MHA

Midlands Highway Alliance Plus

Digital and Environment

Wednesday 17 September 2025

Annual Event 2025

Resilient Infrastructure: Predictive Maintenance and the Role of the Soft Estate

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Climate Emergency

- In 2024, global temperatures were 1.6°C higher than in the pre-industrial era (1850-1900)
- Climate change poses significant risks to UK infrastructure – with estimates that by 2050, up to 25% of the UK's infrastructure could be affected by climate-related events.
- National Flood Risk Assessment in England, last updated on 22 January: “Around a third (38%) of all roads are in areas at risk from one or more sources of flooding. If we apply the climate change projections the percentage of the road network in areas at risk rises to 46% by the mid-century.”

  LSE estimate the total cost of climate change damages to the UK are projected to increase from 1.1% of GDP (c25Bn) at present to 3.3% (£75Bn) by 2050
- Policy change is coming… with DfT commencing consultation on their draft climate change adaptation strategy in 2024. Draft policies include:
  - ✓ Reporting as set out in the fourth climate adaptation reporting strategy, including named highway authorities

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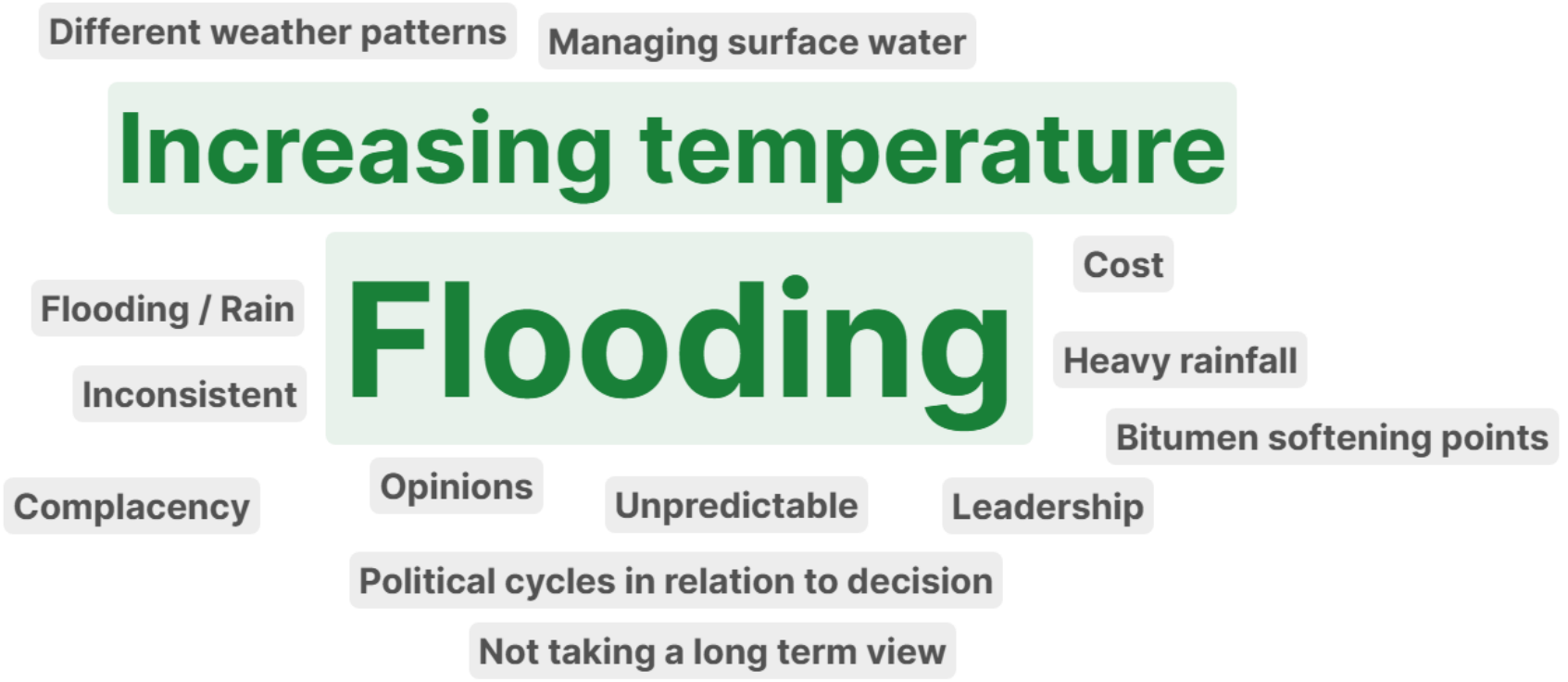
What do you feel is the biggest climate challenge LHA will face?



