure to road and rail infrastructure, both within the County and in the surrounding areas. This may limit the accessibility of the County to tourists.	6	9

## TAKING ACTION

Based on the evaluation of future climate risk, the assessment also highlighted a number of potential adaptation options which could be applied by the council to reduce the impacts of climate change and extreme weather events and to build climate resilience. The four identified opportunities were:

- Conduct a climate resilience review of the transport network
- Outline a coastal development policy
- Improve the provision of green space and pedestrian-only spaces to combat rising temperatures
- Develop a comprehensive vegetation management and design plan

These opportunities would act as suitable next steps to progress Meath County Council's climate change adaptation strategy. This will help to ensure that the Council can continue to provide resilient, Climate Ready services now and in the future.

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# 1 INTRODUCTION

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Ireland's climate is changing, and incremental changes are already evident. The annual average surface air temperature in Ireland has increased by approximately 0.8 °C over the last 110 years and there has been an increase in average annual rainfall of approximately 60mm (5%) in the period 1981-2010, compared to the period 1961-1990<sup>2</sup>. At the same time, extreme weather (including extreme temperatures and rainfall events) has become more frequent and severe.

Projections by Climate Ireland suggest that these changes will continue, dependent upon the volume of greenhouse gases (GHG) that are released into the atmosphere. The following impacts have been identified as likely concerns for Ireland:

- Mean temperatures are set to increase up to 1.7 °C by 2060, with the largest changes expected in the East of Ireland.
- With regard to extreme events, the hottest summer days could be up to 2.6 °C warmer, with peak winter temperatures increasing 3.1 °C by 2060, putting vulnerable people, and assets, at greater risk.
- Extended dry periods in the summer are projected to increase between 12 – 40% by 2060 leading to increasing water scarcity.
- The frequency of heavy rainfall events are projected to increase by 20 % which are likely to impact the reliability and operation of infrastructure assets, networks and systems.
- Sea levels are projected to rise by over half a metre by 2050 placing coastal communities, and infrastructure, under increasing pressure.

As noted above, these predicted changes pose a serious risk to communities and local economies in County Meath. There are likely to be consequences for infrastructure, water supplies, agriculture, business operations, biodiversity, social services, healthcare and many other areas vital to economic and social development. In addition, County Meath's coastal location also means that it is likely to experience more frequent coastal and inland flooding, putting some key infrastructure at risk, particularly within the transport sector. However, it should also be noted that increases in temperature may result in an increase in tourism in the area.

Meath County Council has a key responsibility to tackle the risks that changes in our climate are expected to bring through both mitigation and adaptation, and to additionally take advantage of any new opportunities that climate change may introduce. However, in order to build this strategy, a baseline understanding of both current and future risk needs to be developed. Consequently, County Meath has completed a climate risk and vulnerability assessment to analyse the nature of risks arising from a wide range of climate variables, which are likely to impact across a number of key service areas in the region.

This assessment provides a forward look in to the possible future consequences of climate change across 11 services, which have been identified as priority areas by Meath County Council. It can then be used to inform long-term planning and prioritisation, including proactive engagement with other authoritative bodies who support the operation and management of some of these services, such as the Office of Public Works (OPW) and Irish Water. Ultimately, this analysis of potential climate change impacts should form the basis of any future adaptation strategy that is developed by the Council.

This report is structured as follows:

- Section 1 provides an introduction;
- Section 2 describes the methodology. This includes an overview of the baseline data which forms the foundation of this assessment and the two-step methodology that has been used to quantitatively assess risk.
- Section 3 presents an overview of the results and a summary of possible adaptation options.
- Section 4 provides conclusions and recommendations for further work.

Appendices may be found at the rear of this document, including the complete risk assessment.

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<sup>2</sup> [https://www.climateireland.ie/web\\_resource/resources/status-rep/Surface-Air-Temperature.pdf](https://www.climateireland.ie/web_resource/resources/status-rep/Surface-Air-Temperature.pdf) (accessed 22/03/18)

## 2 METHODOLOGY

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This section describes the methodology that was used to identify the likely impacts of climate change on County Meath, including a summary of relevant climate change projections upon which this study was based.

### 2.1 CLIMATE VARIABLES

The first stage of the risk assessment was to identify the baseline climate condition and key projected changes in climate which are anticipated to occur in Ireland in both the short-term (2020s) and medium-term (2050s).

A changing climate will have a range of impacts on County Meath; these impacts have been summarised in Table 1 overleaf.

Projections of future changes in both temperature and precipitation have been obtained from the climate modelling tool developed by Climate Ireland using both Medium (RCP 4.5) and High emissions (RCP 8.5) projections<sup>3</sup>. The projection data was downloaded at 10 km x 10 km spatial resolution<sup>4</sup>, which is the most granular data available from Climate Ireland.

High resolution projections are not available for events such as heatwaves, high winds, storms, fog and snow. In addition, extreme events occur relatively infrequently so there are fewer data available regarding changes in their frequency or intensity. Therefore, where projections were not currently available for such climate variables at the county-level, projections were taken from the EPA's summary report<sup>5</sup>. The confidence levels of each of these projections have also been adopted and are also informed by expert opinion.

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<sup>3</sup> Representative Concentration Pathways (RCPs) are four greenhouse gas concentration (not emissions) trajectories adopted by the IPCC for its fifth Assessment Report (AR5) in 2014. RCP 4.5 is used to represent 'medium' emissions projections, and RCP 8.5 is used to represent a high emissions scenario.

<sup>4</sup> <https://www.climateireland.ie/#!/tools/climateToolMainViewer> (accessed 12/02/18)

<sup>5</sup> [https://www.epa.ie/pubs/reports/research/climate/EPA\\_Research\\_Report164.pdf](https://www.epa.ie/pubs/reports/research/climate/EPA_Research_Report164.pdf) (accessed 12/02/18)

**Table 1 – CLIMATE PROJECTIONS FOR COUNTY MEATH**

Climate Variable (and baseline)	Projections	Summary	Confidence
<b>Hotter Summers</b>  <b>Mean summer temperature (1981-2000)</b> <b>15.6 °C</b>	<ul style="list-style-type: none"> <li>■ Under all scenarios, projections suggest that, for all months of the year, Ireland will experience an increase in mean temperature. Climate Ireland suggests the following short and long-term projections for County Meath, for both a Medium and High emissions scenario:               <ul style="list-style-type: none"> <li>• 2020s: Annual average summer temperatures will increase by approximately 1.1 – 1.9°C</li> <li>• 2050s: Annual average temperatures will increase by approximately 2.0 – 2.4 °C</li> </ul> </li> </ul>	Strong increase	High
<b>Warmer Winters</b>  <b>Mean winter temperature (1981-2010)</b> <b>5.3 °C</b>	<ul style="list-style-type: none"> <li>■ Winter temperatures, are also anticipated to decrease. This is also expected to result in a decrease in the number of frost days. Temperature and frost day projections are as follows, for both a Medium and High emissions scenario:               <ul style="list-style-type: none"> <li>• 2030s: Annual average winter temperatures will increase by approximately 1.3 °C – 1.4 °C. Number of frost days are projected to decrease by as much as a 57 %</li> <li>• 2050s: Annual average winter temperatures will increase by approximately 1.7 °C – 2.1 °C. Up to a 70% decrease in frost days</li> </ul> </li> </ul>	Moderate increase	High

Climate Variable (and baseline)	Projections	Summary	Confidence
<b>Heatwaves</b>  <b>Maximum summer temperature (1981-2010): 28.7 °C</b>	<ul style="list-style-type: none"> <li>Although Climate Ireland does not provide specific projections for heatwaves 6?, , projections of maximum daily temperature are available which may be indicative of heatwave risk:               <ul style="list-style-type: none"> <li>2030s: Maximum daily summer temperatures projected to increase by 1.5 – 2.1 °C.</li> <li>2050s: Maximum daily summer temperatures projected to increase by 2.5 – 2.8 °C.</li> </ul> </li> <li>These will likely intensify heatwaves, with maximum temperatures increasing and heatwave duration lengthening</li> </ul>	Strong increase (summer)	High
<b>Drought</b>  <b>Average summer precipitation (1981-2010): 210 mm</b>	<ul style="list-style-type: none"> <li>An approximate <b>20% decrease in summer precipitation</b> is indicated under a High emissions scenario in the North East of Ireland.</li> <li>This decrease is likely to result in progressively longer periods without significant rainfall, posing challenges to water-sensitive sectors and regions.</li> <li>However, it should be noted that uncertainties in precipitation projections are greatest in summer, both in terms of magnitude and direction (i.e. wetter or drier)</li> </ul>	Strong increase (summer)	Low
<b>Extreme Rainfall</b>  <b>Average winter precipitation (1981-2010): 227 mm</b>	<ul style="list-style-type: none"> <li>Heavy precipitation days (in which more than 10 mm of rain falls) are likely to increase in frequency in winter.</li> <li>By the 2050s an increase in the number of heavy precipitation days of around 20% above the level of 1981–2000 is projected under both Medium and High emissions scenarios.</li> <li>Although winter precipitation is better understood than summer changes, a large range of uncertainty still exists around these projections</li> </ul>	Strong increase (winter)	Medium

<sup>6</sup> The World Meteorological Organization defines a heatwave as "when the daily maximum temperature of more than five consecutive days exceeds the average maximum temperature by 5 °C, the normal period being 1961-1990".

