

ice

Northern Ireland

Connswater Community Greenway.
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Resilient Infrastructure for Northern Ireland

Planning, delivering, operating
and maintaining infrastructure
for our future



Coleraine to Derry/Londonderry Track Relay
© Eoin McConnell

Executive Summary

Collective action and greater collaboration can drive improved resilience for Northern Ireland's infrastructure.

This report examines infrastructure resilience in Northern Ireland, drawing examples from across infrastructure systems, local and global networks, and stakeholders.

The impacts of climate change on infrastructure are highlighted, along with consideration of the impacts yet to come. Consultations were held by the ICE with those working across the infrastructure spectrum - in policy, operation and maintenance, and as end users - to gather evidence and information for this report, along with public polling.

The ICE makes six recommendations for infrastructure policy makers, stakeholders and professionals, to ensure resilient planning, delivery, operation and maintenance of infrastructure for the future:



#1 Establish the priorities

Establish the 'guiding mind' of an independent, expert-led advisory body to develop collective priorities and support decision-making.



#2 Resilience-led decision making

Hard-wire resilience into decision making. Stakeholders must rapidly create climate adaptation and resilience processes.



#3 Co-ordinated investment

Prioritise infrastructure investment for maximum long-term benefits amid climate change and risks. Efficient spending is crucial.



#4 Embrace our strengths

Infrastructure leaders must use the agility offered by our size and scale. There is great potential for collaboration and innovation.



#5 Harness nature

Nature-based solutions bring broader resilience, meeting carbon and biodiversity targets, attracting green finance and public approval.



#6 Think differently; do differently

The future will be different than we thought. Behavioural change is needed.

Foreword

Our infrastructure systems are being **tested more regularly and more deeply**. The need for sustainable, resilient infrastructure solutions that will meet the needs of society and the economy is becoming ever more critical. There are many **interdependencies between infrastructure systems**. These often become most apparent when something goes wrong, though these interdependencies can unlock opportunities - Northern Ireland's uniqueness in size and scale, combined with the way our infrastructure is operated, give us leverage to allow for **greater cooperation and collaboration** in solving the current and future challenges we face.

This paper provides both a status summary and a call to action for those working across the infrastructure spectrum. The report has been developed in close consultation with ICE members and infrastructure stakeholders as well as gathering data from public polling.

The aim of this report is to elevate and prioritise the topic of infrastructure resilience. While the report highlights a number of challenges and barriers to be overcome, the opportunity is clear. The ICE strongly encourages the collaboration of multiple infrastructure stakeholders under a **shared vision**, to support the provision of essential services which will support **economic activity and help communities to flourish**.

The engineers of today and the engineers of the future have an essential role to play in ensuring resilience in the face of uncertainty. However, engineers cannot do this alone. Now, more than ever, we need **collective action** - from government, policy-makers, infrastructure professionals and citizens - that will drive better outcomes for the people of Northern Ireland.

We all need to do things differently and face our new future - but the solutions are out there.

