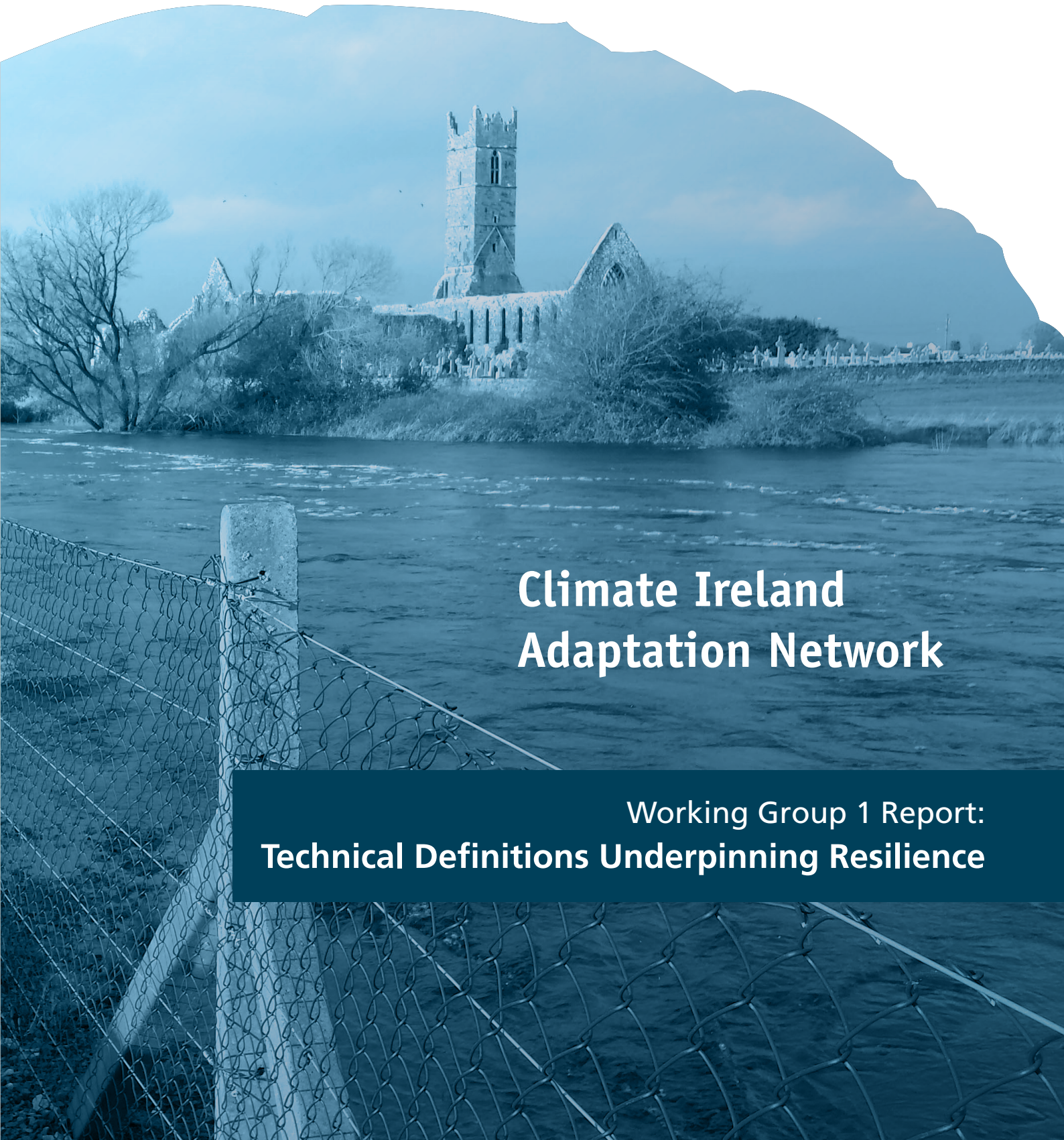
Climate Ireland



Climate Ireland Adaptation Network

Working Group 1 Report:

Technical Definitions Underpinning Resilience

Environmental Protection Agency

The EPA is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

- **Regulation:** Implementing regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.
- **Knowledge:** Providing high-quality, targeted and timely environmental data, information and assessment to inform decision making.
- **Advocacy:** Working with others to advocate for a clean, productive and well-protected environment and for sustainable environmental practices.

Our responsibilities include:

LICENSING

- Large-scale industrial waste and petrol storage activities;
- Urban wastewater discharges;
- The contained use and controlled release of genetically modified organisms;
- Sources of ionising radiation;
- Greenhouse gas emissions from industry and aviation through the EU Emissions Trading Scheme.

NATIONAL ENVIRONMENTAL ENFORCEMENT

- Audit and inspection of EPA-licensed facilities;
- Drive the implementation of best practice in regulated activities and facilities;
- Oversee local authority responsibilities for environmental protection;
- Regulate the quality of public drinking water and enforce urban wastewater discharge authorisations;
- Assess and report on public and private drinking water quality;
- Coordinate a network of public service organisations to support action against environmental crime;
- Prosecute those who flout environmental law and damage the environment.

WASTE MANAGEMENT AND CHEMICALS IN THE ENVIRONMENT

- Implement and enforce waste regulations including national enforcement issues;
- Prepare and publish national waste statistics and the National Hazardous Waste Management Plan;
- Develop and implement the National Waste Prevention Programme;
- Implement and report on legislation on the control of chemicals in the environment.

WATER MANAGEMENT

- Engage with national and regional governance and operational structures to implement the Water Framework Directive;
- Monitor, assess and report on the quality of rivers, lakes, transitional and coastal waters, bathing waters and groundwaters, and measurement of water levels and river flows.