Climate Variable (and baseline)	Projections	Summary	Confidence
<b>Flooding</b>	<ul style="list-style-type: none"> <li>Although specific projections for flooding are not available, the anticipated increases in high intensity winter precipitation events are likely to increase the risk of fluvial flowing.</li> <li>Projections of future flows are beset by uncertainties at the catchment scale, but a broad signal of wetter winters and drier summers is evident across a number of independent studies.</li> </ul>	Moderate increase winter	Low
<b>Sea Level Rise</b>	<ul style="list-style-type: none"> <li>According to the IPCC, on average, global sea level is expected to rise by 0.48 m (0.09-0.81 m) for the period up to 2100. For 2050 it is reasonable to assume a sea level rise in the region of 25cm above present levels<sup>7</sup></li> <li>Taking this in to account, along with isostatic rebound<sup>8</sup>, it has been projected that areas along the Ireland's North East coast in Irelands could experience a rate of 2.2 – 3.7 mm per year<sup>9</sup>.</li> </ul>	Strong increase	High
<b>Coastal Erosion</b>	<ul style="list-style-type: none"> <li>County Meath's coastline is considered to be one of the most at risk areas to coastal erosion; all 21 km of the coastline is comprised of unconsolidated (soft) sediment, which is the more susceptible to erosion<sup>10</sup>.</li> <li>Projected increase in coastal storms and storm surges is likely to exacerbate risk.</li> </ul>	Moderate increase	Medium
<b>Wind Speed/ Storminess</b>	<ul style="list-style-type: none"> <li>There is large uncertainty in projections for mean surface wind speed. However, it is anticipated that the distribution of wind will alter, with winters marginally more windy in Ireland, and summers marginally less so.</li> <li>Mid-Atlantic storms are a key driver of Ireland's climate. Although robust projections of climate-driven changes in these storm tracks are not yet available for Ireland, it is possible that mid-Atlantic storms may become more intense, particularly with long-term warming of sub-tropical Atlantic. However, there is a still a very wide range of inter-model variation.</li> </ul>	Minor increase (winter)	Low

<sup>7</sup> CC, 2013. Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press. Cambridge, UK.

<sup>8</sup> Isostatic rebound refers to the gradual adjustment of landmasses which were previously depressed by the heavy weight of glacial ice due to continental glaciation.

<sup>9</sup> Murphy, C. & R. Fealy, 2009. Climate Change: Meeting the Challenge of Adaptation. Paper presented at the Irish Academy of Engineering. Dublin.

<sup>10</sup> <http://www.euroslon.org/reports-online/part1.pdf> (accessed 14/02/18)



Climate Variable (and baseline)	Projections	Summary	Confidence
<b>Storm Surge</b>	<ul style="list-style-type: none"> <li>■ As projections suggest that an increase in the frequency and intensity of cyclones and associated strong winds in the Atlantic may be expected, storm surge heights could also increase significantly.</li> <li>■ Expected surge levels for the 20- to 30- year return period surge events are likely to increase by up to 9cm, particularly in the North East of Ireland<sup>11</sup>.</li> </ul>	Strong increase	Medium

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<sup>11</sup> Wang, S., McGrath, R., Hanafin, J., Lynch, P., Semmler, T., & Nolan, P., 2008. The Impact of Climate Change on Storm Surge over Irish Waters. Ocean Modelling. 25. 83-94.

## 2.2 IDENTIFYING CLIMATE RISKS

Following the analysis of climate projections (as a function of both High and Medium emissions scenarios), specific climate risks linked to these changes were able to be identified for key service areas. These key service areas comprised:

- Transport
- Planning and land use
- Waste
- Water resource management
- Agriculture
- Built environment
- Ecosystems and biodiversity
- Coastal and marine
- Emergency services.

These key service areas were identified as Meath County Council exercises at least some level of operational control or influence over them. Note, for some of the larger sectors (such as transport and the built environment) these were further sub-categorised to provide better granularity and understanding of risk.

Within each service area, a list of qualitative climate risks was identified against relevant climate hazards. These were considered to be risks which could affect County Meath if a particular shift in climate or climate-related events were to occur. To create the list of climate hazards, evidence from historic events were identified through dialogue with senior Meath County Council employees across relevant departments. Further to this, and reflecting the likely changes in climate that are projected to occur (i.e. outside of historical norms), new and emerging risks were also identified through the EPA's research document<sup>12</sup>.

The next section describes how risk scores was calculated.

## 2.3 APPROACH

To understand the impact that the identified climate risks are likely to have on the 11 key selected service areas in County Meath, a two-step scoring methodology was developed and applied.

Risk was quantified using the following equation:

$$\blacktriangleright \text{Consequence} \times \text{Likelihood} = \text{Future Risk}$$

wherein "consequence" is the level of harm or damage caused by an event and "probability" is the likelihood of the event occurring.

This equation was applied to each risk of the risks identified in each sector to provide both a short term (2020s) and medium term (2050s) calculation of overall risk. The methodology used to calculate and rank climate risk is outlined below.

### 2.3.1. CALCULATING LIKELIHOOD

The first step was to apply a rating based on the likelihood of a particular climate risk occurring; this was achieved using the rating table (Table 2). In this study, likelihood was defined as the probability of a particular event, or climate risk, occurring. The likelihood scores were informed by the EPA's stated confidence levels for each of their estimated climate projections, in addition to expert judgment and through engagement with key stakeholders. Two different values were calculated; one for the short-term (2020s) probability, and one for medium-term (2050s).

Likelihood was defined as follows:

- Almost Certain – could occur several times per year
- Likely – may occur around once per year
- Possible – may occur a couple of times in a generation
- Uncertain - may once in a generation
- Rare – may occur once in a lifetime

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<sup>12</sup> <http://www.epa.ie/pubs/reports/research/climate/researchreport164.html> (accessed 14/02/18)

**Table 2 – CATEGORISATION OF LIKELIHOOD**

Likelihood	Score
Almost Certain	5
Likely	4
Possible	3
Uncertain	2
Rare	1

Adapted from EC and AS/ISO guidance<sup>13</sup>

### 2.3.2 CALCULATING CONSEQUENCE

The second score that was used to calculate risk for each climate hazard was consequence. Consequence was defined, based on best practice guidance<sup>14</sup>, as the level of harm or damage caused by a particular event.

Consequence ratings were calculated using a simple matrix (see Table 3). The ratings define the level of severity of any impact arising from an event across five different categories, notably: financial, fatalities/injuries, reputational, service priority and criticality of impacted service. Where more than one category could be applicable, the most severe grade of consequence was used. As above, two different ratings were generated based on the short-term and medium-term projections.

**Table 3 – CONSEQUENCE SCORING MATRIX**

CONSEQUENCE						
		FINANCIAL	FATALITIES/ INJURIES	SERVICE PRIORITY	REPUTATIONAL	CRITICALITY OF IMPACTED SERVICE
<b>CATASTROPHIC</b>	5	> €3 million	Fatality; multiple permanent injuries	Complete failure to deliver on a service priority	Receives national / international attention with potential for long term impact on public memory; Total loss in public confidence	Critical service (i.e. major risk to public health and safety)
<b>MAJOR</b>	4	€1 million - €3 million	Major injury or illness leading to long term incapacity/ disability; multiple significant injuries	Major impact on a service priority	Receives national / international attention with medium-term impact on public memory	Medium to Major risk to council's reputation / finances
<b>MODERATE</b>	3	€500,000 - €1 million	Moderate injury or illness requiring professional intervention; RIDDOR reportable; multiple minor injuries	Moderate impact (positive or negative) on a service priority	Receives local press attention with medium-term impact on public memory	Medium risk to public health or safety)
<b>MINOR</b>	2	€100,000 - €500,000	Minor injury or illness requiring minimal	Minor impact (positive or	Receives local press attention but with likely	Low to Medium risk to council's

<sup>14</sup> European Commission Non-paper Guidelines for Project Managers: Making vulnerable investments climate resilient; AS 5334-2013 Climate Change Adaptation for Settlements and Infrastructure – a risk based approach.

			intervention or treatment	negative) on a service priority	short-term impact on public memory	reputation / finances
<b>INSIGNIFICANT</b>	1	< €100,000	None, or minimal injury or illness requiring no intervention or treatment	Positive impact on a service or priority	Minor complaints or rumours	Minor risk to public health or safety)

Adapted from EC and AS/ISO guidance

### 2.3.3 CALCULATING RISK

Finally, risk scores were calculated by combining the scores for consequence and likelihood. As both the consequence and likelihood scores were scored out of a maximum of five, the highest risk value which could be achieved in either case was 25.

To allow the different climate risks in each service area to be ranked by severity of future risk, the risk scores were categorised using expert opinion as follows:

- Low risk: 1 – 6
- Medium risk: 7 - 14
- High risk: 15 – 25

Individual scores were calculated for both time periods (i.e. short-term and medium-term) to enable changing frequency and magnitude of risks to be disaggregated.

As a result, this process enabled the vulnerability (to climate change) of services operated by Meath County Council to be identified, including the types of climate variables and time period over which these changes are anticipated to occur to be identified.

### 3 RISK ASSESSMENT

This section summarises notable results obtained across the 11 service areas. The full risk assessment results table can be found in Appendix 1.