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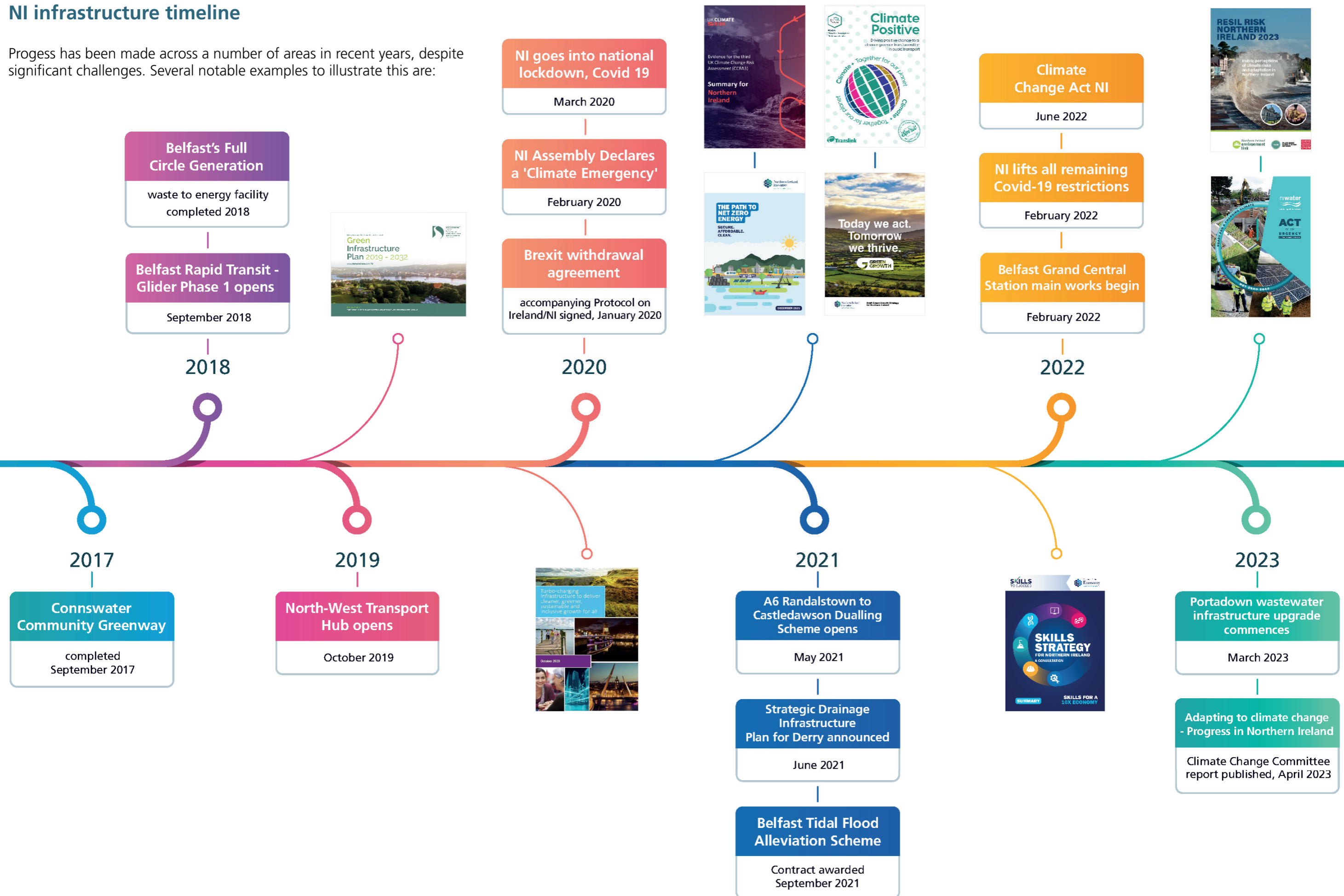
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Water control structure on River Bann at the Cutts, Coleraine

NI infrastructure timeline

Progress has been made across a number of areas in recent years, despite significant challenges. Several notable examples to illustrate this are:



Taking stock

In recent years, we have seen the delivery of a number of key projects and the production of landmark reports and strategies, which serve to highlight the crucial role played by infrastructure in underpinning our ways of life.

The upheaval of extreme weather events have focussed attention on our infrastructure when it is disrupted.

Our society depends on infrastructure, yet collectively we are not doing enough to ensure a resilient future for NI.

We need urgent action.

Nonetheless, we know that progress is being made here around innovation, energy, renewables and understanding current and future weather and climate change risks.

We are working towards our net zero obligations, with Translink set to be net zero by 2040, ahead of government targets. Our consultees highlighted a reduced number of incidents of disruption across our energy networks due to recent adverse weather events than we have seen in the past. Our roll out of full-fibre broadband is ahead of GB³, and the all-island rail strategy looks at medium and long term opportunities around decarbonisation and improved resilience.

In December 2022, the ICE published 'Infrastructure in 2023: A horizon scan of the year ahead for civil engineering'⁴, highlighting pressing needs within infrastructure that apply globally, and can be applied to a local context, covering the range of infrastructure.

Within the context of this report the sections on 'Decarbonisation' and 'Sustainable, resilient infrastructure' are of note, however **with a whole systems view, all of the priority areas for action are necessary in determining infrastructure resilience.**

Concerns over infrastructure resilience in the UK were again raised in the ICE policy statement 'How can the UK's infrastructure system be made more climate resilient?'

The policy position statement finds that 'too little is known about both the condition of existing assets and the performance of the infrastructure system when it comes to climate resilience and adaptation'⁵. Setting out four recommendations for improved infrastructure climate resilience in the UK, the position statement says that:

Policymakers can no longer keep kicking the can down the road when it comes to enacting real change to make the UK's infrastructure system more resilient to the extremes we face both now and in the future.

The scale of the challenge facing us is not to be underestimated – however, by prioritising resilience and adaptation measures we can develop a stronger and more innovative infrastructure system⁶.

UK NIC and CCC call for greater Government action on infrastructure resilience and adaptation to climate change

A recent letter to Whitehall from the chair of the Adaptation Committee of the Climate Change Committee and the chair of the UK National Infrastructure Commission points to a growing need for improving infrastructure resilience and adaptation to climate change. The chairs asked the government to consider five specific steps to close the resilience gap:

- Translate high-level objectives into delivery plans, with clear goals and measurable outcomes for resilience.
- Align policymaking for resilient infrastructure with regulatory cycles.
- Give essential duties to Regulators that presently do not have them.
- Strengthen resilience coordination between infrastructure systems to head-off cascading impacts.
- Embed net zero and climate adaptation in infrastructure planning

What is infrastructure resilience and why does it matter?