CLIMATE SCIENCE AND CLIMATE CHANGE

- Publish Ireland's greenhouse gas emission inventories and projections;
- Provide the Secretariat to the Climate Change Advisory Council and support to the National Dialogue on Climate Action;
- Support National, EU and UN climate science and policy development activities.

ENVIRONMENTAL MONITORING & ASSESSMENT

- Design and implement national environmental monitoring systems: technology, data management, analysis and forecasting;
- Produce the State of Ireland's Environment and Indicator Reports;
- Monitor air quality and implement the EU Clean Air for Europe Directive, the Convention on Long Range Transboundary Air Pollution and the National Emissions Ceiling Directive;
- Oversee the implementation of the Environmental Noise Directive;
- Assess the impact of proposed plans and programmes on the Irish environment.

ENVIRONMENTAL RESEARCH AND DEVELOPMENT

- Coordinate and fund national environmental research activity to identify pressures, inform policy and provide solutions;
- Collaborate with national and EU environmental research activity.

RADIOLOGICAL PROTECTION

- Monitoring radiation levels and assess public exposure to ionising radiation and electromagnetic fields;
- Assist in developing national plans for emergencies arising from nuclear accidents;
- Monitor developments abroad relating to nuclear installations and radiological safety;
- Provide, or oversee the provision of, specialist radiation protection services.

GUIDANCE, AWARENESS RAISING, AND ACCESSIBLE INFORMATION

- Provide independent evidence-based reporting, advice and guidance to government, industry and the public on environmental and radiological protection topics;
- Promote the link between health and wellbeing, the economy and a clean environment;
- Promote environmental awareness including supporting behaviours for resource efficiency and climate transition;
- Promote radon testing in homes and workplaces and encourage remediation where necessary.

PARTNERSHIP AND NETWORKING

- Work with international and national agencies, regional and local authorities, non-governmental organisations, representative bodies and government departments to deliver environmental and radiological protection, research coordination and science-based decision making.

MANAGEMENT AND STRUCTURE OF THE EPA

The EPA is managed by a full-time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by advisory committees who meet regularly to discuss issues of concern and provide advice to the Board.

Climate Ireland

Climate Ireland Adaptation Network

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Technical Definitions Underpinning Resilience

Authors: Alan O'Connor, Annalisa Setti, AnnMaree Manley, Caitriona De Paor, Christopher Phillips, Colm O Looney, Conor Murphy, Cormac McKay, Dervala Leahy, Fintan McGrath, John Fingleton, Jonathan Chambers, Jordan Delmar, Kevin McCormick, Liz Wakefield, Lorcan Connolly, Marta Carrasco, Patrick Barrett, Paul McBride, Ronan Walsh, Suzanne Jackson, Ted McCormack, Tim Kavanagh.

ENVIRONMENTAL PROTECTION AGENCY
An Ghníomhaireacht um Chaomhnú Comhshaoil
PO Box 3000, Johnstown Castle,
Co. Wexford, Ireland

Telephone: +353 53 9160600 Fax: +353 53 9160699
Email: info@epa.ie Website: www.epa.ie
Lo Call 0818 33 55 99

Disclaimer

This Climate Ireland Adaptation Network (CIAN) working group report summarises discussions from working group meetings and written contributions from CIAN members. It is intended to reflect a range of perspectives shared from the group and should be treated as a working document and not interpreted as representing the official views or endorsement of individual contributors or the Environmental Protection Agency (EPA). The EPA, the CIAN working group members and the authors do not accept any responsibility whatsoever for loss or damage occasioned, or claimed to have been occasioned, in part or in full, as a consequence of any person acting, or refraining from acting, as a result of a matter contained in this publication. All or part of this publication may be reproduced without further permission, provided the source is acknowledged.

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Contents

Executive summary

The planet is warming, with Europe warming twice as fast as the global average and extreme weather events becoming more frequent and intense. In this context, there is a need to protect ecosystems, communities, and businesses from the impacts of climate change through adaptation and build resilience into the future. While adaptation refers to the actions taken to adjust to climate impacts, resilience describes the capacity of systems to withstand, absorb, recover, and learn from those impacts.

The role of the Climate Ireland Adaptation Network (CIAN), which was established by the Environmental Protection Agency (EPA) in 2023, is to provide a forum which encourages individuals and organisations to work together to deliver improvements in implementing adaptation measures. It acts as a space where individuals share experiences, seek help from each other and learn from their peers. Following the CIAN seminar in October 2024, four working groups were convened to advance the common understanding across the network of the following critical topics in climate adaptation and resilience: 1) technical definitions of resilience, 2) just resilience, 3) resilient decision-making, and 4) indicator development.

The working groups were designed as collaborative, coproduction spaces that enabled participants to openly share their views, practices, and perspectives. A core goal of the CIAN working groups was to enhance communication between stakeholders, build stronger links across Ireland's adaptation community, and provide a forum to discuss adaptation topics and identify practitioner needs and knowledge gaps. The meetings and workshops were important outcomes, bringing people together, strengthening relationships, and advancing collective learning across the adaptation community.

This report summarises the output of Working Group 1, which explored the definitions and concepts that underpin climate resilience to support consistent planning and decision making across sectors. The report consolidates practitioner perspectives and challenges through a structured, consensus-driven process facilitated by the EPA, reflecting input from public agencies, semi-state bodies, private companies, academia, and civil society. A shared understanding of resilience is essential to avoid fragmented approaches and enable coordinated action, measurable objectives, and integration into national frameworks, sectoral plans, and local authority strategies; this report aims to contribute to this.

