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Introduction

Transport Infrastructure Ireland (TII) oversees approximately 5,300 km of national roads, a network representing just 5% of Ireland's total road length yet carrying over 50% of national traffic and 80–90% of goods transport. This critical role makes the network highly vulnerable to increasing climate-related hazards such as flooding, landslides, and severe storms.

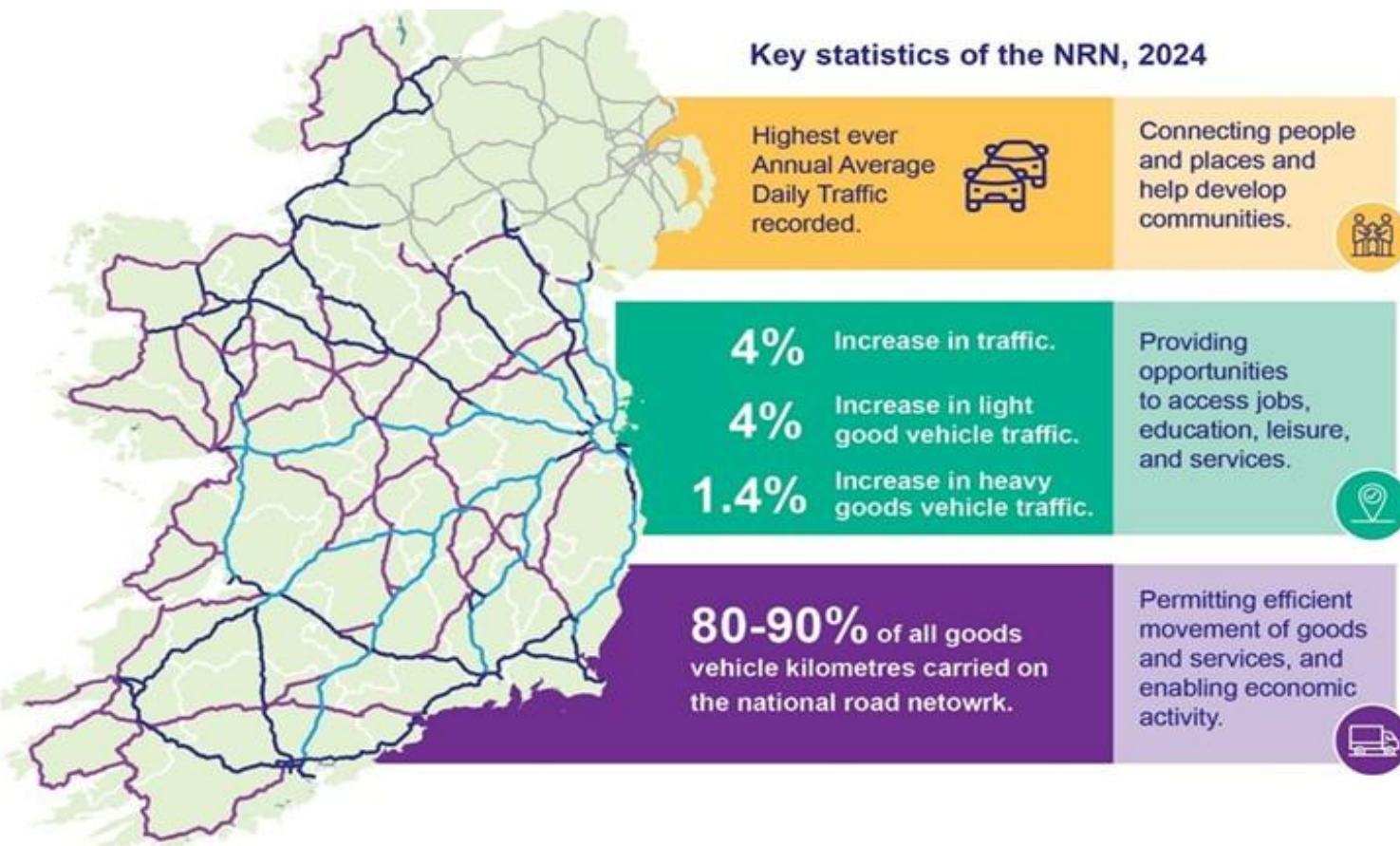


Fig 1: Statistics from the National Roads network

International practice has converged on structured, staged approaches to vulnerability and risk assessment. Frameworks such as the U.S. Federal Highway Administration's Adaptation Framework and the CEDR-led ICARUS project emphasise identifying climate stressors, mapping exposure, evaluating asset sensitivity, and prioritising interventions according to risk, criticality, and adaptive capacity. These methods enable agencies to take early, low-cost resilience actions such as drainage improvements while more detailed modelling progresses.