Infrastructure resilience is the ability of infrastructure systems to anticipate, resist, absorb, recover, adapt, and transform in the face of short-term shocks and long-term stresses⁸. This ability extends across the infrastructure system, beyond physical assets, to include people, nature, processes, decision making, governance, supply chains and more.

We are heavily reliant on infrastructure services and provision. **Our infrastructure supports our communities, our economy and our essential services; it connects with the natural environment, and it connects us as people** – we cannot afford for it not to be resilient. Our infrastructure networks are increasingly interconnected and interdependent - a growing trend as we pursue ambitious goals towards:

- innovative, inclusive and green growth⁹.
- renewable energy targets¹⁰.
- forthcoming climate action plan¹¹.
- outcomes of the draft infrastructure investment strategy review¹².

Growing demand is placing infrastructure systems under pressure, while their fragility has increased due to siloed responsibilities and the legacy of underinvestment¹³.

At the same time, these systems are required to operate in an increasingly volatile and uncertain world. The challenges of adapting to a changing climate and a rapidly evolving security and risk landscape requires **greater infrastructure resilience**. With our *system of systems* operation, **impacts on one infrastructure system or asset type can cascade across the wider system**, affecting connected infrastructure, assets, and the communities they support.

Disruption to the electricity grid could impact a rail network, a road network or a hospital, for example. A washed-out bridge or damaged road could disconnect communities from essential services, places of employment and education, disrupting daily life and local economies. At a global level, the quality of infrastructure provision supports the majority of the UN Sustainable Development Goals (SDGs), such as SDG7 Affordable and Clean Energy, or SDG11 Sustainable Cities and Communities, with SDG9 explicitly mentioning the need for resilient infrastructure¹⁴.

We need to be resilient to the changing climate, but infrastructure resilience is not only about climate change...

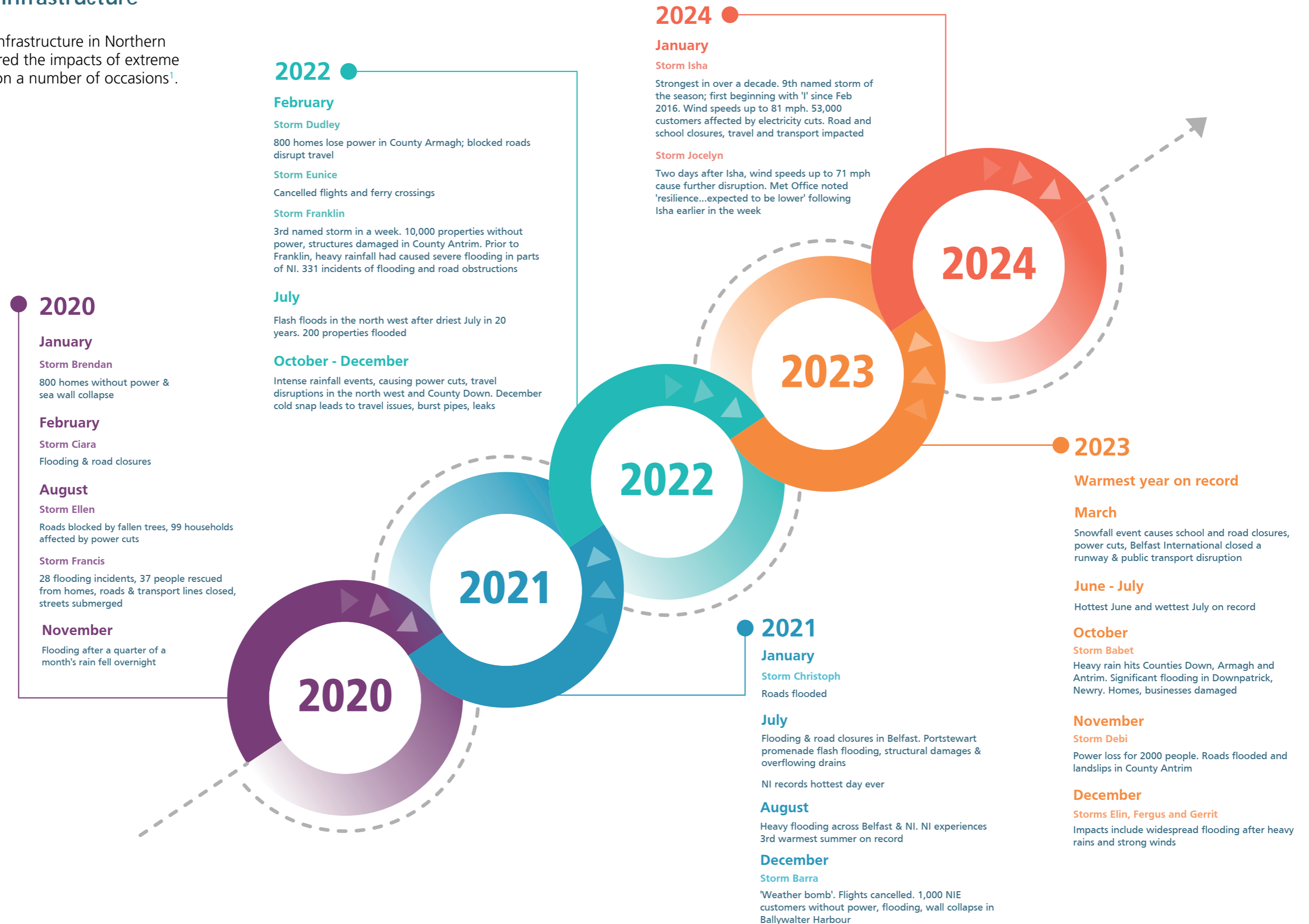
Cyber security is a growing area of risk for infrastructure owners and operators, particularly as digitalisation increases. In 2017, the former CEO of the National Cyber Security Centre, Ciaran Martin, revealed that infrastructure in NI had been hit by significant attacks from hostile nations¹⁵. Electricity supplies have been targeted by hackers¹⁶, as have charities¹⁷ and the health service's IT provider¹⁸. The UK Government announced that it will invest £18.9 million into NI's cyber security industry¹⁹- as such, this is an area of opportunity for resilience in NI.