Asset Data Quality

Many organisations lack the ability to extract and utilise tacit knowledge held by Subject Matter Experts (SMEs) in their asset maintenance and renewals planning process.
The lack of a centralised approach to asset management results in inefficiencies in how asset intervention schedules are developed, leading to budget constraints, increased risk, and suboptimal performance.

Current Industry Challenges:

- Tacit knowledge extraction
- Decentralised Asset Management
- Budget Constraints
- Asset failure Risk
- Performance Gaps

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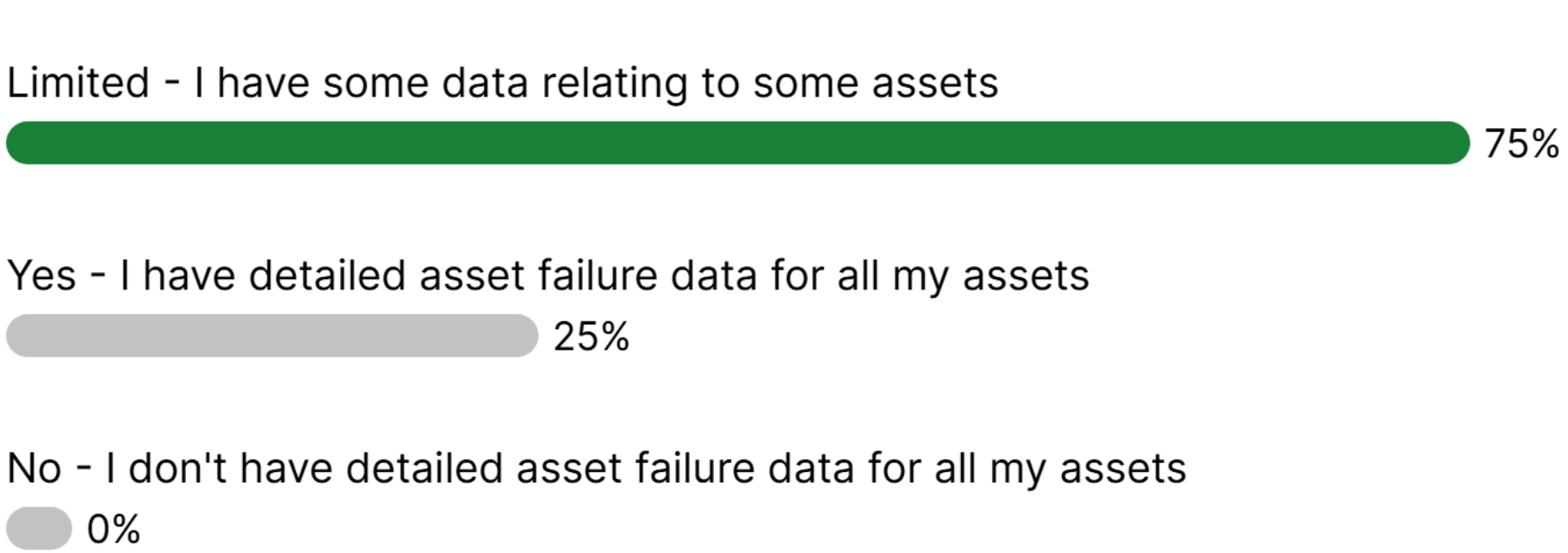
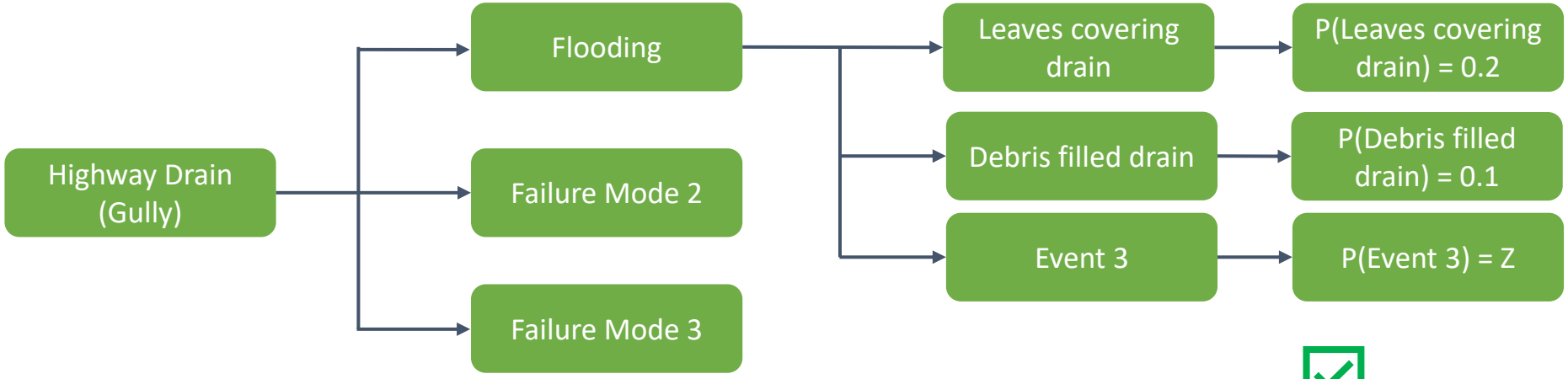
Do you have good quality asset failure data?