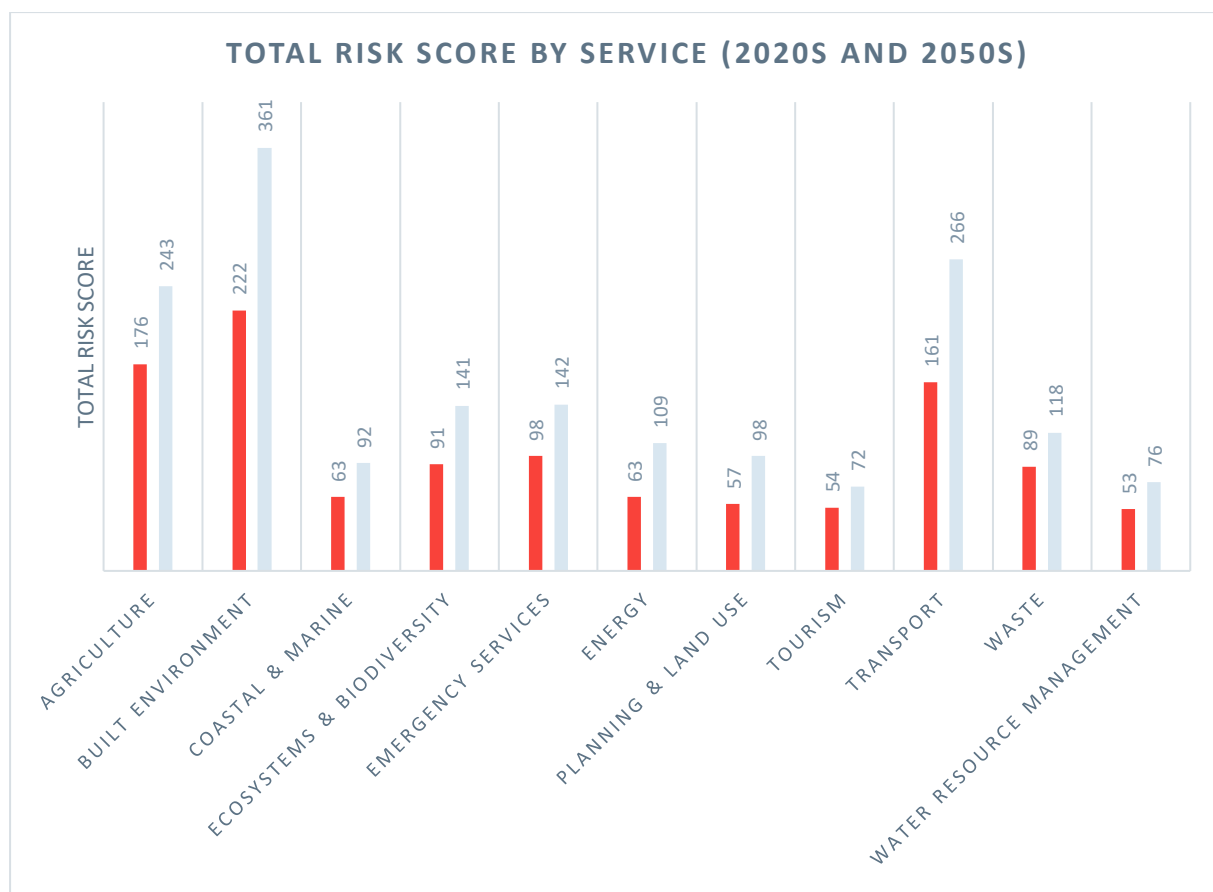
#### 3.1 TOTAL RISK SUMMARY

A large number of potential risks were identified across the 11 service areas; these are summarised in the Figure 1. Here, the total scores for all of the identified climate risks have been summed across all service areas, first for the 2020s, and then for the 2050s.

At a glance, it is evident that there is going to be a significant increase in total risk between the short- and medium-term as changes in our climate are likely to be more pronounced over time. The graphs indicate that there are three areas where either the severity or total number of risks, or both, is much higher than for the other 8 analysed categories. These three services are transport, the built environment and agriculture.

Understanding the nature of these high-risk service areas will therefore be crucial in developing appropriate and cost-effective adaptation options, in order to build resilience to climate change.

**Figure 1 – TOTAL RISK SCORE BY SERVICE**





### 3.2 RISK SCORES BY SERVICE AREA

Table 4 summarises the top three (highest scoring) risks that were identified across each of the 11 service areas. The calculated total risk for both the short- (2020s) and medium-term (2050s) projections is also shown. Note, in each case, the maximum risk score achievable is 25. The scores were classified as follows:

- Low risk: 1 – 6
- Medium risk: 7 - 14
- High risk: 15 – 25

**Table 4 – TOTAL RISK SCORES BY SERVICE AREAS**

RISK AND CONSEQUENCE	RISK SCORE	
	2020s	2050s
<b>TRANSPORT</b>		
Increase in the number of <b>flooding</b> events causing road closures, affecting both private and public transport. This is anticipated to impact business and industry with knock-on effects to the local and wider economy.	9	12
<b>Sea level rise</b> and increased prevalence of <b>storm surge events</b> will lead to an increased risk of flooding to coastal road and rail infrastructure, causing delays, disruption and overcrowding.	6	16
Warmer summers and more frequent <b>heatwaves</b> increase the risk of damage to asphalt roads and pavements, including buckling of the surface and issues with resurfacing. It may also cause reduced visibility and operational disruption (i.e. from fires).	9	15
<b>BUILT ENVIRONMENT</b>		
Increased risk of household water disruptions during periods of <b>drought</b> . This may lead to a decrease in water quality which can cause health and wellbeing concerns.	9	16
<b>Flooding</b> will result in an increased risk of flood damage, damp and mould to residential, commercial and industrial buildings. Flooded communities may require rebuilding and temporary or permanent relocation. Additionally, <b>sea level rise</b> will create a compounded level of risk for buildings in the coastal zone.	9	12
<b>Warmer summers</b> and increased occurrences of <b>heatwaves</b> will increase overheating risk within both new and existing homes.	6	15
<b>ENERGY</b>		
During <b>heatwaves</b> , there may be surges in energy demand to meet cooling requirements.	9	12
As a result of <b>sea level rise</b> and associated increase in frequency and magnitude of storm surges, energy infrastructure will be a greater risk from <b>flooding</b> and some may need to be relocated	6	16
Increases in <b>wind speed</b> and <b>storminess</b> disruption and/or damage to energy infrastructure and supply.	6	12
<b>WASTE</b>		
<b>Warmer summers</b> may increase prevalence of vermin and odour from waste, and waste may (or therefore) require more frequent collection.	9	12
Increased occurrences of <b>flooding</b> may result in a greater possibility of sewerage overflowing, which may also contaminate fresh water supplies.	9	12

RISK AND CONSEQUENCE	RISK SCORE	
	2020s	2050s
<b>Flooding</b> and exposure of historic coastal landfill sites causing ground and surface water pollution	8	16
<b>WATER RESOURCE MANAGEMENT</b>		
<b>Flooding</b> may increase the risk of flood waters infiltrating and contaminating fresh drinking water supply	8	16
<b>Extreme rainfall</b> events may exacerbate water quality risks, particularly if timing coincides with fertilisation of agricultural land.	9	12
During <b>drought</b> events there will be increased pressure on Meath's abstraction points, and the county may be unable to match demand sufficiently. As a result there is potential for hosepipe bans and agriculture/industry bans/restrictions?.	12	20
<b>AGRICULTURE</b>		
<b>Drought</b> will lead to higher irrigation requirements, particularly for high value and specialist crops.	9	12
<b>Warmer and wetter winters</b> , and <b>warmer summers</b> may increase the prevalence of pests and diseases for both crops and livestock.	6	9
<b>Flooding</b> during harvest may restrict ability to harvest crop at the necessary time. This will increase the risk of crop loss, may result in delays in product availability and lead to higher food prices.	6	12
<b>PLANNING AND LAND USE</b>		
<b>Warmer summers</b> and more frequent <b>heatwaves</b> may increase the risk of buildings overheating, particularly for new homes meeting strict energy efficiency regulations.	6	15
<b>Flood</b> risk may further reduce availability of suitable development land and may require development in more flood prone areas.	6	9
As a result of <b>sea level rise</b> , coastal developments are at an increased risk of exacerbated <b>flooding</b> and damage from erosion/land sliding. This may limit availability of suitable land for development in the popular coastal area.	6	12
<b>ECOSYSTEMS AND BIODIVERSITY</b>		
<b>Flooding</b> will result in an increased risk of damage and loss of habitats during flood events.	9	9
<b>Warmer summers</b> and <b>warmer and wetter winters</b> may increase the prevalence of invasive species, both existing and new.	9	9
<b>Drought</b> may increase the risk of loss of some water sensitive species, including some trees and wetland species.	6	12
<b>COASTAL AND MARINE</b>		
Ecosystems in the coastal zone, and the services and the functions they provide, are at a high risk of loss and damage during <b>flood</b> events and <b>storm surges</b> . Those located in sand dunes are particularly vulnerable.	6	12
Increased frequency and intensity of <b>storm surges</b> , in combination with <b>sea level rise</b> will increase erosion rates in the already limited coastline. This will restrict both the housing and recreational activities in the area.	6	12
During <b>droughts</b> , increased drainage of, and damage to, wetland habitats and water courses may occur. This can lead to a decline of and damage to the species they support.	6	9

RISK AND CONSEQUENCE	RISK SCORE	
	2020s	2050s
<b>EMERGENCY SERVICES</b>		
Increase risk of <b>flooding</b> will create a higher demand for rescue services, which may exceed capacity.	8	16
During <b>extreme rainfall</b> and <b>storm events</b> , road damage and blockage could significantly reduce access for emergency vehicles.	9	12
Increased occurrence of <b>heatwaves</b> will increase heat related illnesses, including heatstroke and dehydration.	9	15
<b>TOURISM</b>		
<b>Sea level rise</b> , <b>storm surges</b> and associated <b>flooding</b> may result in loss and/or damage of coastal attractions. This is particularly so for more vulnerable, small businesses which are clustered here.	6	12
<b>Flooding</b> and <b>storms</b> may lead to damage and/or closure to road and rail infrastructure, both within the County and in the surrounding areas. This may limit the accessibility of the County to tourists.	6	9

### 4.3 ADAPTATION OPTIONS

Following the identification of climate impacts and quantification of climate risk, an analysis of existing controls in place to reduce the identified risks was undertaken. This would help to determine how resilient each service area is to climate risk and, by association, how prepared Meath County is to deal with the risks posed by future climate-related events.