TII's evolving framework reflects these international best practices by prioritising pragmatic early interventions while enabling continuous refinement.

This approach provides a scalable and evidence-based model for enhancing the climate resilience of Ireland's national road network.

TII's Approach to Climate Adaptation

TII aims to make infrastructure more resilient before, during and after extreme weather events. In 2022, TII published a six-stage approach setting out the strategy towards adapting the national road network through a changing climate.

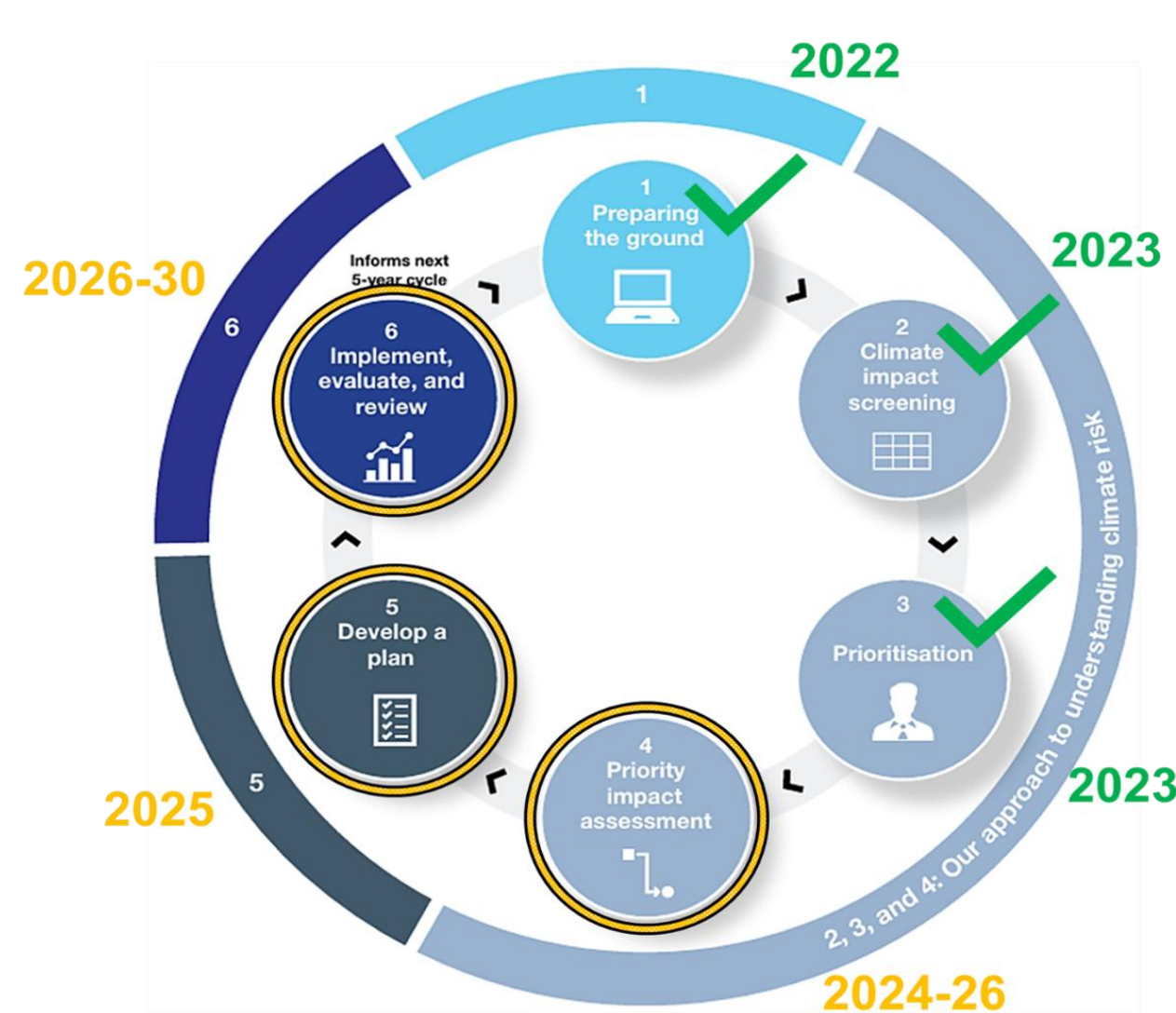


Fig 2: TII's climate adaptation approach

TII's Climate Adaptation Strategy (2022) has the following seven strategic objectives:

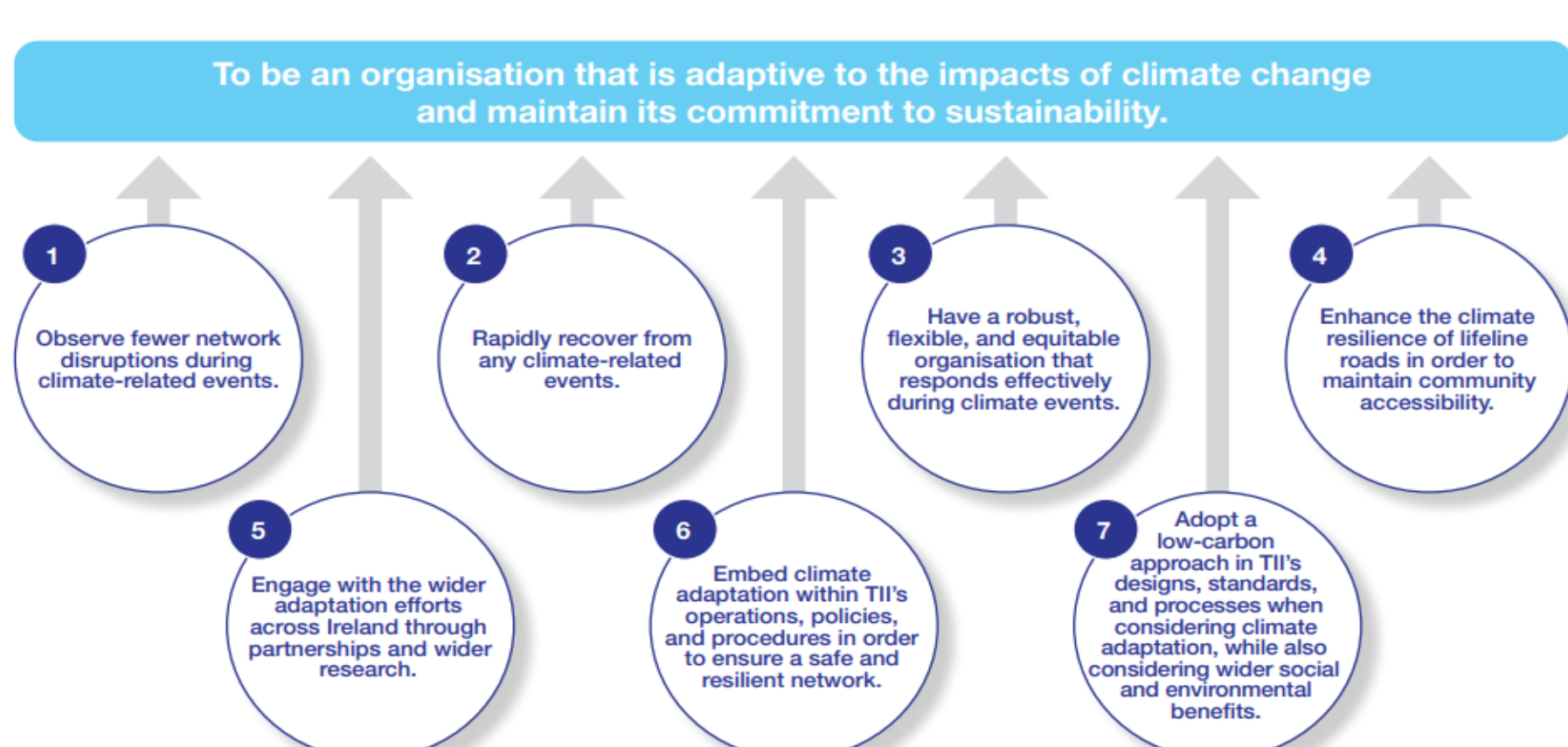


Fig 3: TII's Strategic Objectives

Climate Adaptation Implementation Plan 2026-2030

TII's CAIP outlines the measures for implementation between 2026 and 2030. A total of twenty measures has been set out in the Plan. The type of measures varies to include operational, technological, and policy-based activities. The CAIP aims to focus on:

- Identifying asset locations on the National Roads network that are at risk and vulnerable to climate hazards.
- Developing a programme of proposed measures that will be implemented throughout and beyond the lifetime of the CAIP.
- Improving organisational climate adaptation literacy.
- Establishing and/or strengthening relationships with external stakeholders in the delivery of climate adaptation solutions.

