DISCOVER

NTRO

We drive innovation

We deliver solutions

Our Stakeholders

Road, rail, ports, or airports, whether it's public, private, or active transport, people or freight, the vehicles themselves or the infrastructure our transport system runs on, we get people and things where they're going as efficiently as possible by providing and advising on integrated transport solutions.

Since 1960, the NTRO has been the source of independent expert transport knowledge, advising key decision makers on our nation's most critical challenges. Today, our vision is to deliver an integrated mobility future that is safe, sustainable, and a driver of economic well-being.

Our global network

We are a member of the group of seven Global Research Laboratory Organisations and maintain active partnerships with each of our associates. The United Kingdom's Transport Research Laboratories (TRL), Germany's BASt, India's Central Road Research Institute (CRRI), Sweden's National Road and Transport Research Institute (VTI), China's Research Institute of Highways (RIOH), and the USA's Transport Research Board (TRB) (FHWA).

We maintain certification in ISO 9001:2015 (Quality), ISO 45001:2018 (Occupational Health and Safety), and NATA-accreditation to ISO/IEC 17025.

NTRO maintains certification to both ISO and NATA standards.

Solutions

We deliver integrated transport solutions today, so our clients are ready for tomorrow.

NTRO

ROAD **RAIL** **PORTS** **AIRPORTS**

Asset Performance & Structures	Infrastructure Measurement	Safer Smarter Infrastructure	Sustainability and Materials Performance	Training and Certification	Data and Technology	Transport Futures

Bridgetown, WA
Source The Australian

Source: Department of Fire and Emergency Services, Western Australia

Planning for Resilience

- Road hierarchies, design lives and durability designs are examples of planned resilience

- Key parameters **will change:** the **frequency**, **magnitude** and **intensity** of events may not be known

- Historical observations are **insufficient** for future planning

- Resilience planning must address **chronic** changes, as well as **shock** events

- May extend to non-climate disruptions
(shifts in traffic modes, vehicle types, logistics, and technology etc.)

Higher temperatures

More frequent hot days

Warmer and more acidic ocean

More frequent sea level extremes

Harsher fire weather

More drought

More intense rainfall events

Fewer frosts

Rising sea level

Resilience:

The ability to subsist under changing and challenging circumstance

Durability	Robustness	Reliability
The ability to withstand **wear** over time	The ability to withstand **damage** during **severe** events	The degree of **confidence** attributed to **expected performance**

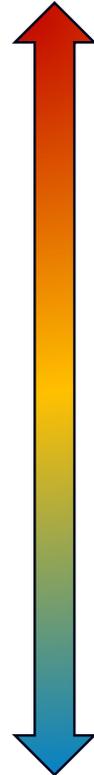| Serviceability	Adaptability	Redundancy
The ability to provide useful **function** under various conditions	Capable of being **readily changed**	Low or **negligible impact** if an asset **stops** providing function

Components of a resilience plan

Criticality

Vulnerability

Adaptation
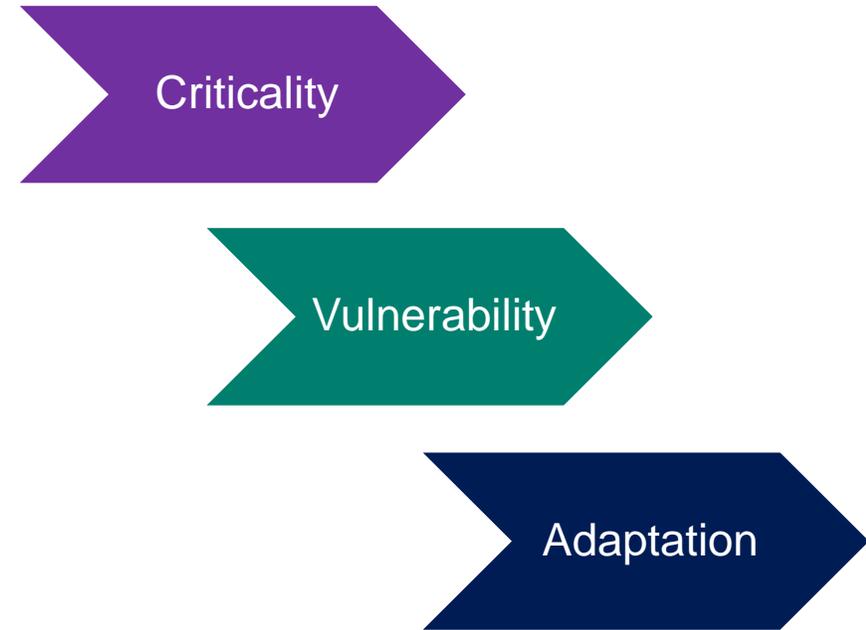
Levels of Service (criticality)