In order to identify adaptation actions, interviews with key stakeholders were conducted with responsible parties within each service area to gather the required information. The information elicited from these interviews formed the baseline assessment of current adaptation measures already, and potential new adaptation opportunities. The complete account of this assessment is described in Appendix 1.

Many of the opportunities identified by stakeholders were relevant to a number of the different service areas and would consequently support the county in adapting to a number of different climate risks (i.e. there were often multiple benefits associated with individual adaptation measures). These helped to form a baseline understanding of the possible options available, from which adaptation pathways can be developed into the future.

One of the issues that was identified by stakeholders when developing this long-list of adaptation options was that the county often had limited control over a number of the climate risks. For example, the Office of Public Works (OPW) has responsibility for the larger flood-related risks and therefore has control over many of the adaptation options in this area. Additionally, Irish Water has recently taken responsibility for the overall management of water sources in the County. Although Meath County Council is still responsible for the maintenance of some of the water infrastructure, nearly all of the operational control now lies with Irish Water. Therefore the identified adaptation options tended to focus on aspects where Meath County Council operated a significant level of control over a particular service.

The full range of identified options is included in the full risk assessment (Appendix 1) and these should be considered in any future strategy. The key **opportunities** for Meath County Council may be summarised as:

- **Climate resilience review of the transport network:** One of the areas that consistently scored highly as an area of future risk was the transport sector. Therefore, undertaking a comprehensive review of resilience across the entire sector would be beneficial in order to build resilience. With this more detailed baseline understanding, specific future risks could be better prioritised and appropriate adaptation options could be developed and integrated. For example, this approach could help to identify the impact that warmer summers and more frequent extreme temperature events are likely to have on

paved surfaces in the county and whether further adaptation measures may be necessary. To mitigate this risk, using different (harder) binders in asphalt and/or accounting for climate risks in maintenance regimes could help to improve resilience and reduce long-term costs. The benefits of a more resilient transport sector would be far reaching, particularly with regards to supporting Meath County Council's economic development strategy.

- **Create a coastal development policy:** Despite the relatively limited length of coastline in Meath, a significant level of important commercial and residential buildings have developed along it. Given the vulnerability of these coastal areas to climate risks (i.e. sea level rise, increases in frequency and magnitude of storm surges and consequential acceleration in coastal erosion), protecting the coastline is of high importance. Creating a development policy for coastal areas would help to appropriately manage new developments in this area, including reducing flood and storm surge risk. In support of this, a review of existing coastal infrastructure should also be undertaken to identify resilience challenges and to prioritise council funding for refurbishment.
- **Improve the provision of green space and pedestrian-only zones to combat the impacts of rising temperatures:** Although increases in average annual temperatures are unlikely to cause a major concern in the short term, the projected increase in occurrences of extreme temperature events could have severe implications for the health and wellbeing of those living and working in Meath. It would therefore be beneficial to incorporate green strategies into building design where possible, such as the through the installation of green roofs, or through the provision of more green spaces and increased tree planting. In addition to both the environmental and social benefits of such policies, it would also show the County to be forward thinking in terms of increasing the resilience of the built environment to future projected temperature changes now.
- **Develop a comprehensive vegetation management and design plan:** Developing such a plan would help to improve habitat resilience, particularly amongst both forests and dunes which are specifically at threat from projected climate change<sup>15</sup>. The plan could include actions such as creating natural fire breaks and fire belts, planting for stands of mixed species and ages and planning for fire risks and incident response planning. In addition, a Biodiversity Net Gain policy could be included within Meath County Council's overarching strategy. This would ensure that any developments would seek to contribute to and enhance the natural environment by minimising impacts on biodiversity, and provide net gains in biodiversity where possible, to increase the resilience of the local ecology.

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<sup>15</sup> <https://nerc.ukri.org/research/partnerships/ride/lwec/report-cards/biodiversity-source14/>

## 4 CONCLUSIONS

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This study has investigated the potential impacts of climate change upon 11 key service areas in County Meath. A methodology was used to calculate the risks evident with each service area, taking account of the likelihood of a range of climate-related events occurring and the consequence of such events occurring. These quantitative assessments of climate risks were then ranked and prioritised. The Excel tool accompanying this report also allows users to re-assess risks as more information becomes available. Users are therefore able to develop flexible plans and strategies to account for a range of future climate and weather-related risks in order to build resilience.

A number of key risks have been identified in this report and provide an opportunity for the Council to build long term resilience strategies into these areas, to ensure that they are a future ready county:

- **Transport, the built environment and agriculture** were the three service areas which received the highest combined total risk scores. These high scores were generated either by a high number of total observed and projected risks, a high value assigned to each risk, or a combination of both.
- **Flooding** was a risk prevalent across nearly all service areas. Transport appears to be particularly vulnerable to flood events and so this will be a key area to focus on with any future adaptation strategy, owing to the wider social and economic consequences caused by disruption.
- **Temperature increases** and increases in the frequency and intensity of **heatwaves** cause limited disruption in the short-term, however the high confidence in temperature projections means that the 2050 risk scores are significantly higher. Daily temperature maxima will also continue to be outside of the average projections provided in this report. Therefore, whilst this is something that is not currently a concern for County Meath, it is likely that it will need to be considered in any medium-term strategy.

### TAKING ACTION

This report may be used by County Meath to better understand and respond to the risks described here, and to encourage dialogue surrounding the development of an adaptation strategy. As such, the assessment highlighted a number of potential adaptation opportunities which may support the development of such a strategy.

The four identified **opportunities** were:

- Conduct a climate resilience review of the transport network
- Develop a coastal development policy
- Improve the provision of green space and pedestrian-only spaces to combat rising temperatures
- Develop a comprehensive vegetation management and design plan

These opportunities would act as suitable next steps to progress Meath County Council's climate change adaptation strategy. This will help to ensure that the Council can continue to provide Climate Ready services now and in the future.



# Appendix A

## RISK SCORES BY SECTOR

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Service	Sub-service	Climate hazard	Risk & Consequences	Gross Risk: Short term 2020s			Gross Risk Medium/Long term 2050s			Existing Controls	Adaptation Options/Opportunities
				Impact	Likelihood	Exposure	Impact	Likelihood	Exposure		
Agriculture	Livestock	SLR	> Risk of total loss of grazing land to SLR. Also increased area of land in high flood risk areas	3	2	6	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Drought	> Will lead to higher irrigation requirements, particularly for high value/specialist crops	3	3	9	3	4	12	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Flooding	> Flooding around harvest may restrict ability to harvest crop at the necessary time. Increases the risk of crop loss, delays in product availability and higher food prices	2	3	6	3	3	9	- OPW undertake river cleanout programmes to facilitate drainage (although influences on hydrogeomorphology)	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Multiple - Wind speed/Storm	> Damage to/loss of farm infrastructure	3	2	6	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Multiple - SLR/Storm surge	> Saline contamination can necessitate high land remediation costs	3	2	6	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Flooding	> Increased risk of crop loss damage	3	3	9	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Multiple - Extreme Rainfall/Flooding	> Water damage to fodder stores can decrease availability for livestock	2	3	6	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	SLR	> Risk of loss of productive land to SLR. Also increased area of land in high flood risk areas	3	2	6	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Heatwaves	> Heat stress in plants may result in lower crop yields	3	2	6	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts. - Engage with IFA where possible
Agriculture	Crop Production	Extreme rainfall	> Impacts on conducting field operations at the desired time e.g. pesticide application windows, seed bed cultivation, harvesting etc. may result in a shortage of certain crops	3	3	9	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Extreme rainfall	> Increased soil erosion and compaction can decrease productivity	2	3	6	2	3	6	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.



Agriculture	Crop Production	Extreme rainfall	> Waterlogged land can decrease productivity	2	3	6	2	3	6	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Extreme rainfall	> Localised risk of decreased trafficability by machinery	2	3	6	2	3	6	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Drought	> Availability of water likely to become the major limiting factor for agricultural production and quality	3	3	9	3	4	12	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Heatwave	> Increases the likelihood of development and spread of exotic diseases	3	2	6	3	4	12	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Extreme rainfall	> Wetter winters may increase the prevalence of pests and diseases	2	3	6	2	3	6	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Heatwaves	> Increase in incidences of heat stress in livestock (particularly in the dairy industry) may reduce productivity	3	2	6	3	4	12	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Flooding	> Increased loss of grazing land for livestock	2	3	6	2	3	6	- No direct control over agricultural activities in relation to flood risk areas.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Extreme rainfall	> Reduced production may lead to increased food prices	3	3	9	3	3	9	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Drought	> Increase in animal stress due to water shortages	2	3	6	3	4	12	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Flooding	> Increased risk of livestock mortality	3	3	9	3	3	9	- No direct control over agricultural activities in relation to flood risk areas.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Crop Production	Coastal erosion	> Higher risk of land loss and damage through land sliding events for coastal farms	2	2	4	2	3	6	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.