Underfunding for infrastructure is significantly diminishing our ability to provide resilient services. The Northern Ireland Water strategy for the 2021–2046 period endorses the need for NI to face up to the impacts of climate change but acknowledges that the infrastructure community faces significant barriers to implementation of the necessary mitigation measures.

A key statement in the strategy highlighted that: *Underfunding of our PC15 business plan 2015-21 (£990m actual versus £1.7bn required) has already resulted in curbs to economic development with new housing and businesses being unable to get connected to our sewerage system in over 100 towns across the province. Indeed, the growth of Belfast City, the primary economic engine of Northern Ireland will stall unless the £1bn investment in strategic drainage, under the Living with Water Programme, is supported. The City Deal risks not realising its full potential, as do the other local council development plans²⁰.*

Impacts on infrastructure

In recent years, infrastructure in Northern Ireland has suffered the impacts of extreme weather events on a number of occasions¹.



Managing impacts: What a changing climate case means for infrastructure

Climate change and the associated changes in the frequency and severity of extreme weather events is already impacting – and will continue to impact – the performance of infrastructure and services. The main climate risks likely to have a significant impact on NI infrastructure and requiring action, according to the 2021 Climate Change Risk Assessment²¹, are:

- Cascading failures in networks such as water, energy, transport and ICT
- Effect on services from river, surface water and groundwater flooding
- Transport disruption from high and low temperatures, high winds, lightning
- Coastal change from erosion, flooding and extreme weather events impacting business locations and infrastructure.

There is a growing body of guidance aimed at helping governments, planners, designers, owners and operators to adapt and improve resilience to climate change. Infrastructure Pathways²² is a good example, along with the European Commission technical guidance on the climate proofing of infrastructure in the period 2021-2027 which provides guidance on both mitigation and adaptation²³, and the Principles for Resilient Infrastructure, published by the United Nations Office for Disaster Risk Reduction²⁴. Locally, Climate NI has developed the NI Adapts Planning Toolkit, which provides the guidance, information, and resources needed to complete the five stages of the 'NI Adaptation Planning Cycle' and develop a first climate change adaptation plan²⁵.



Normal water levels at the Silent Valley reservoir, County Down
Image courtesy of Northern Ireland Water



Low water levels at the Silent Valley reservoir, County Down in May 2020
Image courtesy of Northern Ireland Water

A holistic approach: we need resilient and net zero infrastructure solutions

Focusing on the future resilience of our infrastructure is not enough: we need to achieve this while supporting our efforts to reach net zero targets²⁶. **Achieving net zero carbon emissions is the necessary pathway to limit the worst impacts of climate change yet to come.**

As we rapidly design out the embedded and operational emissions generated from infrastructure that are fuelling the climate crisis, **we need infrastructure systems that are equipped to handle a range of shocks and stresses** in the short, medium and long term.

The draft Infrastructure 2050 Investment Strategy, published in January 2022²⁷, articulates this through five priority areas for investment:

- Decarbonise our economy and society
- Strengthen our essential services
- Enhance our communities and places
- Build a strong, connected and competitive region
- Maximise benefits from new technology and innovation.

The Climate Change Act (Northern Ireland), enacted in June 2022, has injected a sense of urgency in how we approach, plan and fund the decarbonisation of infrastructure, with strategies and plans being developed across infrastructure sectors.