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Required level of service for **shock** events

Functional during an event
- Ensure **robust** design, with active backups

Functional after an event
- Plan short-term redundancies during event
- Design for rapid return-to-service

Disruptions are tolerable
- Assess, repair and maintain post-event
- Design to limit damage

Non-critical asset
- Plan to assess, repair and maintain post-event, though extended down-time is possible
- Employs standard design and minimal engineering (design to code)
- Future decommissioning may be an option

Community Safety

Financially responsible

Acceptable community service

Productive operations and maintenance

Vulnerability assessment

Cover range of **likely**, **possible** and **perfect storm** events

Address **reliability** / **uncertainty** of assessment

Proposed methods for measurement / **monitoring**
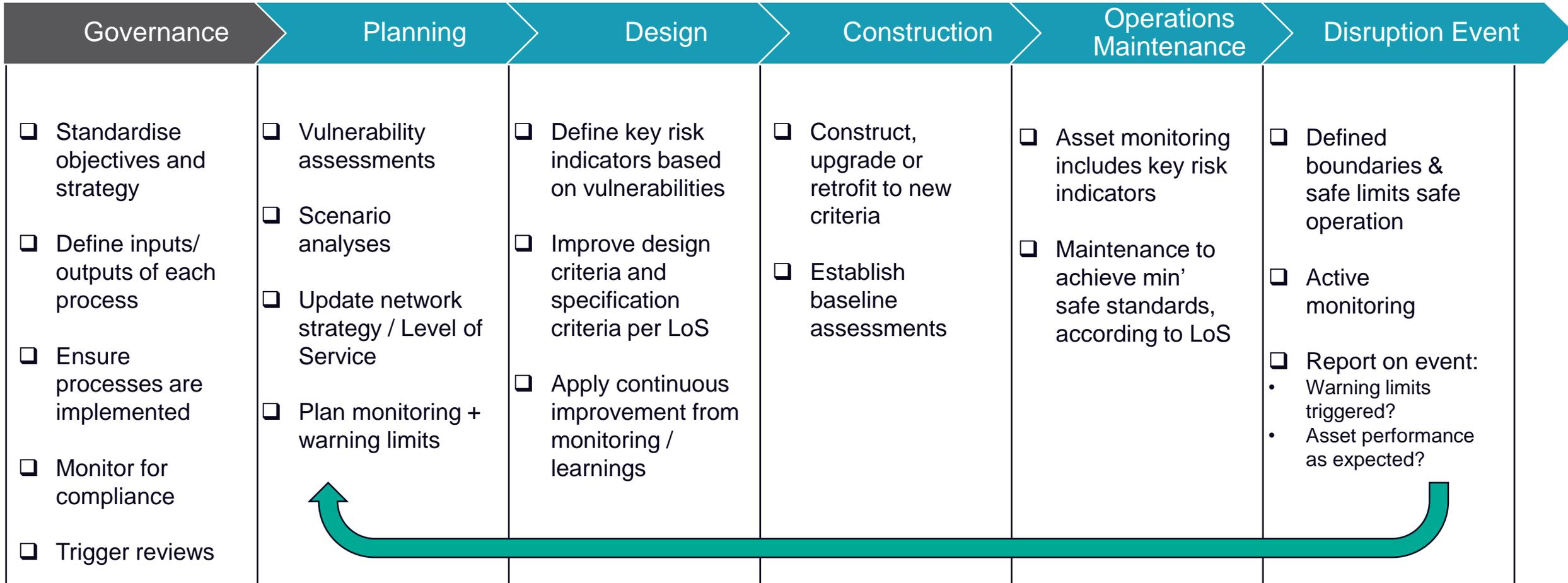
Planning for Adaptation

Conduct **scenario analyses** (if this, then that) in order to:

1. Establish **design/planning** criteria

2. Establish **warning and intervention** limits for key **risk indicators**

3. **'Plan to update the plan'** if disruption-event conditions – or asset responses are unexpected.