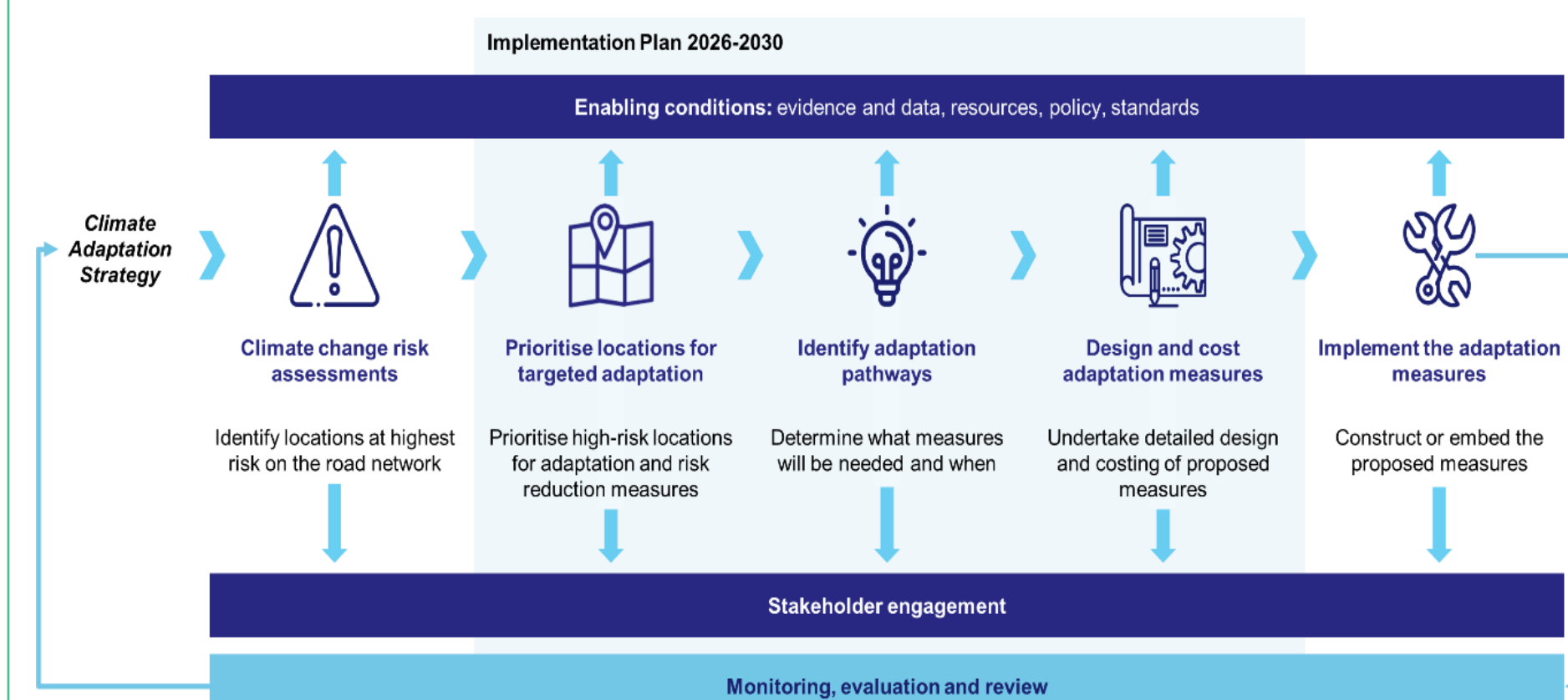


Fig 4: TII's climate adaptation approach on the National Roads network

Flood Analysis Tool

TII acknowledges increased precipitation, flooding and slope failures are the principal climate-related hazards experienced on road infrastructure in Ireland. Thus, these are the immediate hazards that will be explored during the lifetime of the 2026-2030 CAIP.

A Geographic Information System (GIS) driven tool is being developed by TII to identify sections of the road network that are exposed to flooding. This Flood Analysis Tool (the Tool) adopts a vulnerability modelling approach. The Tool merges future flood scenarios with historical flood records, asset information and the economic criticality of the asset.

The Tool adopted the RCP 4.5 (mid-range/'best estimate') and RCP 8.5 (high-end/'business-as-usual') climate scenarios, with analysis focusing on 10-20 year return periods for recurring risks and 100-200 year return periods for more extreme flood events.

The following data sets were integrated into the Flood Analysis Tool:

- An Asset Inventory of the National Roads network assets
- Office of Public Works (OPW) Catchment Flood Risk Assessment and Management (CFRAM) and National Indicative Fluvial Mapping (NIFM)
- OPW's National Coastal Flood Hazard Mapping (NCFHM)
- Met Éireann TRANSLATE 24-Hour Daily Rainfall
- Historical flood event data
- Criticality ratings
- Lifeline roads