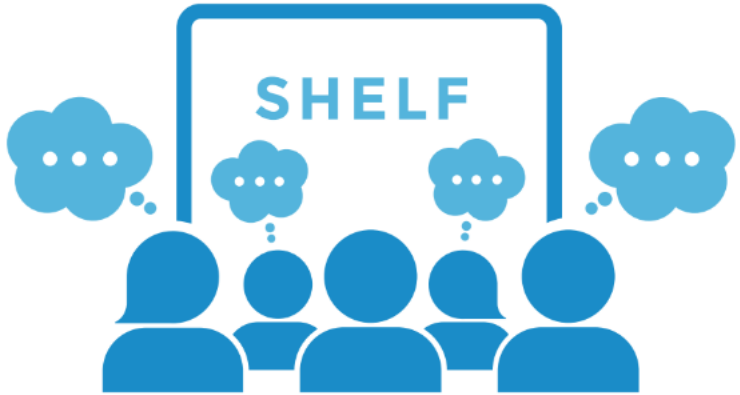


Failure Modes



Knowledge Elicitation & Risk

- Sheffield Elicitation Framework (SHELF)
- Tacit knowledge extraction
- Protocol for capturing judgements
- Likelihood of asset failure
- Transform qualitative expert opinions
- Derive quantitative probabilities
- Minimum, Maximum, Median