Scenario assessments should consider a range of plausible conditions, up to and including 'perfect storm' events

Resilience Plan

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Governance	Planning	Design	Construction	Operations Maintenance	Disruption Event
❑ Standardise objectives and strategy	❑ Vulnerability assessments	❑ Define key risk indicators based on vulnerabilities	❑ Construct, upgrade or retrofit to new criteria	❑ Asset monitoring includes key risk indicators	❑ Defined boundaries & safe limits safe operation
❑ Define inputs/ outputs of each process	❑ Scenario analyses	❑ Improve design criteria and specification criteria per LoS	❑ Establish baseline assessments	❑ Maintenance to achieve min' safe standards, according to LoS	❑ Active monitoring
❑ Ensure processes are implemented	❑ Update network strategy / Level of Service	❑ Apply continuous improvement from monitoring / learnings			❑ Report on event: • Warning limits triggered? • Asset performance as expected?
❑ Monitor for compliance	❑ Plan monitoring + warning limits				
❑ Trigger reviews					

Resilience solutions

NTRO provides a range of resilience solutions, including:

1. Climate change risk assessments

2. Evidence-based weather impacts on the transport network

3. Future-proofing the network to withstand unplanned events

4. Investigating the use of materials that increase the climate resilience of infrastructure

Risk Assessment ①

Impact Measurement ②

Resilience Planning ③

Material Science ④

Transport Decarbonisation

Transport and Infrastructure Net Zero Roadmap and Action Plan

Transport Sector Plan

September 2025

Key priority actions:

1. Invest in enabling low and zero emissions transport infrastructure

2. Electrify and increase transport's energy performance

3. Switch to low carbon liquid fuel (LCLF) alternatives

4. Innovate to expand cost competitive transport technologies

5. Reduce embodied emissions in transport infrastructure

Low and zero emissions transport infrastructure - materials

Concrete

Business as usual:
- Fly ash
- Slag

Some adoption:
- Glass
- Slag aggregates
- Plastics

Future:
- Calcined clay
- Lithium mining by-products
- Bottom ash

Granular

Business as usual:
- Marginal materials
- Crushed concrete
- Crushed brick
- Glass

Some adoption:
- RAP
- Slag aggregates

Future:
- Bottom ash
- IBAA
- Shredded rubber

Recycled Plastics

All Business as usual:
- Temporary traffic management devices
- Noise walls
- Geosynthetics (geogrids and geotextiles)
- Pipes and conduits