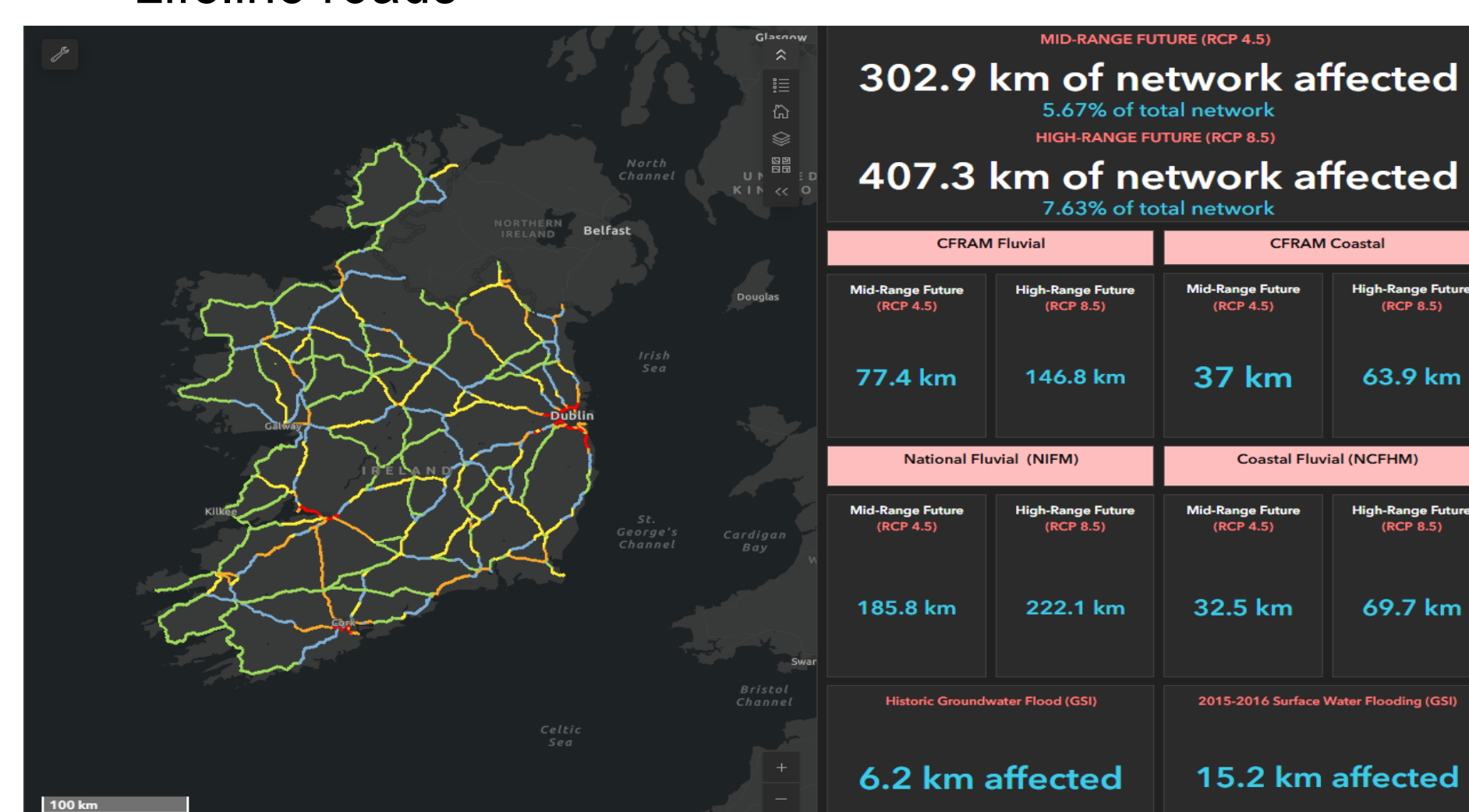


Fig 5: TII's Flood Analysis Tool

Vulnerability Risk Assessment

The tool uses this vulnerability modelling approach which aligns with international best practice and integrates with the conceptual risk assessment framework as set out by the Intergovernmental Panel on Climate Change (IPCC). The vulnerability process is broken down as follows:

1. Define Objectives and Scope
2. Assemble and Integrate Data
3. Assess Exposure
4. Assess System Sensitivity
5. Characterise Adaptive Capacity
6. Determine Vulnerability
7. Prioritise Assets and Identify Adaptation Options
8. Develop Implementation Strategy
9. Integrate Results into Decision-Making

The following table presents the output of the Flood Analysis Tool. Currently over 300 to 400 kilometers of the National Roads network is exposed to RCP 4.5 and RCP 8.5 future flooding scenarios, respectively

	RCP 4.5	RCP 8.5	RCP 4.5 that have previous Historic Flood Events	RCP 8.5 that have previous Historic Flood Events
Exposed to Future Flood Events	301 km	406 km	53 km	69 km
Exposed to Future Flood Events on Tier 1 & Tier 2 criticality segments of the Network	45 km	67 km	10 km	15 km
Exposed to Future Flood Events on Tier 1 criticality segments of the Network	12 km	18 km	2 km	3 km
Lifeline Routes: Exposed to Future Flood Events	46 km	59 km	8 km	10 km

Fig 6: TII's Flood Analysis Tool outputs

Conclusions

TII's CAIP applies a vulnerability risk-based framework to assess road assets' exposure, network criticality, sensitivity, and resilience capacity to climate hazards. The Flood Analysis Tool has been developed to consolidate available data and support the prioritisation of locations for detailed risk assessment. This Tool will continue to evolve as new data becomes available, enabling the inclusion of additional climate hazards.

TII will adopt a Dynamic Adaptive Policy Pathways (DAPP) approach to support flexible decision-making. DAPP includes the identification of 'tipping points' that signal when further adaptation measures should be implemented

TII's CAIP aims to transition from a reactive to a proactive approach in managing disruptive weather events. TII has decoupled the initial CAIP from the full assessment framework, allowing the plan's development to proceed using known vulnerabilities while the broader framework is developed and refined.

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