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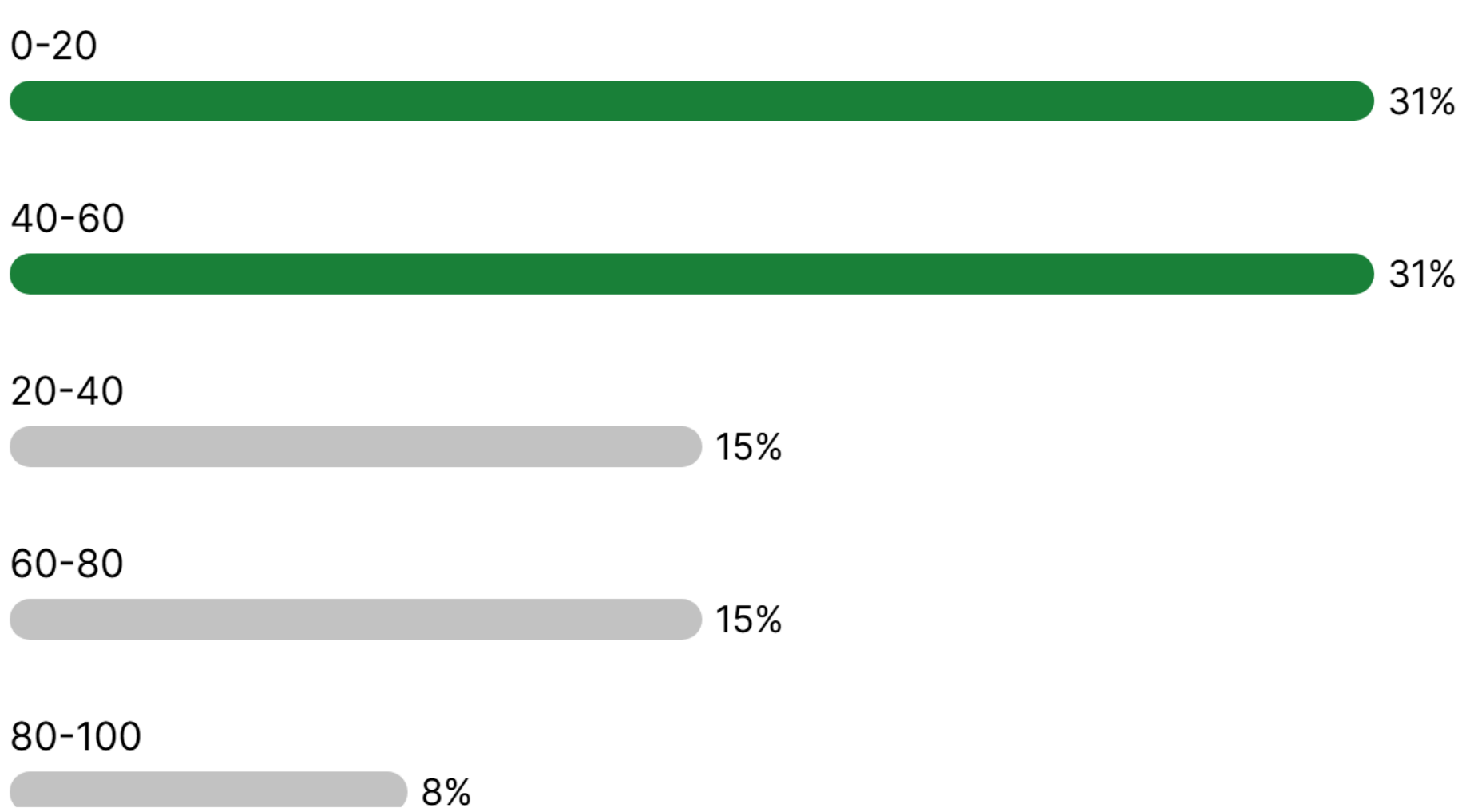
In your opinion, how likely is a highway gully in your LHA to fail if you don't undertake maintenance this year?



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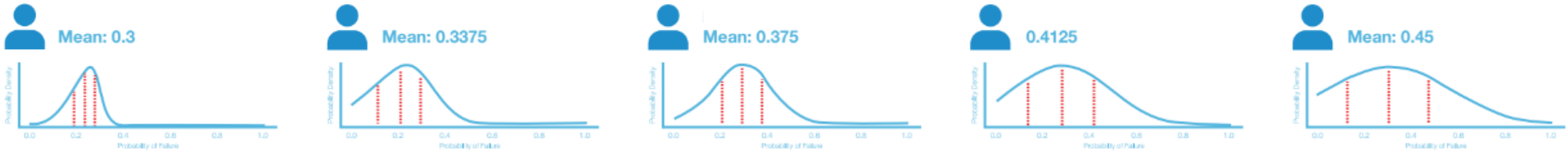

Mean: 0.375

- Leaf fall season extension
- Greater silt run off
- Intense rainfall
- Growing seasons & rates