Asphalt

Business as usual:
- RAP
- CR
- Glass

Some adoption:
- Plastics
- Fly ash

Future:
- Carbon charBottom ash

Stabilisation

Business as usual:
- Fly ash
- Slag
- RAP

Some adoption:
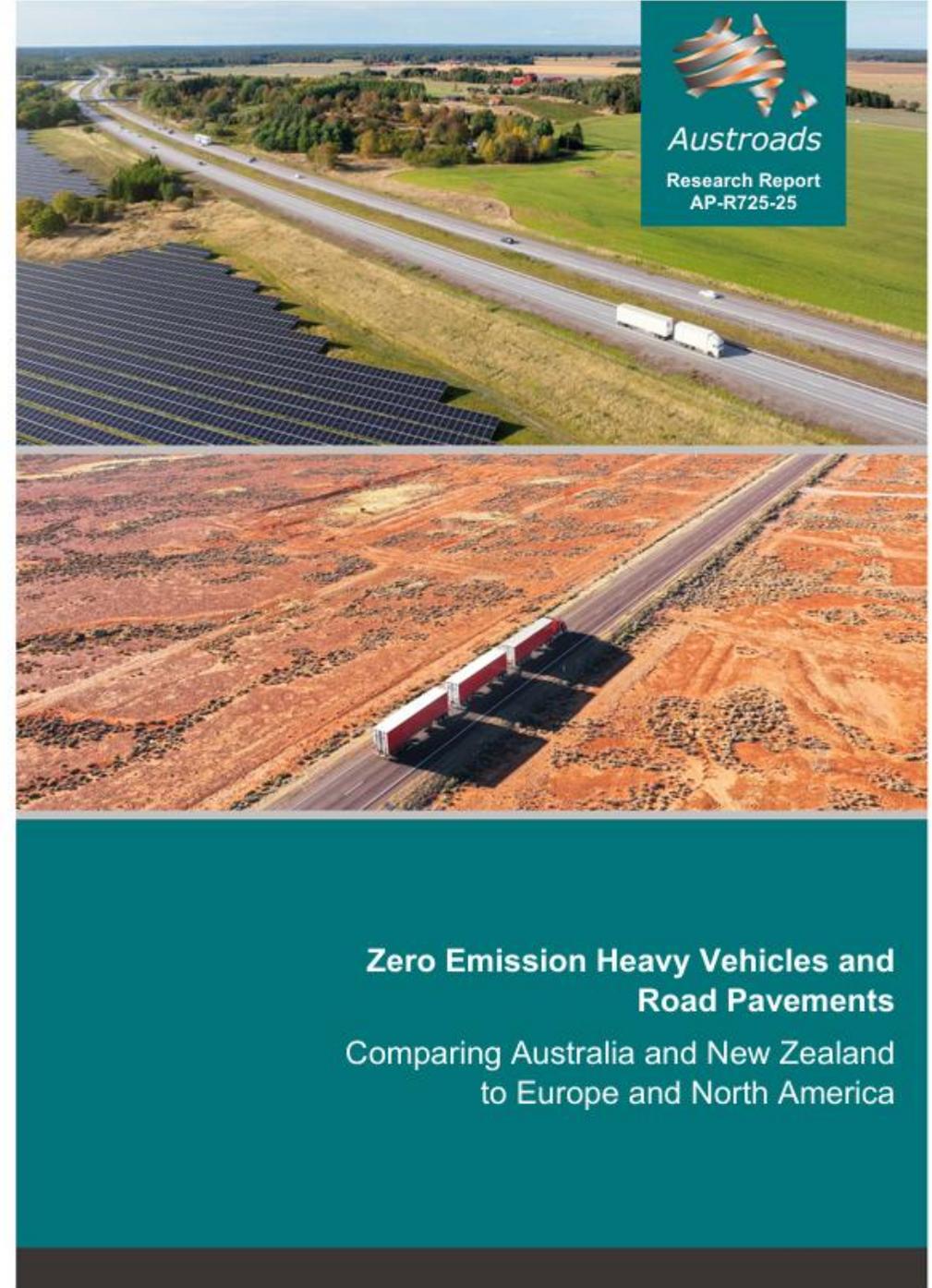- Crushed concrete

Future:
- Bottom ash
- IBAA

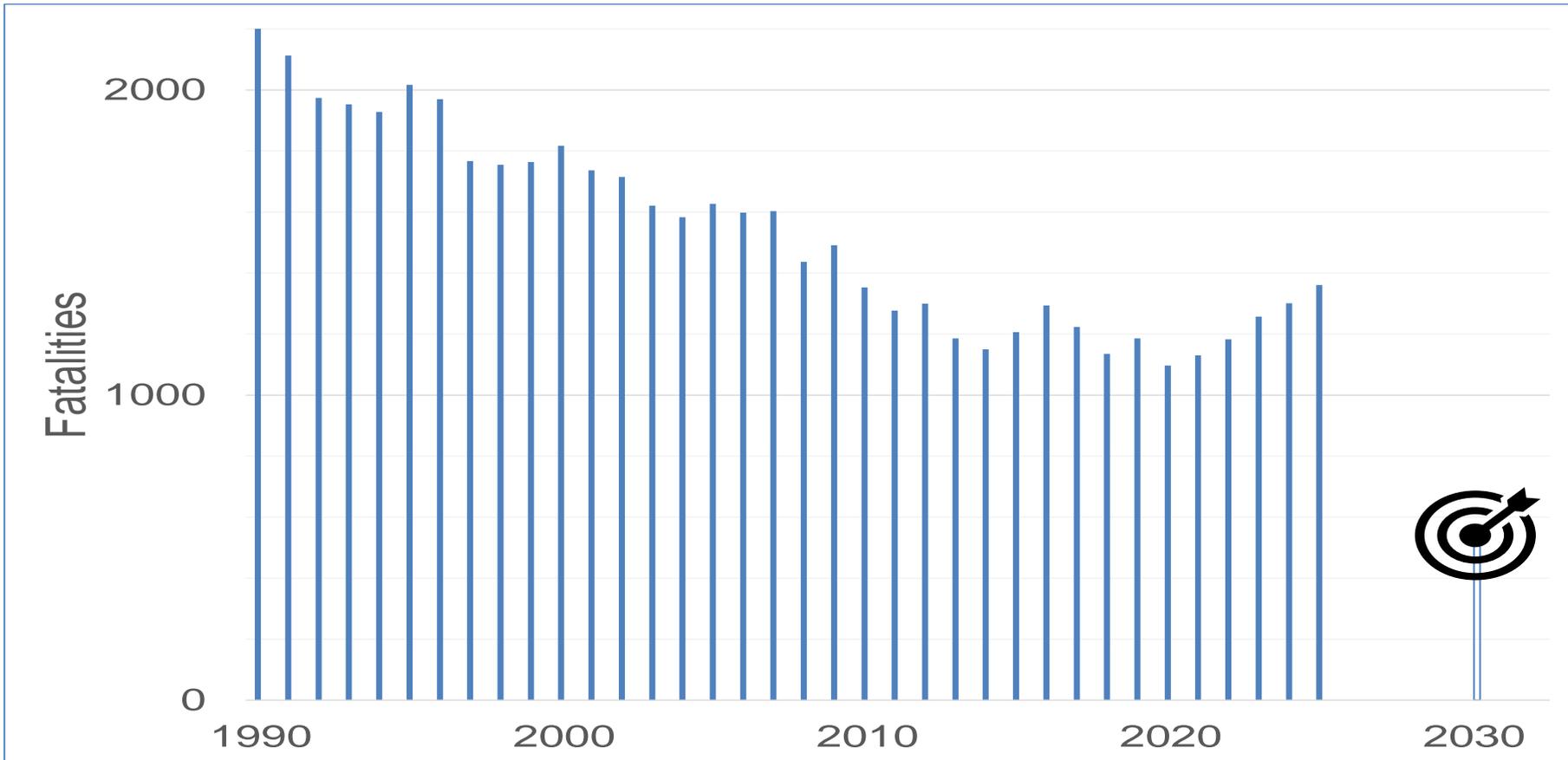# Low emissions heavy vehicles

Zero Emissions Vehicles

- Emerging technologies available

- Higher tare mass:
  1. Lower pay load at same gross mass
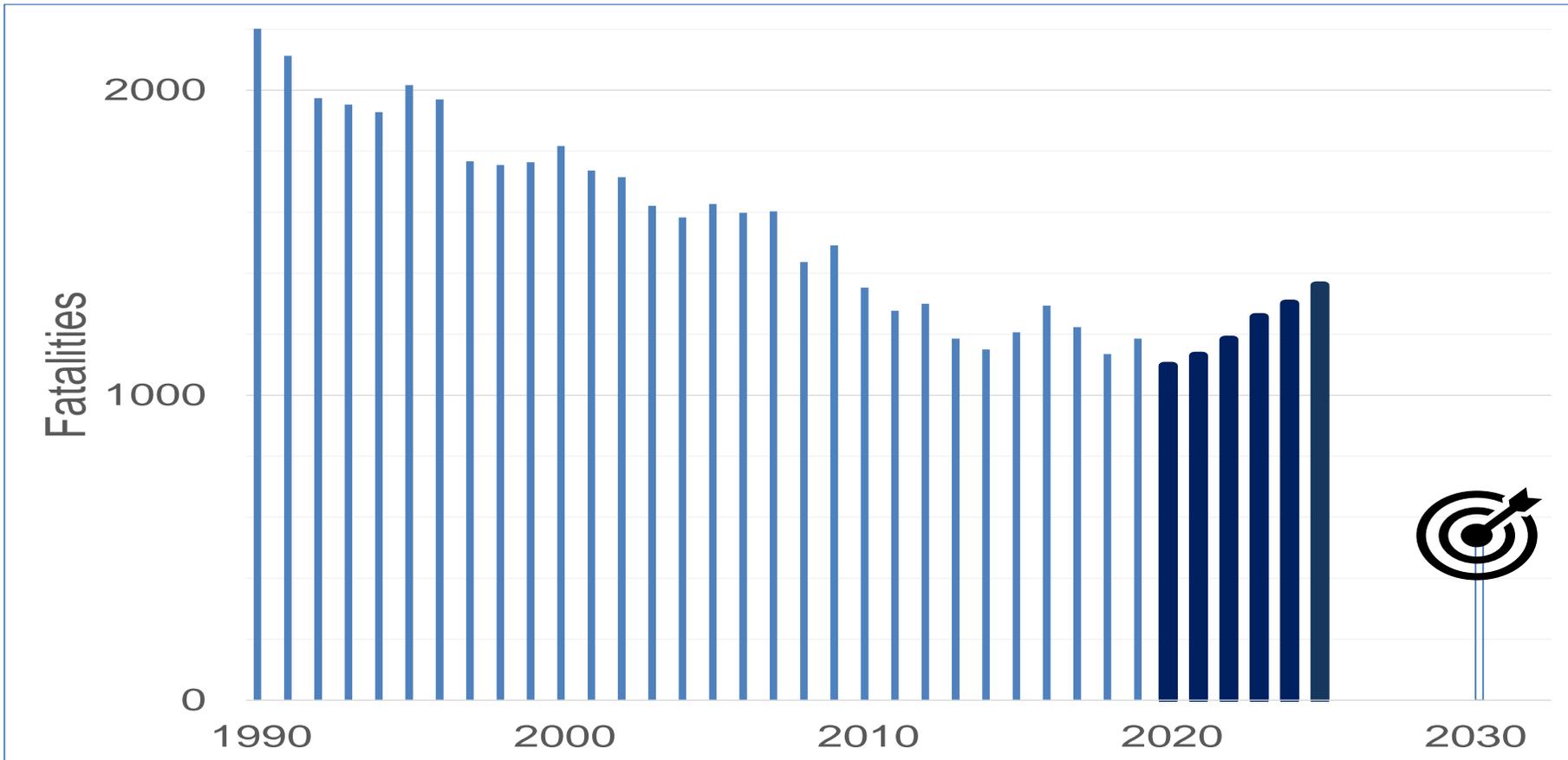 2. Retain payload at increased gross mass

Road and bridge performance under increased gross mass

Austroads
Research Report
AP-R725-25

Zero Emission Heavy Vehicles and Road Pavements
Comparing Australia and New Zealand to Europe and North America

Transport Safety

A modern fleet built for speed and precision

World-class vehicles, deployed nationally and internationally, enabling high-speed, high-accuracy network measurement.

Automatic Crack Detection Vehicle

ACD

Network Survey Vehicle

NSV

Intelligent Pavement Assessment Vehicle

iPAVE

iSSAVE

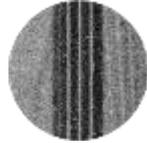Intelligent Safe Surface Assessment Vehicle

iLINE

RQT/URV

Ride Quality Test + Unsealed Roads Vehicle

HWD/FWD

Heavy/Falling Weight Deflectometer

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Intelligent Pavement Assessment Vehicle

iPAVE

Dilapidation   Structural

✓ **Structural Assessment - deflectometer**

Measures how much the pavement bends under the iPAVE at traffic speed, generating deflection profiles to estimate fatigue and bearing capacity. Pinpoints weaknesses to guide smarter maintenance spending

✓ **Laser Crack Measurement System** (LCMS-2®)

High-speed, vehicle-mounted system using lasers and cameras to detect and map pavement cracks and surface defects in 3D.