'The Power of Water'²⁸ from Northern Ireland Water and 'Better. Connected'²⁹ from Translink are good examples of first steps within NI infrastructure. The new PAS 2080 global standard framework for managing infrastructure carbon places greater emphasis on whole life carbon while aligning more strongly with the transition to a net zero carbon economy by 2050³⁰.

As noted in the IPCC Climate Change 2023 Synthesis Report ...

Deep, rapid, and sustained mitigation and accelerated implementation of adaptation actions in this decade would reduce future losses and damages related to climate change for humans and ecosystems (very high confidence). As adaptation options often have long implementation times, accelerated implementation of adaptation in this decade is important to close adaptation gaps (high confidence). Comprehensive, effective, and innovative responses integrating adaptation and mitigation can harness synergies and reduce trade-offs between adaptation and mitigation (high confidence)³¹.



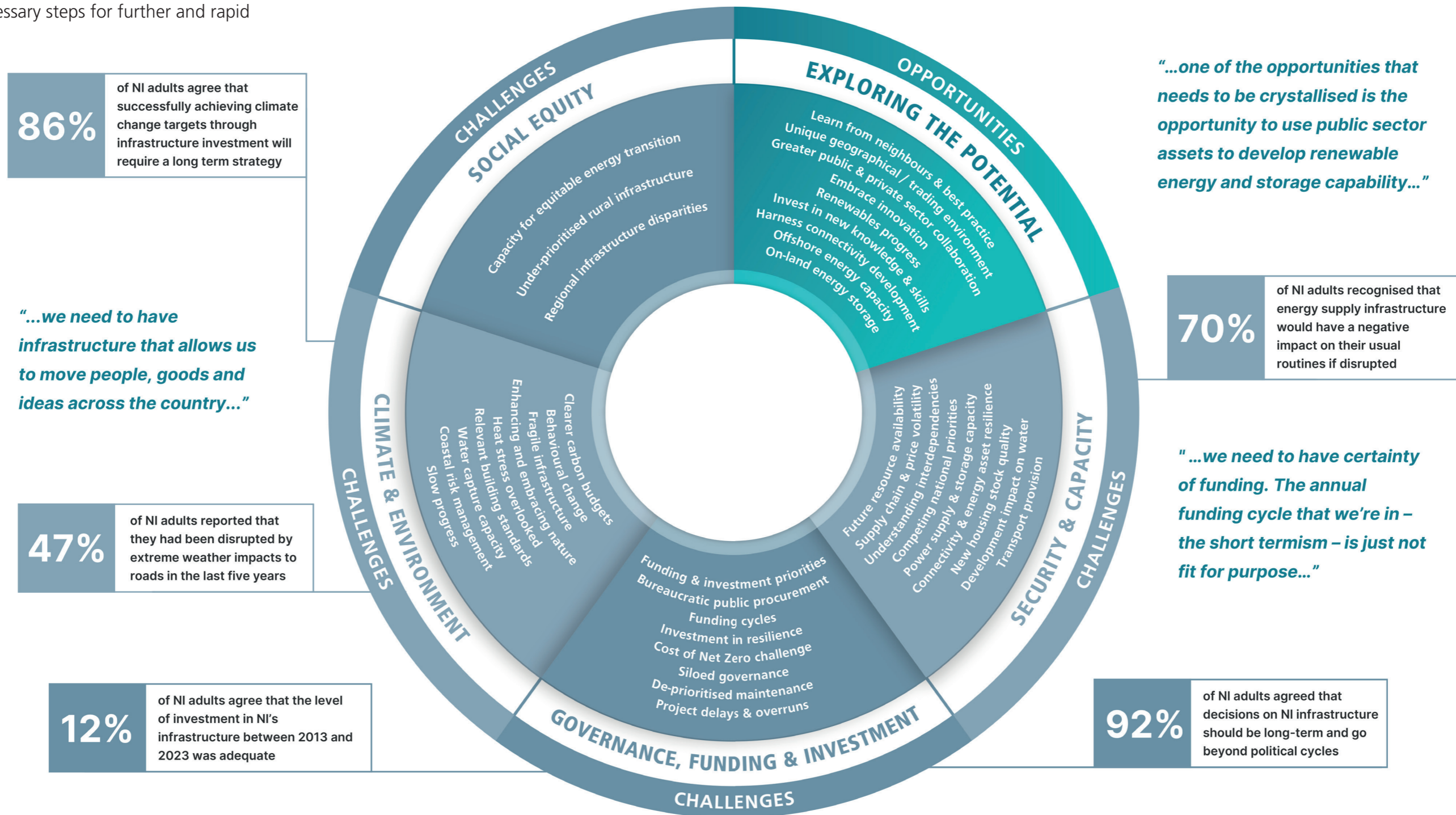
Storm impact, Downshire (Larne railway line)
Image courtesy of Translink

Insights from our consultees: Expert discussions and YouGov public polling*

In 2023, the ICE engaged with over 50 consultees working across the infrastructure spectrum, from policy to operation and maintenance as well as end users. There is a wealth of expertise here already, excellent work being undertaken and a collective will to take the necessary steps for further and rapid progress.