The group explored four key areas:

1. Irish resilience aims and objectives,
2. Reference trajectories,
3. Standards,
4. Scenario testing.

Working group participants proposed that resilience can be defined as *"the capacity of societal, environmental, and economic systems to withstand acute and chronic climate-related hazards, while responding to, adapting to, and addressing vulnerability in ways that maintain the system's essential function, identity and structure, and maintaining the capacity for future learning and transformation"*.

The Working Group identified a number of cross-cutting issues, including the urgent need for clear definitions and measurable objectives, the importance of reference trajectories and quantitative targets to guide planning, and the adoption of systems thinking to address interdependencies between infrastructure, ecosystems, and communities. Equity and fairness emerged as central principles, with calls for standards and strategies that are inclusive, proportionate, and adaptable to diverse social and geographical contexts. Long-term investment in local capacity and skills development is essential, alongside reforms in insurance and risk-sharing to protect vulnerable groups. Scenario planning and risk registers should become standard practice, supported by effective communication strategies using trusted messengers and tailored narratives to engage diverse audiences. Adaptability and futureproofing of methodologies were also emphasised to ensure resilience strategies remain relevant amid uncertainty, alongside the need for coordinated governance, practical guidance, and participatory methods to enable implementation and accountability.

This report suggests that Ireland's resilience planning must be underpinned by a better shared understanding of future scenarios, and the setting of trajectories for climate resilience linked to agreed reference warming-level scenarios and/or emission pathways. There is a need for policy to establish a national resilience goal which incorporates reference trajectories into national frameworks, sectoral plans, and local authority strategies. These trajectories would provide a common basis for decision-making, investment, and long-term planning, ensuring alignment with scientific scenarios and anticipated risks, allowing for technical standards for infrastructure and services to be updated.

1. Introduction

Purpose of the report

Following the CIAN seminar in October 2024, four working groups were convened to examine in more detail the following key adaptation and resilience topics:

- Working Group 1: Technical definitions of resilience
- Working Group 2: Just resilience
- Working Group 3: Resilient decision-making
- Working Group 4: Indicator development

The aims of the working groups were to:

1. Provide a forum to share, discuss, and summarise the current understanding and perspectives of sectors in relation to important climate resilience topics.
2. Identify practitioner (i.e. public agencies, semi-state bodies, private companies, academia, and civil society) needs and knowledge gaps.
3. To build stronger links between those involved in adaptation practices in Ireland.

Each working group was tasked with preparing a concise report summarising the work of the group.

Background on the CIAN Working Group 1

While climate adaptation refers to the actions taken to adjust to climate impacts, climate resilience describes the capacity of systems to withstand, absorb, recover, and learn from those impacts. The purpose of this working group was to explore definitions underpinning climate resilience for Ireland that support consistent planning and decision-making across sectors. It is essential that technical definitions are practical and usable by all stakeholders, while aligning with national aims and standards for resilience. Without this clarity, adaptation efforts risk becoming fragmented and difficult to implement across governance levels. The approach taken by this group reflects practitioner perspectives gathered through engagement, ensuring that the work is informed by real-world experience and sectoral needs rather than abstract theory.

To achieve these aims, the group explored four key areas:

1. Irish resilience aims and objectives,
2. Reference trajectories,
3. Standards,
4. Scenario testing.

Better understanding these elements will enable Ireland to move from ambition to implementation by delivering coordinated governance, inclusive engagement, and sustained investment. Establishing technical definitions and standards will also support the integration of resilience into national frameworks, sectoral plans, and local authority strategies, ensuring that adaptation measures are robust, equitable, and responsive to future climate risks.

Scope and intended use of the report

This summary report is designed to capture current perspectives, opinions, challenges, and opportunities related to the working group's topic. It serves as a shared reference for stakeholders, supporting adaptation planning and practice by consolidating insights and framing key considerations for future action. By presenting practitioner-informed views, the report aims to strengthen a common understanding and encourage dialogue across sectors.

2. Methodology

The EPA facilitated the development of this report in partnership with members of the CIAN working group. This group consisted of representatives from diverse sectors and organisations, including Government Departments, public agencies, semi-state entities, private companies, academic institutions, and non-profit organisations.

The EPA organised three working group meetings in collaboration with working group members between April and October 2025 to assist in report drafting (see Figure 1 for the co-production process). An initial Table of Contents (ToC) was created through group discussions and was revised iteratively during the first two workshops based on participants' written and verbal feedback. This feedback was compiled and shared for further refinement in later meetings, with consensus being sought in each session. Consensus was established through structured discussion of each section, iterative revisions based on collective feedback, and confirmation of agreement from all participants during meetings. Where differing views arose, these were documented and considered in subsequent drafts to ensure transparency.