Agriculture	Livestock	Coastal erosion	> Higher risk of land loss and damage through land sliding events for coastal farms	2	2	4	2	3	6	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Heatwaves	> Increase in spread of 'tropical diseases' i.e. SBV	3	2	6	3	4	12	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.
Agriculture	Livestock	Drought	> Decrease in the availability of fodder for livestock owing to water shortages	2	3	6	3	4	12	- No direct control over agricultural activities in relation to climate risk.	- Engage with agricultural community to understand how council can support resilience efforts.



Built Environment	Housing	Flooding	> Flooded communities may require rebuilding and temporary or permanent relocation	3	3	9	4	3	12	- New buildings not permitted in - OPW flood risk review identified dwellings at risk of flooding.	None identified/required. Considered low risk.
Built Environment	Public Services	Flooding	> Risk of flood damage, damp and mould to public buildings	3	3	9	4	3	12	- Flood risk assessment completed by OPW did not identify any public buildings at risk of flooding. - Historically, Meath CC had a swimming pool over in Trim. Not owned any more, and no other assets in areas at risk. - All new buildings would be in line with guidelines.	None identified/required.
Built Environment	Housing	Drought	> Risk of household water disruptions. May lead to a decrease in quality which can cause health and well-being concerns	3	3	9	4	4	16	- No direct control over water infrastructure	
Built Environment	Business/ Industry	Flooding	> Risk of flood damage, damp and mould to industrial buildings- may result in reduced production	3	3	9	3	3	9	- New infrastructure will not be built in flood risk zones. - Specific risks against industry not understood.	- Engage/encourage business/industry to understand climate change risk.
Built Environment	Housing	SLR	> Loss of natural flood defences increases the risk of coastal flooding of houses located in the coastal zone	3	2	6	4	4	16	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Built Environment	Housing	Flooding	>Risk of flood damage, damp and mould to houses	3	3	9	3	3	9	- New buildings not permitted in flood zone - OPW flood risk review identified dwellings at risk of flooding.	None identified/required. Considered low risk.
Built Environment	Public Services	Extreme rainfall	> Risk to slope/ embankment stability	3	2	6	3	3	9	No action on privately owned land.	None identified/required.
Built Environment	Business/ Industry	Heatwaves	> Potential risk of digital infrastructure damage and failure from effect of extreme heat	2	3	6	2	4	8	- no direct control over digital infrastructure	

Built Environment	Business/ Industry	Coastal erosion	> May push some public services into areas at risk of land damage/land sliding events. Relocation may be necessary	3	2	6	3	3	9	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Built Environment	Public Services	SLR	> Loss of natural flood defences increases the risk of coastal flooding of services/amenities located in the coastal zone	3	2	6	3	4	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Built Environment	Public Services	Storm surge	> Areas outside of the normal coastal flood zone may be at an increased risk of flooding during extreme storm surge events	2	3	6	3	4	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Built Environment	Housing	Coastal erosion	> May push some houses/settlements into areas at risk of land damage/land sliding events. Relocation may be necessary	3	2	6	4	3	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Built Environment	Business/ Industry	SLR	> Loss of natural flood defences increases the risk of coastal flooding of businesses located in the coastal zone	3	2	6	4	4	16	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.



Built Environment	Business/ Industry	Flooding	> Severe flooding increases risk of stock loss/damage, service disruption. Could generate significant economic impacts	3	3	9	3	3	9	- New infrastructure will not be built in flood risk zones. - Specific risks against industry not understood.	- Engage/encourage business/industry to understand climate change risk.
Built Environment	Public Services	Extreme rainfall	> Sewers are expected to fill and spill more frequently	3	2	6	3	3	9	- Unclear what the risk is. Sewers and drains managed by OPW.	- Review of infrastructure to identify assets at risk from flooding/extreme rainfall
Built Environment	Business/ Industry	Extreme rainfall	> Risk to slope/ embankment stability	3	2	6	3	3	9	- Unclear what the risk is. No existing controls	- Review of infrastructure to identify assets at risk from flooding/extreme rainfall
Built Environment	Housing	Extreme rainfall	> Risk to slope/embankment stability	3	2	6	3	3	9	- Unclear what the risk is. No existing controls	- Review of infrastructure to identify assets at risk from flooding/extreme rainfall
Built Environment	Public Services	Multiple - Extreme Rainfall/ Wind speed/ Storm	>Risks to building fabric from moisture wind and driving rain, may lead to closures	3	2	6	3	3	9	- No additional controls beyond building controls.	- review building standards to determine controls in relation to physical damage. - Review spend on maintenance of public buildings.
Built Environment	Business/ Industry	Multiple - Extreme Rainfall /Wind speed /Storm	>Risks to building fabric from moisture wind and driving rain, may lead to closures	3	2	6	3	3	9	- No additional controls beyond building controls.	- review building standards to determine controls in relation to physical damage. - Review spend on maintenance of public buildings.
Built Environment	Housing	Multiple - Extreme Rainfall/ Wind speed/ Storm	>Risks to building fabric from moisture wind and driving rain	3	2	6	3	3	9	- No additional controls beyond building controls.	- review building standards to determine controls in relation to physical damage.
Built Environment	Business/ Industry	SLR	> May push some industry sites into flood prone areas. Relocation may be necessary	3	2	6	3	4	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Built Environment	Business/ Industry	Storm surge	> Areas outside of the normal coastal flood zone may be at an increased risk during extreme storm surge events	2	3	6	3	4	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.



Built Environment	Housing	Storm surge	> Areas outside of the normal coastal flood zone may be at an increased risk during extreme storm surge events	2	3	6	3	4	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Built Environment	Public Services	Flooding	> Loss of public green space	3	3	9	3	3	9	- No anticipated losses of public green space.	None identified/required.
Built Environment	Housing	Heatwaves	> Overheating risk within both new and existing homes (particularly the former)	3	3	9	3	5	15	- Follow existing requirements on overheating for new builds, has not been an issue so far	- Continue to follow new and updated overheating building regulations. Look particularly into how council homes may be impacted, with occupants less able to deal with impacts
Built Environment	Business/ Industry	Heatwaves	> A decrease in productivity for employees during warmer conditions, particularly where cooling provisions are inadequate	2	3	6	2	5	10	- No direct control over businesses.	- Review building standards to determine controls in relation to physical damage. - Ensure all new buildings have considered future temperatures
Built Environment	Business/ Industry	Drought	> Water shortages pose a risk to normal running of some industries, particular where water is needed for cooling	3	3	9	4	4	16	- Availability would be the responsibility of the OPW	- None identified/required
Built Environment	Public Services	Heatwaves	> Increased risk of overheating in all buildings	2	3	6	3	5	15	All buildings follow overheating regulations, but this has not been an issue so far	- Continue to review as conditions change



Coastal & Marine	Not applicable	Multiple - Wind speed/Storm	> Can exacerbate the rate of coastal erosion	3	2	6	3	3	9	-A number of existing coastal erosion protection measures in place, such as cliff stabilisation work and reconstruction of sand dunes at various points around the coast.	-Complete review of the coastline to understand where the most vulnerable areas are and where future protection measures may be necessary
Coastal & Marine	Not applicable	Drought	> Increased drainage of, and damage to, wetland habitats and water courses- can lead to a decline of and damage to the species they support	2	3	6	3	4	12	-No existing controls	-Review of existing vulnerability of existing wetland habitat to changes in rainfall
Coastal & Marine	Not applicable	Coastal erosion	> Increased erosion to the already limited coastline will limit the housing/recreational activities in the area	3	2	6	3	3	9	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from SLR, coastal erosion and storm surge - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Coastal & Marine	Not applicable	Heatwaves	> Increasing temperatures may negatively impact biodiversity- freshwater species are particularly vulnerable	2	3	6	2	4	8	- No existing controls	-Review of existing vulnerability of existing wetland habitat to changes in rainfall
Coastal & Marine	Not applicable	Storm surge	> Increased storm activity will increase beach erosion and loss of sediment	3	3	9	3	4	12	- Cork University currently undertaking a coastal erosion study- will develop any actions necessary to implement	- Support academic research to understand the potential impacts of SLR on coastal ecosystems. This includes reviewing outcomes of Cork University Study and developing actions from the results.
Coastal & Marine	Not applicable	Multiple - SLR/Storm surge/Coastal erosion	> Will increase damage/destruction of coastal habitats and reduce natural resilience of coastlines to accommodate change- rate of loss is very likely to increase. This will also generate increased maintenance costs for any hard flood defences	3	2	6	3	4	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Support academic research to understand the potential impacts of SLR on coastal ecosystems. This includes reviewing outcomes of Cork University Study and developing actions from the results.
Coastal & Marine	Not applicable	Heatwaves	> Risks to coastal and marine ecology may be exacerbated by increase in pathogens	2	3	6	2	4	8	- No existing controls	
Coastal & Marine	Not applicable	Extreme rainfall	> May negatively impact dune evolution and vegetation	2	3	6	2	3	6	- Existing controls to protect dunes from further damage from people, but nothing to explicitly protect from extreme rainfall	-Complete a cost/benefit analysis of further hard engineering intervention to manage dune migration
Coastal & Marine	Not applicable	Heatwaves	> Decrease in cold water species, but an increase in non-native species	1	3	3	1	4	4	-No existing controls	No adaptation options identified/necessary