✓ **Light detection and Ranging** (LiDAR)

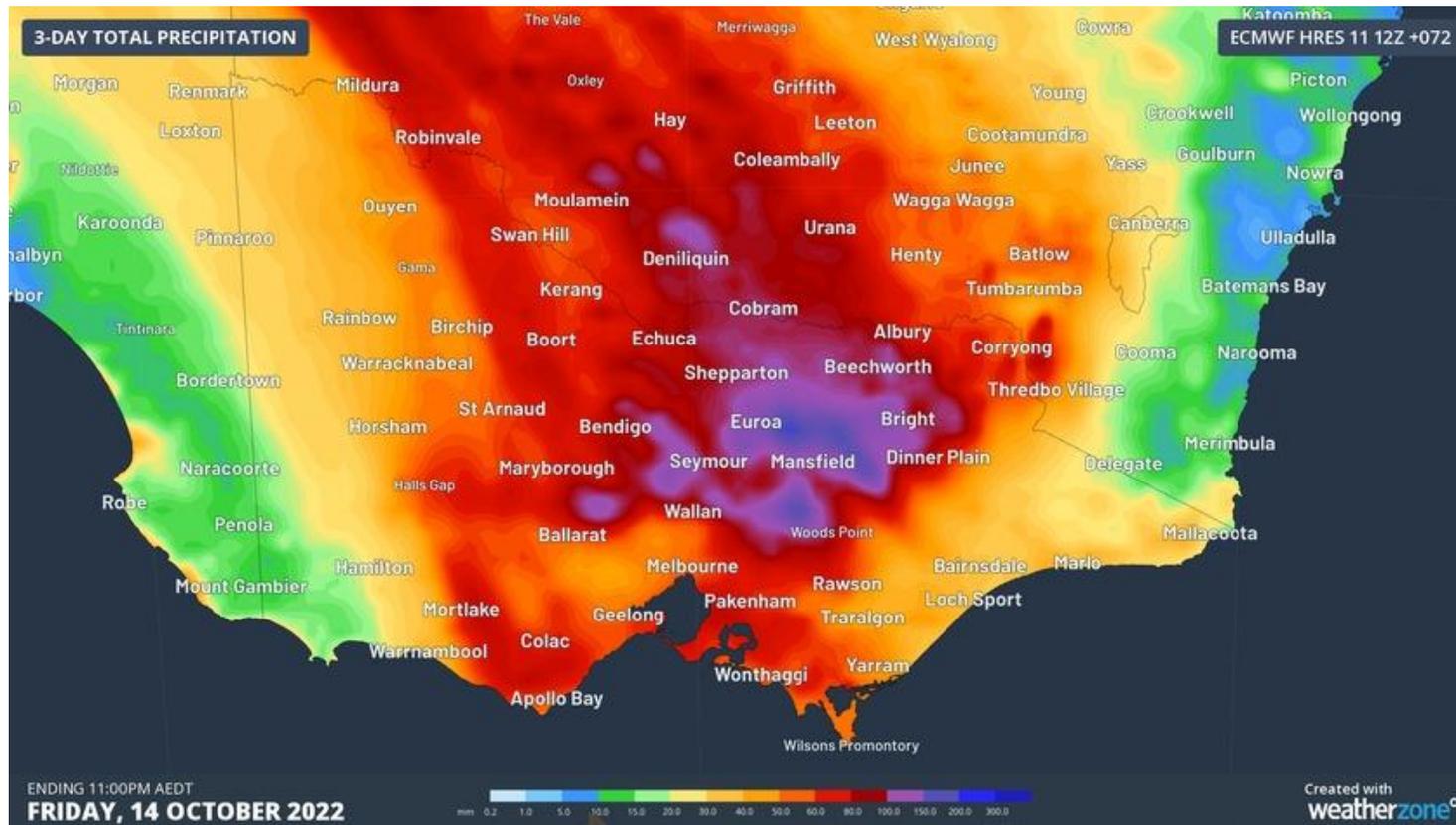Measures deflection velocity to assess roughness, rutting, and cracking via high-res 3D surface profiles.