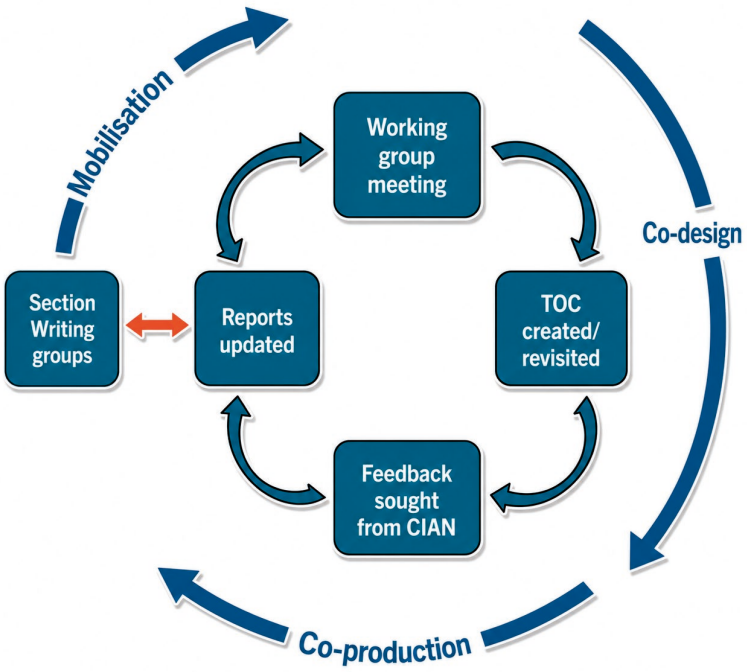

Figure 1: Co-production process with CIAN working group members. Starting with working group meetings there were three iterations of the cycle prior to the drafts being finalised.

Key themes that emerged from working group meetings were shared in the CIAN 2025 seminar, during which focused workshop sessions were organised to gather final input. This input was incorporated into the final report to ensure it represented the combined knowledge and viewpoints of practitioners from across the climate adaptation community.

3. Resilience aims and objectives

Resilience can be defined as the capacity of societal, environmental, and economic systems to withstand acute and chronic climate related hazards, while responding to, adapting to, and addressing vulnerability in ways that maintain the system's essential function, identity and structure, and maintaining the capacity for future learning and transformation (Folke et al., 2010; IPCC, 2022).

Understanding why aims and objectives for Irish climate resilience are necessary starts with the global context: the planet is warming, Europe is warming twice as fast as the global average, extreme events are becoming more frequent and intense (IPCC, 2022; EEA, 2023). While Europe's warming trend is pronounced, Ireland's temperature increase is moderated by its oceanic position and is broadly in line with global trends. There is a moral and legal requirement to protect ecosystems, communities, and businesses from the impacts of climate change and build resilience into the future. The Climate Action and Low Carbon Development Act 2015–2021 provides the legislative framework for Adaptation policy in Ireland (Government of Ireland, 2015). Sections 5 and 6 outline the requirement for a National Adaptation Framework (NAF) and Sectoral Adaptation Plans (SAPs) (Department of Climate, Energy and the Environment, 2018, 2025). The NAF sets out the potential implications of climate change for Ireland and outlines the national strategy for the development of adaptation measures. The second and current NAF was published in June 2024. 10 SAPs covering 13 key sectors across eight lead Departments were published in November 2025. The SAPs describe and assess the extent of the risks presented by climate change to each sector, and present action plans to address these risks and ensure climate resilience within the sector. They include actions to mainstream adaptation into policy and administration at the sectoral level over the next five-year period.

Key challenges remain in defining and implementing resilience objectives in Ireland. Getting a clear picture of the future climate conditions Ireland should be resilient to is a fundamental challenge. Planning to be resilient for the future requires an understanding of the risks and scenarios we face. The EPA-funded Operationalising Resilience in Irish Climate Action project, led by Irish Climate Analysis and Research UnitS (ICARUS) at Maynooth University, examined how resilience is defined and implemented across Irish climate policy (Murphy et al, 2025). While adaptation refers to the actions taken to adjust to climate impacts, resilience describes the capacity of systems to withstand, absorb, recover, and learn from those impacts. In practice, adaptation measures seek to build climate resilience, but the two terms are used differently across policy documents. ORICA found that inconsistent and sometimes fragmented definitions of resilience exist across national, sectoral, and local adaptation policies, hindering coherence and effective implementation, and that clearer, shared resilience frameworks are needed to support practitioners and improve coordination. ORICA also highlighted the importance of integrating formal and informal policy processes, enhancing cross-sectoral cooperation, and strengthening participatory approaches, all of which align closely with the gaps identified in current Irish resilience efforts.

Practitioners felt that guidance from the Irish Government and the EU Commission is limited and struggle with using available guidance, with no detailed frameworks for sectors such as SMEs or for natural and human systems, as outlined in the NAF. However, the upcoming European Climate Adaptation Plan, supported by the new integrated framework for European Climate Resilience and Risk Management, aim to bring a more consistent, EU-wide approach to how countries assess climate risks and plan for resilience. Coordination across agencies is limited, with insufficient clarity on synergies, co-benefits, and potential unintended consequences, for example, balancing community and nature-based solutions with infrastructure hardening. While a lot of work has been done regarding SAP Guidelines, the National Framework for Climate Services (NFCS), and CIAN to provide pathways for collaboration, there remain challenges in integrating these across sectors.

International examples of resilience definitions

To ground this work in established international thinking, the following section outlines how key global bodies define and apply the concept of resilience across different sectors.

Intergovernmental Panel on Climate Change:
The Intergovernmental Panel on Climate Change (IPCC) defines resilience as *"the capacity of social, economic, and environmental systems to cope with a hazardous event, trend, or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure while also maintaining the capacity for adaptation, learning, and transformation"* (IPCC, 2022).

European Council: Climate Resilience
The European Council provides a high-level policy definition of climate resilience within its 2021 Council document on climate adaptation. In this context, climate resilience is defined as *"the capacity of human and natural systems to learn, adapt and transform in response to risks that are induced or exacerbated by climate change."* This framing emphasises not only the ability to adjust to climate-related risks but also the transformative capacity required to respond to systemic, long-term climate pressures across both human and ecological systems (EU Council, 2021).

EU Mission on Adaptation to Climate Change
The EU Mission on Adaptation offers a more operational, impact-focused definition of climate resilience in its 2022 Climate Q&A guidance. It defines climate resilience as *"the ability to withstand the unavoidable climate impacts. To build resilience, one must adapt to already present effects of climate change and to prepare to withstand future climate risks."* This definition clearly distinguishes between existing and future climate pressures and highlights the need for proactive adaptation measures to reduce vulnerability over time (EU Missions, 2022).