Ecosystems & Biodiversity	Not applicable	Extreme rainfall	> Increase in invasive species, both existing and new	3	3	9	3	3	9	- Those working in the department are trained to be aware of emergence of known invasive species.	- Ensure training is updated as new species are known -Develop a strategy for tackling invasive and non-native species. Work to reduce their impact and spread within the county
Ecosystems & Biodiversity	Not applicable	Extreme rainfall	> Waterlogged soils may increase erosion rates	3	3	9	3	3	9	-Maintenance of ditches to improve drainage during flood events	- Complete a review of vulnerable sites and identify any new drainage demands required
Ecosystems & Biodiversity	Not applicable	Flooding	> Increased risk of damage and loss to habitats during flood events	3	3	9	3	3	9	-Drainage and flood defences as described above for the county as a whole, but not directly protecting habitats	-To increase understanding of climate change, and its impacts on the priority habitat and species within County Meath, and what can be done to adapt to changes. Consider the multi-functional benefits provided by habitats in decision making.
Ecosystems & Biodiversity	Not applicable	Multiple - Wind speed/Storm	> Increased incidence of extreme storm events can increase numbers of 'seabird wrecks' - dead seabirds being washed onto beaches	3	2	6	3	3	9	-No direct controls	-To increase understanding of climate change, and its impacts on the priority habitat and species within County Meath, and what can be done to adapt to changes. Consider the multi-functional benefits provided by habitats in decision making.
Ecosystems & Biodiversity	Not applicable	Storm surge	> Increased risk of loss and damage to coastal species	2	3	6	2	4	8	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Support academic research to understand the potential impacts of SLR on coastal ecosystems. This includes reviewing outcomes of Cork University Study and developing actions from the results.
Ecosystems & Biodiversity	Not applicable	Multiple - Wind speed/Storm	> Risks to forests from wind damage during exceptional storm events	2	2	4	3	3	9	-No direct controls	-To increase understanding of climate change, and its impacts on the priority habitat and species within County Meath, and what can be done to adapt to changes. Consider the multi-functional benefits provided by habitats in decision making.



Ecosystems & Biodiversity	Not applicable	Heatwaves	> Increase in prevalence of invasive species, both through the spread of existing and introduction of new	2	2	4	3	4	12	- Those working in the department are trained to be aware of emergence of known invasive species.	- Ensure training is updated as new species are known -Develop a strategy for tackling invasive and non-native species. Work to reduce their impact and spread within the county - Strategy will need to have a particular focus on SSSI, as there is a risk the council may become non-compliant in terms of their management which could have financial and reputational costs
Ecosystems & Biodiversity	Not applicable	Drought	> Higher water abstraction rates can cause ecological damage	3	3	9	3	4	12	- No direct controls in place	- No adaptation options necessary/identified
Ecosystems & Biodiversity	Not applicable	SLR	> Ecosystems in the coastal zone (and the services/functions they provide) are at a high risk of loss/damage > Loss of low lying land and habitat from coastal squeeze leading to increased erosion and sedimentation	3	2	6	4	4	16	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Support academic research to understand the potential impacts of SLR on coastal ecosystems. This includes reviewing outcomes of Cork University Study and developing actions from the results.
Ecosystems & Biodiversity	Not applicable	Coastal erosion	> Increase risk of loss and damage to coastal species	2	2	4	2	3	6	- No direct controls in place	--Increase the quality and habitat diversity of wildlife sites. Deliver large scale habitat creation where opportunities exist, create buffer zones for vulnerable or fragmented habitats. '--Promote practise of adaptive management
Ecosystems & Biodiversity	Not applicable	Drought	> Increased risk of loss of some sensitive species, including some trees (i.e. beech)and wetland species	2	3	6	3	4	12	- New biodiversity category in the Meath Pride of place category to try and reduce species loss	- Include Biodiversity Net Gain policy in the County Development Plan. This would ensure development does not have a negative impact on biodiversity and hedges against future losses of biodiversity.
Ecosystems & Biodiversity	Not applicable	Drought	> Increase in risk of forest fires	3	3	9	4	4	16	No direct controls in place	- No adaptation options identified/required

Emergency Services	Not applicable	Heatwaves	> Decrease in the functionality of hospitals and other emergency services	3	3	9	4	4	16	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.
Emergency Services	Not applicable	SLR	> Increase risk of flooding will create a higher demand for rescue services which may exceed capacity	4	2	8	4	4	16	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.
Emergency Services	Not applicable	Drought	> Increase in wildfires and demand for fire and rescue	4	3	12	4	4	16	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.
Emergency Services	Not applicable	Multiple - Wind speed/ Storm	> Road damage and blockage could significantly reduce access for emergency vehicles	4	2	8	4	3	12	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.
Emergency Services	Not applicable	Drought	> Potential water shortages, may be a particular concern for fire services	4	3	12	4	4	16	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.
Emergency Services	Not applicable	Flooding	> Potential for damage to residential and commercial properties and infrastructure disrupting access and leading to health risks	4	2	8	4	3	12	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Review of infrastructure to identify assets at risk from climate change.
Emergency Services	Not applicable	Multiple - Wind speed/ Storm	> Increased likelihood of accidents caused by storm debris, particularly when on the roads	4	2	8	4	3	12	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.
Emergency Services	Not applicable	Extreme rainfall	> Damage to roads can decrease response times	4	3	12	4	3	12	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.
Emergency Services	Not applicable	Flooding	> Increased risk of people becoming trapped in homes and needing evacuation.	4	3	12	5	3	15	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.
Emergency Services	Not applicable	Heatwaves	> Increase in heat related illnesses, including heatstroke and dehydration	3	3	9	3	5	15	- Emergency services and scenario planning take place regularly. This includes weather related events.	- Continue to review and update as conditions change.



Energy	Not applicable	Drought	> Demand for freshwater for use in cooling is likely to rise significantly during hotter temperatures, which may affect already stretched supply	3	3	9	3	4	12	- No direct control of power distribution in County Meath	None required
Energy	Not applicable	Flooding	> Disruption/damage to energy infrastructure, particularly electrical transmission. Risk of power cuts and shortages	3	3	9	3	3	9	- No existing controls, as energy infrastructure outside of Meath CC control. - New infrastructure will not be built in flood risk zones.	- Engage with ESB to understand level of risk. All energy infrastructure is managed by ESB. They should have an understanding of the risks from climate change.
Energy	Not applicable	Heatwaves	> Increase in temperature of cooling water can reduce its efficiency and may lead to higher costs	2	3	6	2	4	8	- No direct control of power distribution in County Meath	None required
Energy	Not applicable	Extreme rainfall	> Increased risk of damage and disruption to energy infrastructure/supply	3	2	6	4	3	12	- Planning applications for critical services are kept out of flood zones. Same criteria as for other developments. ESB are responsible for substations etc. and are normally located.  - Solar farms are to be kept out of 1/1000 year flood zones.	None required - compliance with the guidance. OPW.
Energy	Not applicable	Heatwaves	> Increase and surges in energy demand to meet cooling requirements. This can have significant reputational risks if demand cannot be met and may also increase prices	3	3	9	4	5	20	- No houses have cooling in place at present, and no current demand for cooling	- Continue to monitor temperatures in new build houses for change in demand in relation to cooling
Energy	Not applicable	SLR	> Coastal energy infrastructure at a greater risk from flooding and may require some to be relocated	3	2	6	4	4	16	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief schemes. - Engage with (power company) to understand level of risk.
Energy	Not applicable	Heatwaves	> Reduction in the capacity of distribution and transmission lines in higher temperatures, may reduce efficiency and increase costs	2	3	6	2	4	8	- No direct control of power distribution in County Meath	None required
Energy	Not applicable	Coastal erosion	> Coastal energy infrastructure may be at risk from potential erosion/land sliding events and may require some to be relocated	3	2	6	4	3	12	- risk unknown	- Engage with ESB to understand level of risk. All energy infrastructure is managed by ESB. They should have an understanding of the risks from climate change.
Energy	Not applicable	Multiple - Wind speed/Storm	> Increased disruption/damage to energy infrastructure/supply	3	2	6	4	3	12	- No direct control of power distribution in County Meath	Not applicable