The message is clear, for infrastructure to be resilient, we must re-prioritise, and to a degree, re-organise. Our processes need to enhance, not hinder, our ability to be resilient. There is an opportunity now to address these challenges in pursuit of a more resilient Northern Ireland.

“...there is a uniqueness of size and scale...”



*Survey conducted by the YouGov analysis institute, 27-31 July 2023. Total sample size was 502 adults. The figures have been weighted and are representative of all Northern Ireland adults (aged 18+)

Examples of adaptation and resilience

There are examples of adaptation and resilience already at work both locally and around the world. The following are included as a small selection of what is achievable, to show what clients and designers need to do more of and to give encouragement.

Belfast Resilience Strategy

Following a city resilience assessment, in December 2020 Belfast released its Resilience Ambitions document – acting as its first climate plan. Setting out 30 transformational programmes as decade-long interventions, the ambitions set a background for long-term planning for the city.

The assessment identified a wide range of shocks and stresses, raising awareness of existing and emerging risks. It flagged up the capacity of the city's infrastructure as a top priority shock.

Infrastructure is interwoven with many of the 30 transformational programmes for Belfast. For some of them, **resilient infrastructure will be critical to their delivery**. Resilient, coordinated infrastructure will explicitly benefit these programmes:

- 10 – Local Development Plan: a Critical Lever for Resilience
- 18 – Public Transport
- 19 – Sustainable Drainage
- 20 – A Zero Emissions city bus fleet by 2030
- 23 – Electric vehicle infrastructure
- 25 – Developing a Hydrogen Eco System
- 30 – Fuel Poverty.

Programme 1, 'New city-wide structures to collaborate on climate action', which sets up two permanent structures to drive partnership and collaboration, is a good example of how establishing spaces for collective action to tackle major challenges is an important step in finding solutions³⁶.



M1 Westlink Motorway.
© Andrew Hazard Photography & Design.



New Zealand Wellbeing Budget

New Zealand's recovery from Cyclone Gabrielle

Shortly after the New Zealand Infrastructure Commission released their 2022-2052 infrastructure strategy³⁷, New Zealand was hit by mass flooding and disruption brought about by Cyclone Gabrielle. Post-cyclone recovery measures are ongoing, and lives and infrastructure are still impacted more than one year on, raising questions about the resilience of the country's infrastructure.³⁸.

The Wellbeing Budget 2023 recognises the fragility of New Zealand's infrastructure, as demonstrated by Cyclone Gabrielle, and commits funding for greater resilience, starting with an initial 6 billion NZD investment in cyclone rebuild, and a new figure of 71 billion NZD committed over the next 5 years to infrastructure investment, including the first phase of a National Resilience Plan³⁹.

Actions are also included in New Zealand's Infrastructure Action Plan⁴⁰ which address climate resilience, long-term planning and strengthened investment and decision-making. Across both strategies there is recognition that **long-term investment allows for long-term planning**, with ambitions for clear programmes of work to give clarity to the infrastructure sector. As the New Zealand Lifelines Council makes clear, despite enthusiasm and investment in infrastructure resilience, particularly critical infrastructure, problems remain in New Zealand.⁴¹ Investment may not be a fix all and importantly the Government is taking steps to improve infrastructure resilience.

Connswater Community Greenway

The Connswater Community Greenway is an urban regeneration project that is transforming East Belfast by combining improved flood protection with the creation of public spaces and pedestrian-cycle routes that connect communities.

The Greenway is designed to play a central role in the East Belfast Flood Alleviation Scheme, protecting 40,000 residents⁴².

Connswater is an example of the role nature can play in infrastructure resilience to climate change, but also of the additional co-benefits to society that can be delivered through infrastructure planning. **Well thought out infrastructure can do more than have a singular purpose or function.**



Connswater Community Greenway.
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Where now? Recommendations for planning, delivering, operating and maintaining infrastructure for the future

The message is clear, there is a lot to do, and action must be accelerated - across all sectors and at all stages of the infrastructure life cycle. Our consultees told us unequivocally, the current 'patch and repair' or 'sticking plaster' approach to infrastructure is not serving us well. The conclusions of this report have been organised into six recommendations which cover **equipping society for the future** in terms of foundational needs and adopting new ways of thinking, doing and working together to improve infrastructure resilience.