WHO: Measuring Health System Resilience
This World Health Organization (WHO) document provides guidance to help health authorities prepare for the health risks of climate change, outlining a framework for measuring the climate resilience of health systems, selecting indicators for measuring the climate resilience of health systems, and data sources for indicators to measure the climate resilience of health system functions and outcomes of health system resilience (WHO, 2022). While the document does not provide an explicit definition it does describe the capacities required for health systems to anticipate, respond to, cope with, recover

from, and adapt to climate-related shocks and stresses. This helps build toward a functional definition of climate resilience.

EU: Critical Entities Resilience (CER) Directive

Adopted and published in 2022, the Critical Entities Resilience Directive (the CER Directive) provides a legal framework for the reinforcement and protection of the resilience of essential (and other) processes across 11 critical sectors, including energy, transport, health, water, food, and digital infrastructure (European Union, 2024). Article 2 of the CER defines climate resilience for critical entities as *"a critical entity's ability to prevent, protect against, respond to, resist, mitigate, absorb, accommodate and recover from an incident"*. It frames resilience as the ability to prevent, protect against, respond to, and recover from incidents that could significantly disrupt essential services.

4. Reference trajectories for climate resilience

As the prospects for limiting global warming to 1.5°C by 2100 fade, Ireland needs to prepare and plan to be resilient for more severe warming if global efforts to limit global warming to below 2°C by 2100 do not succeed (EPA, 2025). In January 2026, Copernicus Global Climate Highlights found that the globe has warmed by about 1.4°C above the pre-industrial level and if warming continues at the same rate as it has in the last 30 years, the globe could be at +1.5°C of warming by the end of this decade (Copernicus Climate Change Service, 2026). The Climate Action and Low Carbon Development Act 2021, mandates legally binding five-year carbon budgets, including sector-specific emissions ceilings, and identifies reduction targets to achieve climate neutrality by no later than 2050. However, there are no equivalent resilience targets to guide the nation's progress towards climate resilience, and as noted above there is no shared definition of what the country is building resilience against, which could support coherence among practitioners. Ireland's approach to establishing clear reference trajectories for climate resilience should remain closely aligned with the outcomes of the integrated framework for European Climate Resilience and Risk Management, currently under development, and expected for adoption in the second half of 2026, which aims to deliver a more ambitious, coherent EU wide approach to climate preparedness (European Commission, 2026). Resilience planning depends on anchoring analysis to clear reference trajectories, and there are different threshold options to be considered; including Global Warming Levels (GWLs), Representative Concentration Pathways (RCPs), or Shared Socioeconomic Pathways (SSPs). Reference trajectories enhance risk management and ensure that adaptation strategies remain relevant as climate impacts evolve. The recent European Scientific Advisory Board on Climate Change (ESAB) publication "Strengthening resilience to climate change – Recommendations for an effective EU adaptation policy framework", published on 16 February 2026 recommends adopting a common reference for adaptation planning, preparing for climate risks consistent with a pathway to 2.8–3.3 °C of global warming by 2100 (ESAB, 2026). This would imply higher levels of warming in Europe, which is already about 1 °C warmer than the global average (ESAB, 2026). The ESAB also advises that this reference trajectory should be complemented by the systematic use of more adverse scenarios for stress-testing.

Met Éireann's TRANSLATE project provides the first standardised and bias-corrected national climate projections for Ireland. The National Climate Change Risk Assessment (NCCRA) published by the EPA in 2025 evaluated national risks using TRANSLATE outputs based on emissions scenarios RCP8.5 (high-emissions) and RCP4.5 (moderate-emissions) pathways (EPA, 2025). TRANSLATE data were used by sectors that published SAPs, with sectors also incorporating NCCRA risks into the second iteration (2025), and Local Authorities due to integrate them in the next Local Authority Climate Action Plans (last completed 2024). Adoption of these pathways will result in greater alignment across sectors regarding where and how adaptation efforts should be focused, as well as a common understanding of the future climate.

In comparison France has developed its climate adaptation trajectory (TRACC) based on the possibility of a +3°C global rise, equivalent to +4°C for mainland France by the end of the century (Ministère de la Transition écologique, 2023). Importantly, France based its GWLs on RCPs and applied them to 2100, demonstrating how other countries are linking GWLs and RCPs for their official planning frameworks. France uses temperature thresholds rather than naming specific RCPs because GWLs offer a clearer, more impact focused basis for policy planning. These GWLs are closely informed by RCP pathways, but they are not the same thing; instead, they represent the temperature outcomes that different emissions pathways could lead to. Using thresholds allows France to plan against the physical impacts associated with a given level of warming, regardless of which specific pathway the world follows to get there. France has formally given legal force to TRACC, placing it into the national Environment Code via a decree adopted on 23 January 2026 (Climate-ADAPT, 2026). The decree defines the objectives of this trajectory and how it must be updated, and an accompanying order sets out the specific warming levels and the procedures for making regional climate projections available through Météo France (Climate-ADAPT, 2026). In practice, TRACC becomes a legally recognised benchmark that public authorities, planners, and decision makers in France must use when assessing climate risks and developing adaptation measures This model could influence future policy directions at both the EU and national levels, and a similar framework could be considered in Ireland.