Planning & Land Use	Not applicable	Coastal erosion	> Coastal developments at an increased risk of damage erosion/land sliding. May limit availability of suitable land for development in popular coastal area	3	2	6	4	3	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Planning & Land Use	Not applicable	Storm surge	> Poses an immediate threat to coastal development, increasing the risk of flooding and damage to coastal properties	3	3	9	3	4	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Planning & Land Use	Not applicable	Drought	> Risk of water shortages if water provisions are not adapted in accordance with planning/land use changes	3	3	9	4	4	16	- Not under direct control of the County - would be the responsibility of OPW	
Planning & Land Use	Not applicable	Flooding	> Exacerbated isolation for those in rural locations	2	3	6	3	3	9	- Flood mapping and flood zoning in place. - Developments are not permitted in 1/100 - 1/1000 year flood risk zone. - Developments also need to show a consideration for flood adaptation	None identified/required.
Planning & Land Use	Not applicable	Flooding	> Flood risk may further reduce availability of suitable development land and may require development in more flood prone areas	2	3	6	3	3	9	- Flood mapping and flood zoning in place. - Developments are not permitted in 1/100 - 1/1000 year flood risk zone. - Developments also need to show a consideration for flood adaptation - Development plan excludes sites at risk of flooding.	- None required. OPW provide guidance for development in existing flood risk areas (e.g. town centres).
Planning & Land Use	Not applicable	Heatwaves	> Increased risk of buildings overheating in the summer, particularly for new homes meeting strict energy efficiency regulations	2	3	6	3	5	15	- No current controls in place, has not been an issue so far	- More/better provision of green space and pedestrian-only spaces - Use of planting to provide suitable tree (shade) cover - Encourage brown/green roofs on all non-domestic buildings





Planning & Land Use	Not applicable	SLR	> Increases the risk of flooding in the desirable coastal areas. May move some currently safe areas into the high risk zone, impacting future development	3	2	6	4	4	16	<ul style="list-style-type: none"> <li>- Schemes have been undertaken to combat this. OPW has mapping CFRAMS. Has coastal flooding maps.</li> <li>- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion</li> </ul>	<ul style="list-style-type: none"> <li>- Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.</li> </ul>
	Not applicable	Extreme rainfall	> Existing drainage (two facets - existing channels, but also built drainage as part of development) capacity may be exceeded with more extreme rainfall occurrences	3	3	9	3	3	9	<ul style="list-style-type: none"> <li>- OPW responsible for dealing with drains.</li> <li>- Planning applications go through department - no development in flood zones (1 in 100 and 1 in 1000). Can be exceptions in towns already there, e.g. Navan.</li> <li>- Guidance provided from the OPW for exceptional circumstances.</li> <li>- Guidance provided by the department of environment for internal drainage</li> </ul>	<ul style="list-style-type: none"> <li>- Investigate land management opportunities for water attenuation in council owned land</li> <li>- Encourage integration, and use of, Suds e.g. swales adjacent to roads to mitigate flood volumes, subsurface storage (i.e. interconnected detention basins).</li> <li>- Other measures could also include the incorporation of more green and brown roof, increase use of blue roofs (like green roofs but for water storage), the use permeable paving and the inclusion of surface water features.</li> </ul>

Tourism	Not applicable	Extreme rainfall	<ul style="list-style-type: none"> <li>&gt; Increased risk of erosion and damage to heritage sites, decreasing tourist damages</li> <li>&gt; Reduced visitor satisfaction (also diminishing accessibility which could impact the above)</li> <li>&gt; Damage to paths and other tourist infrastructure, leading to temp closures and/or diversions</li> <li>&gt; Increased risk to public posed by land slip and rock fall especially near cliff and coastal areas</li> </ul>	3	3	9	3	3	9	<ul style="list-style-type: none"> <li>- Diversion of footpaths during periods of poor weather</li> </ul>	<ul style="list-style-type: none"> <li>-Complete a full review of tourist hot spots at risk</li> <li>-Identification of alternative routes for access</li> <li>- Develop and improve monitoring and maintenance plans</li> <li>-Drainage schemes to mitigate flows</li> </ul>
Tourism	Not applicable	Coastal erosion	<ul style="list-style-type: none"> <li>&gt; Loss/damage of coastal attractions- particularly for more vulnerable small businesses which are clustered here</li> </ul>	3	2	6	3	3	9	-No existing controls	<ul style="list-style-type: none"> <li>-Complete a full review of tourist attractions and hotspots at risk from coastal erosion, Incorporate this into full review of vulnerability for the coastline to climate change</li> </ul>
Tourism	Not applicable	SLR	<ul style="list-style-type: none"> <li>&gt; Loss/damage of coastal attractions- particularly for more vulnerable small businesses which are clustered here</li> </ul>	3	2	6	3	4	12	-No existing controls	<ul style="list-style-type: none"> <li>--Complete a full review of tourist attractions and hotspots at risk from coastal erosion, Incorporate this into full review of vulnerability for the coastline to climate change</li> </ul>
Tourism	Not applicable	Drought	<ul style="list-style-type: none"> <li>&gt; May negatively affect Ireland's 'green landscape' which could reduce appeal of the area</li> <li>&gt; Increased risk of wildfires (particularly open heathland and open access sites) could cause public safety issue</li> </ul>	3	3	9	3	4	12	- No existing controls	<ul style="list-style-type: none"> <li>-Develop vegetation management/design plan to improve habitat resilience, to include actions such as creating natural fire breaks and fire belts, planting for stands of mixed species and ages and planning for fire risks (and appropriate incident response). Note, forests particularly at threat here.</li> </ul>
Tourism	Not applicable	Flooding	<ul style="list-style-type: none"> <li>&gt; Damage/closure to roads/rail, both within the County and in the surrounding areas, may limit the accessibility of the County</li> </ul>	3	3	9	4	3	12	<ul style="list-style-type: none"> <li>- Main roads into the County are quite resilient, however diversion strategy in place when necessary. No direct control over other forms of transport</li> </ul>	<ul style="list-style-type: none"> <li>- Consider key tourist routes as part of risk review of infrastructure</li> </ul>



Transport	Road	Flooding	> Increase in the number of flooding events causing road closures- impacting business and industry, risk of damage to cars driving through flood waters	3	3	9	4	3	12	<ul style="list-style-type: none"> <li>- Already have procedures in place for diverting traffic away from flooded roads</li> <li>- Flood risk assessment from OPW identifies assets at risk of flooding. Main focus is on habitable dwellings, but also looks at other assets.</li> <li>- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion</li> </ul>	<ul style="list-style-type: none"> <li>- Develop a more comprehensive diversion plan for the most frequently flooded roads. Use various social media platforms and council website to raise awareness</li> <li>- Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief</li> </ul>
	Road	Coastal erosion	> Increased risk of landslides and loss/damage to coastal roads	3	2	6	3	3	9	<ul style="list-style-type: none"> <li>- Application for a coastal erosion scheme in Laytown that has been applied for Bettystown/Laytown MD. In direct response to erosion.</li> <li>- Flood risk assessment from OPW identifies assets at risk of flooding. Main focus is on habitable dwellings, but also looks at other assets.</li> <li>- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion</li> <li>- Major flood risk issues are dealt with a national scale. Opportunity to deal with minor flood risks.</li> </ul>	<ul style="list-style-type: none"> <li>- Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.</li> <li>- Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief schemes.</li> </ul>
	Road	Multiple - Wind speed/Storm	> Increased road closures owing to storm damage (due to wind- loading of structures) and an increase in windblown debris, including blocking of drains and spillways	3	2	6	3	3	9	<ul style="list-style-type: none"> <li>- Procedures are currently in place for diverting traffic away from flooded roads</li> </ul>	<ul style="list-style-type: none"> <li>- Develop a more comprehensive diversion plan for the most frequently flooded roads. Use various social media platforms and council website to raise awareness</li> <li>- Ensure proactive maintenance, particularly during 'at risk' periods (i.e. autumn and winter)</li> </ul>

Transport	Bus	Flooding	> Damage to depots and buses driving through flood waters	3	3	9	3	3	9	- No existing controls, as depots not in control of Meath CC. - No new depots would be permitted in flood risk zones, in line with national guidelines.	- Consider bus routes and depots as part of risk review of roads. Buses out of Meath CC control. Action is to ensure that roads are maintained, and new bus facilities are not built in areas prone to flooding.
Transport	Bus	Multiple - Wind speed/Storm	> Increased delay's to service through road closures from road degradation/debris	3	2	6	3	3	9	- No direct control on bus network, but road clearing and road diversion strategy in place when necessary	
Transport	Rail	Coastal erosion	> Increased risk of landslides and loss/damage to coastal rail infrastructure	3	2	6	3	3	9	- Application for a coastal erosion scheme in Laytown that has been applied for Bettystown/Laytown MD. In direct response to erosion.	- Engage with Iaranrod Eireann (IE) to identify areas that could be susceptible to coastal erosion. Nicholas would have best understanding of liaison with IE. - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Transport	Rail	SLR	> Increased risk of flooding to coastal rail infrastructure causing delays, disruption and overcrowding, delays, etc.	3	2	6	4	4	16	- Very limited responsibility as a county for the rail network. Would only work where rail tracks cross with road network. - Flood risk assessment from OPW identifies assets at risk of flooding. Main focus is on habitable dwellings, but also looks at other assets. - Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Engage with Iaranrod Eireann (IE) to identify areas that could be susceptible to flooding. Nicholas would have best understanding of liaison with IE. - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country-wide. Draw on actions from that study.
Transport	Rail	Storm surge	> Increased risk of damage to coastal rail infrastructure from flooding/debris	3	3	9	4	4	16	- No direct control over rail infrastructure	- Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country-wide. Draw on actions from that study.