#1 Establish the priorities

A guiding mind is needed. Collaboration is the key to resilience. Nonetheless, a degree of governance - a 'guiding mind' - will provide the enabling environment for cross-sector action. Establishing an independent and expert advisory body, comparable to Infrastructure Commissions and similar bodies in other jurisdictions, would be a positive step. Through this, **a collective set of priorities to deliver resilient infrastructure could be established.** This would provide the right body and governance to support the initiation of resilience projects. Its expertise could help analysis and provide support where difficult decisions must be made, particularly where there are compelling and competing priorities. An independent Infrastructure Commission could instigate a **full infrastructure assessment** to determine the starting point against a number of key factors and to support prioritisation.

The expert body could also act as a single source of truth for the configuration of our infrastructure systems, to understand collective risks and the potential for cascading failure. This would further **enable prioritised investment and policy focus** to feed into an infrastructure strategy.

This would facilitate the determination of where, at critical points, investing in certain assets or networks greatly benefits the forward-planning and development of others, such as renewable energy supply versus storage capacity. The ICE notes the previous commitment by the Executive to establishing an Infrastructure Commission, and believes there remains significant value in progressing such a body. This is particularly important given the likely continued constraint on the public purse and the additional risk that inflationary pressures may remain for some time.



#2 Resilience-led decision making

Infrastructure stakeholders need to rapidly and effectively develop processes for climate adaptation and resilience, learning from other countries. Existing knowledge and understanding of climate risk should be accessible, and importantly, understood by key-decision makers. **Adaptation measures should be planned at sector or system levels, rather than for individual assets.**



#3 Co-ordinated investment

Since infrastructure underpins most of what society needs to function, it is important to prioritise investment. This will **provide maximum long-term benefits, whether in good times or bad.** Climate change and other risks will lead to increased costs, whether through proactive or reactive action, and preparedness will minimise the impacts.

Government departments will need to make the best use of constrained budget and spend public money wisely.

A joined-up approach remains essential to this end - engagement with consultees in preparing this report has made it clear, in no uncertain terms, that the annual funding cycles currently used 'are simply not fit for purpose'. Funding levels must also be adequate to meet longer-term resilience planning and future infrastructure needs, as well as providing for current requirements.

Political leaders must also appreciate and commit to investing in society's future, and that of the coming generations, through the infrastructure being maintained, planned, built and delivered now, and also through the training and development pathways offered. There are many more challenges yet to come and the next generation must be equipped to face them - not just to survive, but to thrive.



#4 Embrace our strengths

Infrastructure leaders, from clients to engineers, must celebrate and make use of the agility provided by Northern Ireland's size and scale. As one consultee for this report put it, 'we all know each other' and the importance of this should not be underestimated. There is **great potential for collaboration, innovation and co-creation.**

All consultees were enthusiastic about working together to improve infrastructure resilience and yield shared value from these efforts.



#5 Harness nature

Nature based solutions and a nature positive approach to addressing climate and other risks **can bring physical, environmental, and social resilience dividends.** Conversely, leaving nature out of the equation, or worse, continuing to damage and degrade our precious eco-systems on land, and in water is taking us dangerously close to reaching tipping points.

Utilising natural or green infrastructure in projects can assist in meeting targets for carbon and biodiversity, attract green finance investment and improve public perception of infrastructure projects. Policy makers must adapt to drive a nature-positive approach and ensure this is prioritised by those designing and developing projects.



#6 Think differently; do differently

Engineers are vital to infrastructure resilience and have a significant role to play in creating and designing the solutions to deliver it. They should be encouraged to test innovative solutions, to deliver resilience best practice and play a critical role in **establishing a new direction for infrastructure resilience.** However, engineers must recognise that the future is going to be different from anticipated and change is needed - engineers must innovate harder, think creatively and reject the status quo.

If behaviours are to change, from government decision makers to the public, engineers must provide the solutions to enable this, from safe spaces for active travel to systemic catchment scale nature-based interventions for resilience.

Conclusions

To ensure we have resilient infrastructure, fit to face the challenges of the future, we must establish priorities and hard-wire resilience into decisions.

Resources are scarce, so there is a need for smart thinking - but there is strength and depth in the expertise of our stakeholders, policy-makers and infrastructure professionals.

Opportunities must be taken now to avoid significant penalties later – penalties which could have a profound effect on the way we live and work every day.

The messaging from our consultations and research is clear – the time to act is now.



Flooded dwelling due to high water levels in the Lough Neagh catchment

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About this report

This report has been prepared for the Institution of Civil Engineers Northern Ireland (ICE NI) by Arup. Consultations were held and facilitated by ICE with key infrastructure representatives across NI, supported by a survey of ICE members and a YouGov public poll.