Another example is where the UK Government is also using GWLs to provide guidance for businesses to integrate climate change risk assessment and adaptation planning into their environmental management systems (Environment Agency, 2023). Organisations are advised to plan for a +2°C rise by 2050 and a +4°C rise by 2100, directly linking adaptation efforts to warming trajectories. The Environment Agency audits these plans periodically as part of broader compliance checks, ensuring that climate resilience is embedded in both policy and practice.

When choosing a framework, both its ease of communication and its practicality for implementation should be considered as well as analysing how it could be applied at national, sectoral, and local levels. Additionally, clear guidance and definitions are needed to ensure consistent implementation and translation to risk assessments, technical standards, policies and plans. Lastly, while establishing a national common framework for climate resilience can enhance coordination and policy coherence, it is still important to operate within a certain level of uncertainty.

Summary of Climate Reference Trajectories:

- Ireland: RCP4.5 and RCP8.5 used in the National Climate Change Risk Assessments
- France: GWLs based on temperature thresholds (e.g., 3°C globally by 2100, 4°C for France)
- United Kingdom: GWLs for adaptation guidance (+2°C by 2050, +4°C by 2100).
- ESAB: Recommends SSP2 4.5 as a common EU-wide reference trajectory (2.8–3.3°C by 2100)

5. Standards

Standards play a critical role in ensuring effective, just and equitable resilience across Irish society. They provide benchmarks for preparedness, helping to set consistent expectations for infrastructure, services, and communities. The guiding principles are clarity, proportionality, and adaptability: standards must be clear enough for practitioners to apply, scaled to the criticality and design life of assets, and flexible enough to evolve with new risks. For Ireland, this may mean updating drainage and flood defence standards to reflect projected sea-level rise and developing standards for managing infrastructure and services during heatwaves. Standards offer accountability and potential comparability across sectors, providing a benchmark for performance and a means of managing risk. However, standards also risk locking in outdated thresholds and may not capture cascading or systemic risks. To remain effective, standards must be updated regularly to incorporate evolving climate projections and emerging cross sectoral risks. A systems-based approach that combines technical standards with social and community dimensions can help ensure resilience is future-proofed and equitable.

Having solid engineering standards incorporated into adaptation plans, provide clear thresholds for flood resilient design for example setting minimum floor level elevations based on a 1 in 100-year flood event. These thresholds help ensure consistency and safety across developments. However, as climate change increases rainfall intensity and sea level rise, the baseline assumptions behind these standards gradually become outdated and must be adjusted to reflect changing climate risks. Dynamic Adaptive Pathways Planning (DAPP) is a planning approach that helps manage evolving climate risks by identifying flexible adaptation options and trigger points so decisions can adjust over time as conditions change (Langendijk et al,2025). Using a DAPP approach for floor level standards, would require building floors to today's threshold while identifying future trigger points (e.g., projected flood levels in 2050 being exceeded) that would initiate additional measures such as installing flood barriers, or updating planning requirements.

6. Scenario testing

Scenario testing is an important tool for stress-testing resilience measures against acute and compounding risk. The principle is robustness over prediction, decisions should work across a range of futures, not hinge on a single forecast. In Ireland, scenario testing could involve evaluating how infrastructure copes with repeated flood events, how agriculture withstands back-to-back droughts like 2018, or how emergency services respond to overlapping flood and wind events. Existing structures, such as the National Emergency Planning Group, provide platforms for multi-level coordination, while clear standards are needed to guide engineers and practitioners in applying scenario testing consistently.

The advantages are that testing can expose vulnerabilities and identify no-regret strategies (such as nature-based flood management or improved water efficiency). It is also important to guard against potential maladaptation, where actions intended to reduce climate risks may inadvertently increase them over time, for example, flood mitigation tree planting that later becomes vulnerable to wildfire. However, it can be resource-intensive, may overwhelm decision-makers with complexity, and requires careful communication to avoid confusion. Practical progress can come from templates, participatory exercises and guidance on decision making under uncertainty. In practice, the incorporation of nature-based solutions within flood relief schemes needs to be carefully designed and often combined with traditional grey defences, ensuring they complement rather than replace engineered protection while still delivering wider resilience benefits.

7. Cross-cutting issues

Contributions to the report sections highlight a necessity for clear, commonly understood definitions and objectives for reference trajectories, standards and scenarios when determining what resilience means and how it is evaluated across various systems. There was significant emphasis placed on the importance of reference trajectories and quantitative objectives to ground planning and ensuring consistency at national, sectoral, and local levels. A systems thinking approach is discussed throughout, which highlights the interconnectedness of infrastructure, ecosystems, and communities, and the importance of avoiding fragmented strategies. This systems orientation is also reflected in broader European work such as the EU Climate Risk Assessment (EUCRA), which places strong emphasis on cross sectoral risk interactions and resilience. The forthcoming EUCRA 2 (expected in 2028), along with future updates to Ireland's NCCRA, are set to deepen this systems-based perspective and support more coherent, integrated risk management. Equity and fairness are also pivotal across sections, with appeals for standards and strategies that are inclusive, proportionate, and adaptable to diverse social and geographical contexts. This work also aligns with the EU principle of just resilience defined in the 2023 EC Guidelines as ensuring adaptation does not create uneven burdens or leave vulnerable groups behind and is explored further in our accompanying Working Group 2; Just Resilience report (European Environment Agency, 2023). The significance of adaptability and future-proofing is stressed in both the standards and scenario sections, to ensure that policies stay pertinent amid uncertainty. Lastly, all sections emphasise the necessity of coordination across multiple levels, practical guidance, and participatory methods to facilitate climate resilience implementation, learning, and accountability throughout government, sectors, and society.