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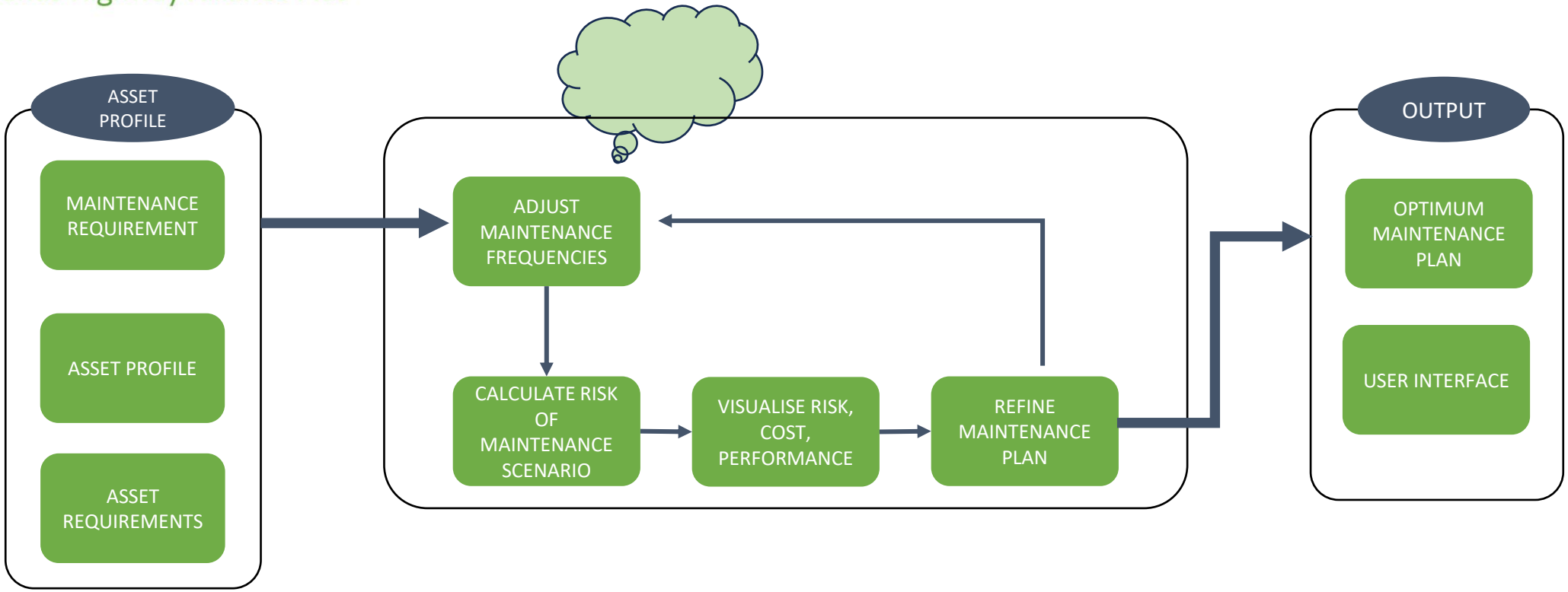

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Ingest Asset Portfolio - Provides you a system to collect the correct information on your asset portfolio from across your business.

Understand risk factors and impact – Have greater certainty that your assets are working for you in the way you expect them to.

Simulate scenarios – Give you the ability to see how your asset portfolio reacts under different conditions. This reduces risk by trying an idea out digitally, before implementing on your asset portfolio.

Asset Intervention plan (OPEX and CAPEX interventions) – You are able to chose the path that ensures you have the lowest cost for the whole life of your assets in line with the performance and risk requirements you require of those assets.

Visualisation of Results – Allows you to understand the expected requirements and interventions required over your asset portfolio in the future.

Exporting Results – Allows you to communicate these requirements to a wider audience, ensuring an aligned approach across your business.

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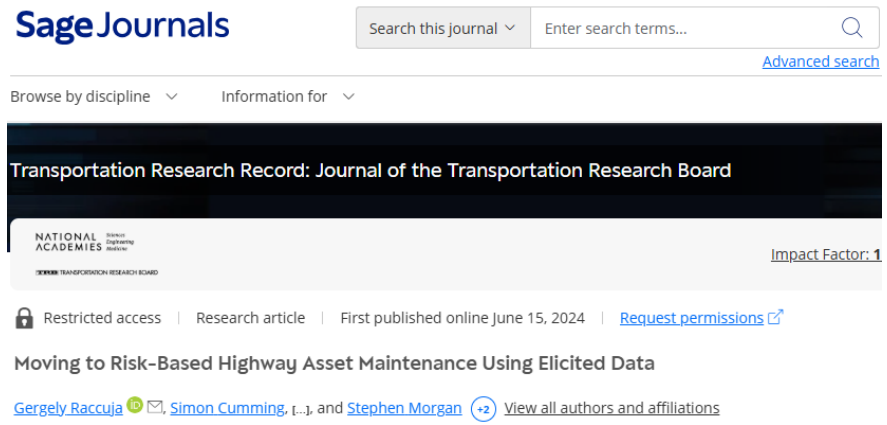
- Defensible mathematical rigour to evidence difficult decisions
- Operational savings through better decisions
- Improved asset performance at portfolio level
- Employee wellbeing due to reduced workplace stress
- Consistent approach
- Fostering collaboration