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Construction Employers Federation	Federation of Master Builders	Northern Ireland Local Government Association	Translink

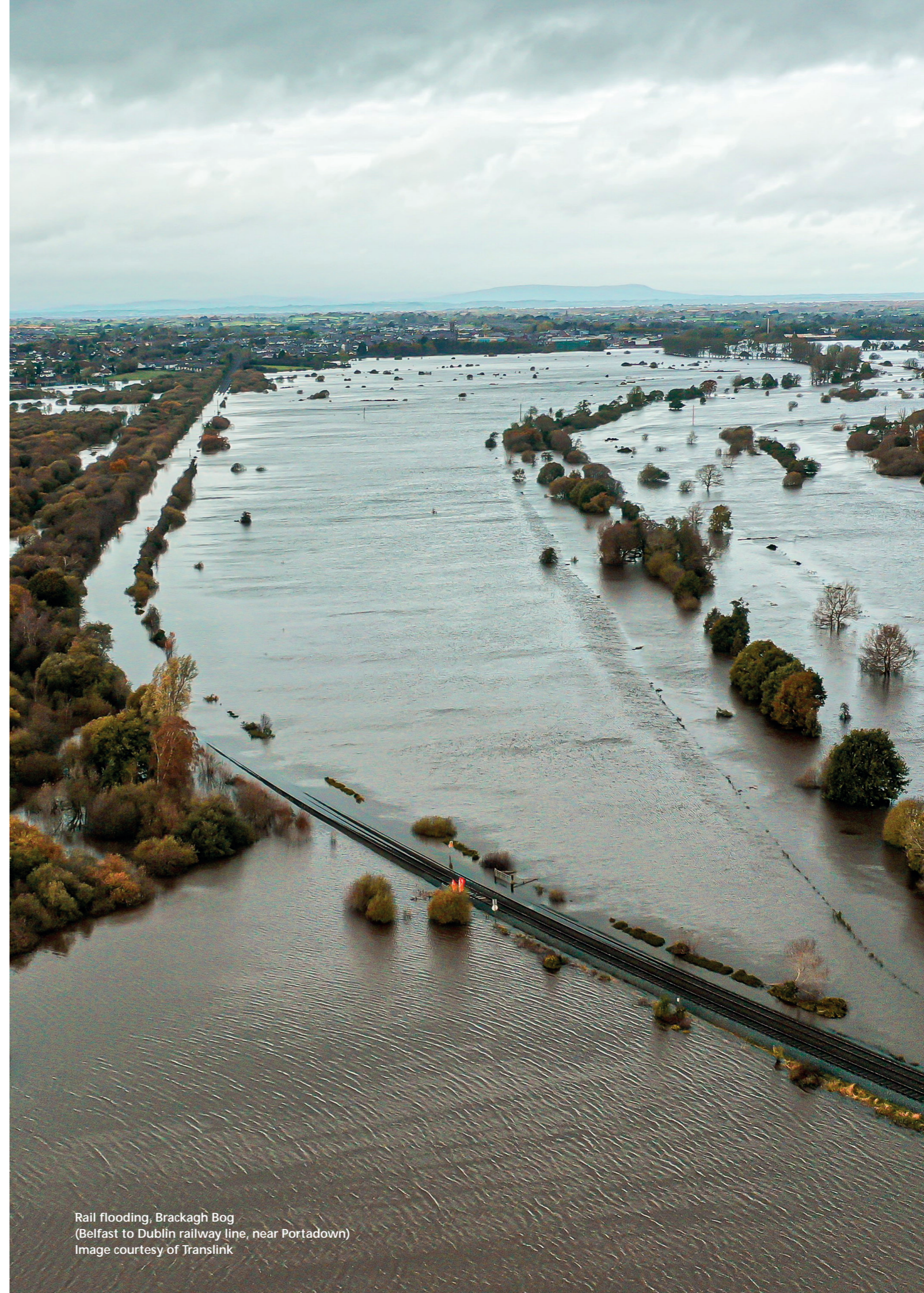
With thanks to the ICE NI members who provided valuable insight through our survey on Infrastructure Resilience.



The Institution of Civil Engineers (ICE) is a 97,000-strong global membership organisation with over 200 years of history, and representing around 2,500 members across Northern Ireland. It is a centre of engineering excellence, qualifying engineers and helping them maintain lifelong competence, assuring society that the infrastructure they create is safe, dependable and well designed. Its network of experts offers trusted, impartial advice to politicians and decision makers on how to build and adapt infrastructure to create a more sustainable world.

ARUP

Dedicated to sustainable development, Arup is a collective of engineers and designers, consultants and experts working globally. Founded to be humane and excellent, we collaborate with our clients and partners using imagination, technology and rigour to shape a better world. With a deep understanding of Northern Ireland and the people living and working here, we work closely with government departments, local authorities, communities, developers and investors to support sustainable development, collaborating to create a more resilient future for the region.



Rail flooding, Brackagh Bog
(Belfast to Dublin railway line, near Portadown)
Image courtesy of Translink