8. Conclusions and future considerations

Working group participants suggested that resilience can be defined as *"the capacity of societal, environmental, and economic systems to withstand acute and chronic climate related hazards, while responding to, adapting to, and addressing vulnerability in ways that maintain the system's essential function, identity and structure, and maintaining the capacity for future learning and transformation"*.

The working group concluded that Ireland's approach to climate resilience must be determined by defining what future conditions we are planning for and setting clear reference trajectories to guide that planning. This involves recognising that different climate trajectories have associated risks as well as the potential for opportunities for innovation, healthier environments, and more sustainable livelihoods particularly where adaptation and mitigation actions are integrated to generate synergies and co benefits, as highlighted in the CCAC (2025) framing. Linking resilience strategies to agreed warming levels and emissions pathways helps ensure that actions are consistent, coordinated, and targeted at the risks Ireland is most likely to face. Defined trajectories provide a common basis for decision-making, investment, and long-term planning, ensuring that resilience strategies are aligned with scientific scenarios and future risks. ESAB recommend adopting SSP2 4.5 as a common EU reference trajectory to prepare for physical climate risks consistent with 2.8–3.3 °C of global warming by 2100, while the NCCRA advises planning under RCP 4.5 and RCP 8.5 to capture a wider range of plausible futures and ensure robust national adaptation decision making. Building on this foundation, resilience should then be supported by clear definitions, measurable objectives, and inclusive frameworks that reflect justice, vulnerability, and community capacity. Embedding equity at every stage of planning through fair participation, resource distribution, and recognition of diverse needs will strengthen adaptation outcomes. Resilience must go beyond consultation to empower communities, integrate health and well-being, and guarantee equitable access to green and blue spaces.

The working group believes that achieving this would be supported by establishing a national resilience goal and incorporating reference trajectories into national frameworks, sectoral plans, and local authority strategies. Technical standards for infrastructure and services should be updated to reflect projected climate impacts, and vulnerability assessments must combine robust data with community perspectives to guide proportionate and inclusive measures. Justice principles should be embedded into planning tools, funding criteria, and foresight frameworks to ensure decisions are fair and actionable. Long-term investment in local capacity and skills development is essential, alongside reforms in insurance and risk-sharing to protect vulnerable groups. Scenario planning and risk registers should become standard practice, supported by effective communication strategies using trusted messengers and tailored narratives to engage diverse audiences. Approaches providing a structured method for exploring multiple future scenarios and identifying trigger points that guide decisions over time require implementation. Ireland needs to move from ambition to implementation, delivering coordinated governance, inclusive engagement, and sustained investment to help ensure resilience becomes a lived reality for all communities.

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An Ghníomhaireacht um Chaomhnú Comhshaoil

Tá an GCC freagrach as an gcomhshaol a chosaint agus a fheabhsú, mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ar thionchar díobhálach na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

- Rialáil: Rialáil agus córais chomhlíonta comhshaoil éifeachtacha a chur i bhfeidhm, chun dea-thorthaí comhshaoil a bhaint amach agus díriú orthu siúd nach mbíonn ag cloí leo.
- Eolas: Sonraí, eolas agus measúnú ardchaighdeáin, spriocdhírithe agus tráthúil a chur ar fáil i leith an chomhshaoil chun bonn eolais a chur faoin gcinnteoireacht.
- Abhcóideacht: Ag obair le daoine eile ar son timpeallachta glaine, táirgiúla agus dea-chosanta agus ar son cleachtas inbhuanaithe i dtaobh an chomhshaoil.

I measc ár gcuid freagrachtaí tá:

CEADÚNÚ

- Gníomhaíochtaí tionscail, dramhaíola agus stórála peitril ar scála mór;
- Sceitheadh fuíolluisce uirbigh;
- Úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe;
- Foinsí radaíochta ianúcháin;
- Astaíochtaí gás ceaptha teasa ó thionscal agus ón eitlíocht trí Scéim an AE um Thrádáil Astaíochtaí.

FORFHEIDHMIÚ NÁISIÚNTA I LEITH CÚRSAÍ COMHSHAOIL

- Iniúchadh agus cigireacht ar shaoráidí a bhfuil ceadúnas acu ón GCC;
- Cur i bhfeidhm an dea-chleachtais a stiúradh i ngníomhaíochtaí agus i saoráidí rialáilte;
- Maoirseacht a dhéanamh ar fhreagrachtaí an údaráis áitiúil as cosaint an chomhshaoil;
- Caighdeán an uisce óil phoiblí a rialáil agus údaruithe um sceitheadh fuíolluisce uirbigh a fhorfheidhmiú
- Caighdeán an uisce óil phoiblí agus phríobháidigh a mheasúnú agus tuairisciú air;
- Comhordú a dhéanamh ar líonra d'eagraíochtaí seirbhíse poiblí chun tacú le gníomhú i gcoinne coireachta comhshaoil;
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

BAINISTÍOCHT DRAMHAÍOLA AGUS CEIMICEÁIN SA CHOMHSHAOL

- Rialacháin dramhaíola a chur i bhfeidhm agus a fhorfheidhmiú lena n-áirítear saincheisteanna forfheidhmithe náisiúnta;
- Staitisticí dramhaíola náisiúnta a ullmhú agus a fhoilsiú chomh maith leis an bPlean Náisiúnta um Bainistíocht Dramhaíola Guaisí;
- An Clár Náisiúnta um Chosc Dramhaíola a fhorbairt agus a chur i bhfeidhm;
- Reachtaíocht ar rialú ceimiceán sa timpeallacht a chur i bhfeidhm agus tuairisciú ar an reachtaíocht sin.