Transport	Bus	Storm surge	> Increased risk of damage to coastal roads from flooding/debris	3	3	9	3	4	12	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Transport	Rail	Heatwaves	> Passenger and staff comfort reduced- over heating	2	3	6	3	5	15	No direct controls	No direct controls
Transport	Bus	SLR	> Possible increased disruption to services caused by coastal flooding	3	2	6	4	4	16	- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.
Transport	Road	Storm surge	> Increased risk of damage to coastal roads from flooding/debris	3	3	9	4	4	16	- Application for a coastal erosion scheme in Laytown that has been applied for Bettystown/Laytown MD. In direct response to erosion. - Flood risk assessment from OPW identifies assets at risk of flooding. Main focus is on habitable dwellings, but also looks at other assets. - Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion	- Climate Resilience review of the entire road network - Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study. - Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief schemes.
Transport	Bus	Heatwaves	> Passenger and staff comfort reduced- over heating	2	3	6	3	5	15	No direct controls	No direct controls
Transport	Bus	Extreme rainfall	> Delays to service through road damage/closures	3	3	9	3	3	9	- Diversion plans in place for frequently flooding roads	- Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief schemes.
Transport	Road	Extreme rainfall	> Increased risk of landslides leading to damage to roads and bridges > Erosion of unpaved shoulders > Traffic disruption and congestion	3	2	6	3	3	9	- Flood risk assessment from OPW identifies assets at risk of flooding. Main focus is on habitable dwellings, but also looks at other assets.	- Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief schemes.
Transport	Bus	Coastal erosion	> Increased risk of landslides and loss/damage to coastal roads	3	2	6	3	3	9	- No existing controls in place	- Review of infrastructure to identify assets at risk from climate change.

Transport	Road	SLR	> Increased flood risk for coastal roads	3	2	6	4	4	16	<ul style="list-style-type: none"> <li>- Application for a coastal erosion scheme in Laytown that has been applied for Bettystown/Laytown MD. In direct response to erosion.</li> <li>- Flood risk assessment from OPW identifies assets at risk of flooding. Main focus is on habitable dwellings, but also looks at other assets.</li> <li>- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion</li> </ul>	<ul style="list-style-type: none"> <li>- Develop coastal development policy, taking SLR, coastal erosion and storm surge into account. Should draw on guidance from OPW. Should also draw on study being undertaken country wide. Draw on actions from that study.</li> <li>- Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief schemes.</li> </ul>
Transport	Rail	Flooding	> More frequently flooded track causing damage and cancelled services. Implications for commuting/ accessibility	3	3	9	4	3	12	<ul style="list-style-type: none"> <li>- No direct controls as Rail is managed by Iaranrod Eireann (IE) (state body). No current measures from Meath CC.</li> </ul>	<ul style="list-style-type: none"> <li>- Engage with Iaranrod Eireann (IE) to identify areas that could be susceptible to flooding. Nicholas would have best understanding of liaison with IE.</li> </ul>
Transport	Road	Multiple - Heatwaves/ Summer temperature increase	> Prolonged hotter temperatures increases risk of damage to asphalt roads and pavements and causes problems with resurfacing, including buckling of existing surfaces. There may also be reduced visibility and operational disruption (i.e. from fires)	3	3	9	3	5	15	<ul style="list-style-type: none"> <li>- Do not currently consider temperature resistance of asphalt in design. Have experienced more flood than heat damage so far.</li> </ul>	<ul style="list-style-type: none"> <li>- Monitor impact of heat on existing road network, and where necessary, consider more heat resistant asphalt materials (and binders) in future procurement</li> <li>- Account for climate risks in maintenance regimes</li> </ul>
Transport	Rail	Extreme rainfall	> Increase in bridge scour can cause delays and cancellations	3	2	6	3	3	9	<ul style="list-style-type: none"> <li>- No direct controls as Rail is managed by Iaranrod Eireann (IE) (state body). No current measures from Meath CC.</li> </ul>	<ul style="list-style-type: none"> <li>- Engage with Iaranrod Eireann (IE) to identify areas that could be susceptible to flooding. Nicholas would have best understanding of liaison with IE.</li> </ul>
Transport	Bus	Flooding	> Increase in road closures during floods causing disruption and delays	3	3	9	4	3	12	<ul style="list-style-type: none"> <li>- Diversion plans in place for frequently flooding roads</li> <li>- Coastal flood controls include improved water storage, concrete channels and development of flood walls, input of reform culverts and stream diversion.</li> </ul>	<ul style="list-style-type: none"> <li>- Engage with bus companies to understand what measures are in place in case of flooding.</li> </ul>



Waste	Not applicable	Multiple - Extreme Rainfall/Wind speed/Storm	> Increased risk of damage to waste facilities	3	3	9	4	3	12	- New waste facilities would be subject to guidance. - No examples of waste facilities being affected by floods.	- Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief schemes. -Develop guidance for waste site operators and examples of adaptation opportunities -Raise awareness of climate change impacts with the sector
Waste	Not applicable	Flooding	> Flooding of landfill sites can increase groundwater/surface water contamination	4	3	12	4	3	12	- One closed landfill has been capped to keep water out. Constantly being monitored. - No new landfills permitted in flood risk zones. - No direct control over active land fill site as it is privately managed. Licensed and monitored by the EPA.	- Review data from closed landfill to ensure rainfall events don't impact contaminants leaving the site. -Develop guidance for waste site operators and examples of adaptation opportunities -Raise awareness of climate change impacts with the sector
Waste	Not applicable	Flooding	> Increased risk of sewerage flooding/overflow	4	3	12	4	3	12	- River cleanout programmes to facilitate drainage (although influences on hydro geomorphology)	-Undertake vulnerability mapping to provide more detail on current/future vulnerability to flooding
Waste	Not applicable	Heatwaves	> Increase risk of fires in waste facilities, particularly in landfill sites	3	3	9	3	4	12	- No controls at present, EPA has the majority of control over landfill sites	- Use council controlled waste permits to include conditions that would prevent fire
Waste	Not applicable	Drought	> Reduced availability of water for anaerobic digestion and composting.	2	3	6	2	4	8	- No anaerobic digesters at present so no current controls, however may become more of an issue in the future	-Develop guidance for operators if uptake does increase, concerning climate resilience
Waste	Not applicable	Multiple - Extreme Rainfall/Wind speed/Storm	> Increased disruption to waste collection where roads have been blocked/damaged	3	3	9	3	3	9	- No additional controls to infrastructure controls.	- Review of infrastructure to identify assets at risk from flooding/extreme rainfall to inform low cost 'minor works' flood relief schemes.
Waste	Not applicable	Heatwaves	> Prevalence of vermin and odour/dust more likely and may require more frequent waste collection	3	3	9	3	4	12	- Council can issue conditions in cases where odour is excessive	- Evidence review of the impact of past weather events on waste infrastructure
Waste	Not applicable	Flooding	> Increased waste arising in the aftermath of flood events	2	3	6	3	3	9	- No existing controls to stop sewerage getting into water courses in event of a flood, however there will be a big dilution factor. - No new water treatment works will be permitted in flood risk zone.	- Establish level of risk of sewer surcharges. - Develop measures in case of sewer surcharges



Water Resource Management	Not applicable	Multiple - SLR/Coastal erosion	> Increased risk of saline intrusion into aquifers or water bodies	4	2	8	4	4	16	- Currently this is not a major issue, few boreholes are located in coastal regions. The closest are approximately 3- 4 km away which are not close enough to be impacted at the moment. '- Some major groundwater sources being developed on the east coast. This would be a feature for works supporting this.	- Ensure saline intrusion is considered as part of planning applications for east coast groundwater sources.
Water Resource Management	Not applicable	Drought	> Increased pressure on the current abstraction points. Unlikely to be able to match demand sufficiently. Potential for hosepipe bans and agriculture/industry bans	3	3	9	4	4	16	- Previous small issues with maintaining a consistent supply in some rural areas, however this has recently been improved. - Large water supply scheme for Dublin via the River Shannon may be used to improve the supply in Meath - Leaks and bursts in water pipes are captured using GIS to ensure maintenance work is undertaken by the water conservation unit (within Irish water) when necessary, minimising water losses.	None required- at the moment water supply appears to be adequate, even during drought periods. However this is likely to require review in the future.
Water Resource Management	Not applicable	Heatwaves	> Surges in demand for water may extend beyond capacity. Increased demand for water for cooling energy and industry infrastructure may be particularly significant. Prices may also increase.	4	3	12	4	5	20	- No direct control on this (only now in charge of maintenance), but can report to Irish Water	- Increase education around water conversations during droughts/heatwaves
Water Resource Management	Not applicable	Extreme rainfall	> Water quality risks are most likely to be exacerbated during extreme weather events, particularly if timing coincides with fertilisation of agricultural land	4	3	12	4	3	12	- Spreading activities are licensed, with no- spread buffer zones applied near water courses. '- Assessments of farms are undertaken to see if they are likely to be at risk of causing contamination and information on good farming practices is provided. - Some rivers have been fenced off to protect against contamination from livestock.	- Introduce a spreading buffer zone to the flood zones. Spreading activities are currently licensed, but do not apply to flood zones. Increasing the buffer zone would help avoid pesticides entering the water course when flooding happens.



<b>Water Resource Management</b>	Not applicable	Flooding	> Increased risk of flooding and contamination of water supply	4	3	12	4	3	12	<ul style="list-style-type: none"> <li>- Any new development is subject to national guidelines. Sometimes new, isolated houses might apply for their own borehole - again would need to be outside of the flood zone.</li> <li>- Historic site in Slane is in a flood zone. Had to be built up to ensure that it was safe from flood water.</li> <li>- Irish Water is building climate resilience initiatives into all new large initiatives and will be providing support to councils to implement this.</li> </ul>	None required - works at Slane undertaken recently (~2010).
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