✓ **Cameras**

High resolution, self-cleaning cameras for visual ratings
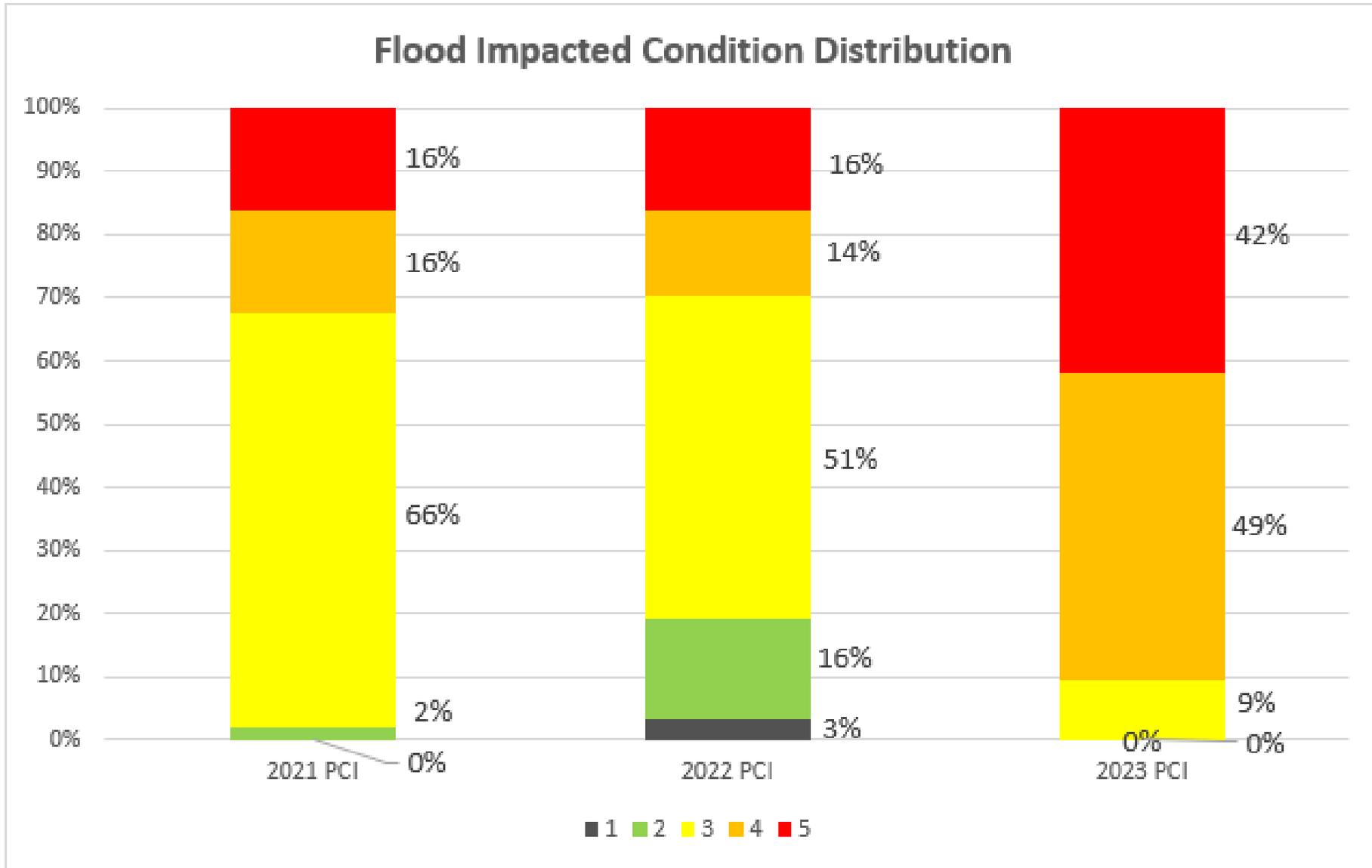
Flood assessment

Flood event in October 2022

Source: Rain arrives in Melbourne as Victoria braces for flooding (weatherzone.com.au)

INNOVATION DRIVEN

ntro.org.au

Pavement Condition Index (PCI)

Flood Impacted Condition Distribution