BAINISTÍOCHT UISCE

- Plé le struchtúir náisiúnta agus réigiúnacha rialachais agus oibriúcháin chun an Chreat-treoir Uisce a chur i bhfeidhm;
- Monatóireacht, measúnú agus tuairisciú a dhéanamh ar chaighdeán aibhneacha, lochanna, uiscí idirchreasa agus cósta, uiscí snámha agus screamhuisce chomh maith le tomhas ar leibhéil uisce agus sreabhadh abhann.

EOLAÍOCHT AERÁIDE & ATHRÚ AERÁIDE

- Fardail agus réamh-mheastacháin a fhoilsiú um astaíochtaí gás ceaptha teasa na hÉireann;
- Rúnaíocht a chur ar fáil don Chomhairle Chomhairleach ar Athrú Aeráide agus tacaíocht a thabhairt don Idirphlé Náisiúnta ar Ghníomhú ar son na hAeráide;
- Tacú le gníomhaíochtaí forbartha Náisiúnta, AE agus NA um Eolaíocht agus Beartas Aeráide.

MONATÓIREACHT AGUS MEASÚNÚ AR AN GCOMHSHAOL

- Córais náisiúnta um monatóireacht an chomhshaoil a cheapadh agus a chur i bhfeidhm: teicneolaíocht, bainistíocht sonraí, anailís agus réamhaisnéisiú;
- Tuairiscí ar Staid Thimpeallacht na hÉireann agus ar Tháscairí a chur ar fáil;
- Monatóireacht a dhéanamh ar chaighdeán an aeir agus Treoir an AE i leith Aeir Ghlain don Eoraip a chur i bhfeidhm chomh maith leis an gCoinbhinsiún ar Aerthruailliú Fadraoin Trasteorann, agus an Treoir i leith na Teorann Náisiúnta Astaíochtaí;
- Maoirseacht a dhéanamh ar chur i bhfeidhm na Treorach i leith Torainn Timpeallachta;
- Measúnú a dhéanamh ar thionchar pleananna agus clár beartaithe ar chomhshaol na hÉireann.

TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Comhordú a dhéanamh ar ghníomhaíochtaí taighde comhshaoil agus iad a mhaoiniú chun brú a aithint, bonn eolais a chur faoin mbeartas agus réitigh a chur ar fáil;
- Comhoibriú le gníomhaíocht náisiúnta agus AE um thaighde comhshaoil.

COSAINT RAIDEOLAÍOCH

- Monatóireacht a dhéanamh ar leibhéil radaíochta agus nochtadh an phobail do radaíocht ianúcháin agus do réimsí leictreamaighnéadacha a mheas;
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha;
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta;
- Sainseirbhísí um chosaint ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

TREOIR, ARDÚ FEASACHTA AGUS FAISNÉIS INROCHTANA

- Tuairisciú, comhairle agus treoir neamhspleách, fianaise-bhunaithe a chur ar fáil don Rialtas, don tionscal agus don phobal ar ábhair maidir le cosaint comhshaoil agus raideolaíoch;
- An nasc idir sláinte agus folláine, an geilleagar agus timpeallacht ghlan a chur chun cinn;
- Feasacht comhshaoil a chur chun cinn lena n-áirítear tacú le hiompraíocht um éifeachtúlacht acmhainní agus aistriú aeráide;
- Tástáil radóin a chur chun cinn i dtithe agus in ionaid oibre agus feabhsúchán a mholadh áit is gá.

COMHPHÁIRTÍOCHT AGUS LÍONRÚ

Oibriú le gníomhaireachtaí idirnáisiúnta agus náisiúnta, údaráis réigiúnacha agus áitiúla, eagraíochtaí neamhrialtais, comhlachtaí ionadaíocha agus ranna rialtais chun cosaint chomhshaoil agus raideolaíoch a chur ar fáil, chomh maith le taighde, comhordú agus cinnteoireacht bunaithe ar an eolaíocht.

BAINISTÍOCHT AGUS STRUCHTÚR NA GNÍOMHAIREACHTA UM CHAOMHNÚ COMHSHAOIL

Tá an GCC á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóir. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inbhunaitheacht i leith Cúrsaí Comhshaoil
- An Oifig Forfheidhmithe i leith Cúrsaí Comhshaoil
- An Oifig um Fhianaise agus Measúnú
- An Oifig um Chosaint ar Radaíocht agus Monatóireacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tugann coistí comhairleacha cabhair don Ghníomhaireacht agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Headquarters

PO Box 3000,
Johnstown Castle Estate,
County Wexford, Ireland

T: +353 53 916 0600
F: +353 53 916 0699
E: info@epa.ie
W: www.epa.ie
LoCall: 0818 33 55 99

Regional Inspectorate

McCumiskey House,
Richview, Clonskeagh Road,
Dublin 14, Ireland

T: +353 1 268 0100
F: +353 1 268 0199

Regional Inspectorate

Inniscarra, Co. Cork,
Ireland

T: +353 21 487 5540
F: +353 21 487 5545

Regional Inspectorate

Seville Lodge, Callan Road,
Kilkenny, Ireland

T: +353 56 779 6700
F: +353 56 779 6798

Regional Inspectorate

John Moore Road, Castlebar,
Co. Mayo, Ireland

T: +353 94 904 8400
F: +353 94 902 1934

Regional Inspectorate

The Glen, Monaghan,
Ireland

T: +353 47 77600
F: +353 47 84987

Regional Offices

The Civic Centre,
Church St, Athlone,
Co. Westmeath, Ireland

T: +353 906 475722

Climate Ireland

EPA headquarters office
PO Box 3000
Environmental Protection Agency
Johnstown Castle Estate
Co. Wexford
Y35 W821
Email: info@epa.ie
www.epa.ie