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Staffordshire County Council
Climate Preparedness across Highways Infrastructure

- Gold standard climate projections - analysing medium and high scenarios (UKCP18) against a 1961-1990 baseline
- Evaluating the effects of climate change on 16 highway asset groups
- Typical 1km sections approach
- Working with council and operatives to understand likely impacts
- Develop strategies to enhance resilience
- Cost benefit analysis for mitigation and adaptation measures

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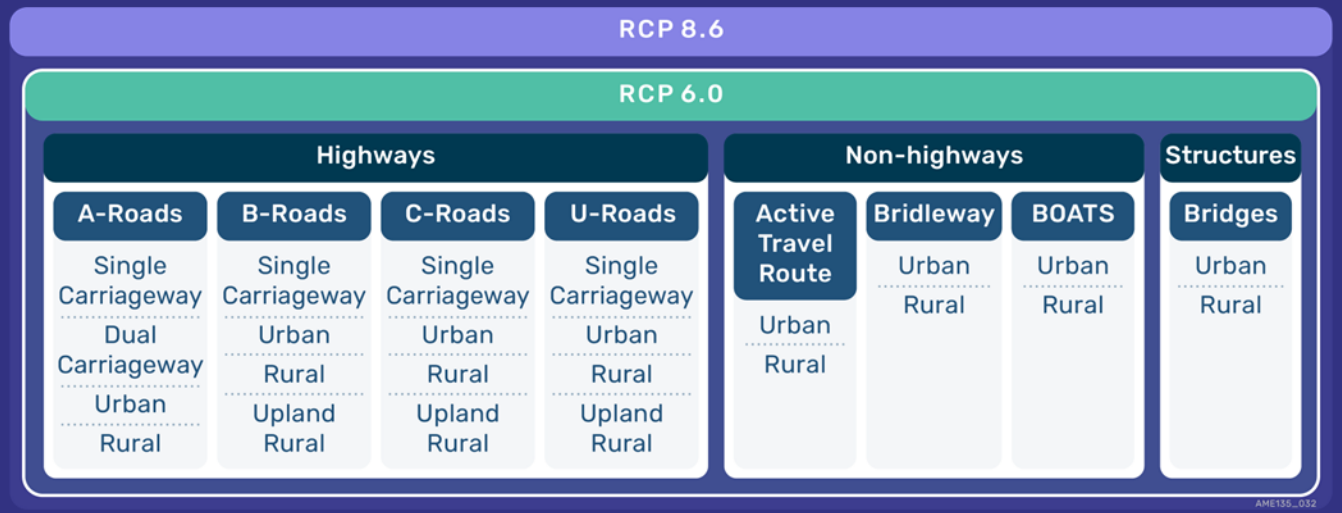
Staffordshire County Council
Climate Preparedness across Highways Infrastructure

Typical 1km Section



Climate Parameters

Wildfire risk index

Mean, minimum, and maximum temperatures, probability of heatwaves, hot days (e.g., above 25°C and 28°C, 35 °C).

Number of days with winds exceeding specified thresholds (>38mph).

Changes in grass growing, leaf fall period

Frequency and duration of dry spells (e.g., 10 and 20 consecutive dry days), number of days with precipitation exceeding 25mm and 40mm.

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Climate change effects: the role of the soft estate

- Drought– extending season for leaf fall
- Heat increase – reducing plant growth
- Higher rainfall – more silt run off
- Flooding – mobilising pollutants and restricting growth
- Blurring the season – e.g. timing of new planting
- Storm events and high winds - higher risk of trees falling

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Adaption and mitigation: the role of the soft estate

- Vegetated areas absorb rainfall, reduce surface run off and reduce erosion around assets
- SuDS - retention ponds, swales - reduce flash flooding and protect watercourses
- Wetland creation – slow the flow from surrounding land
- Vegetated areas cool surrounding areas mitigating urban heat island effect
- Trees and plants sequester carbon dioxide
- Wetted vegetation e.g. peat bogs – reduces wildfire risk and slows the flow
- Vegetated embankments - add stability

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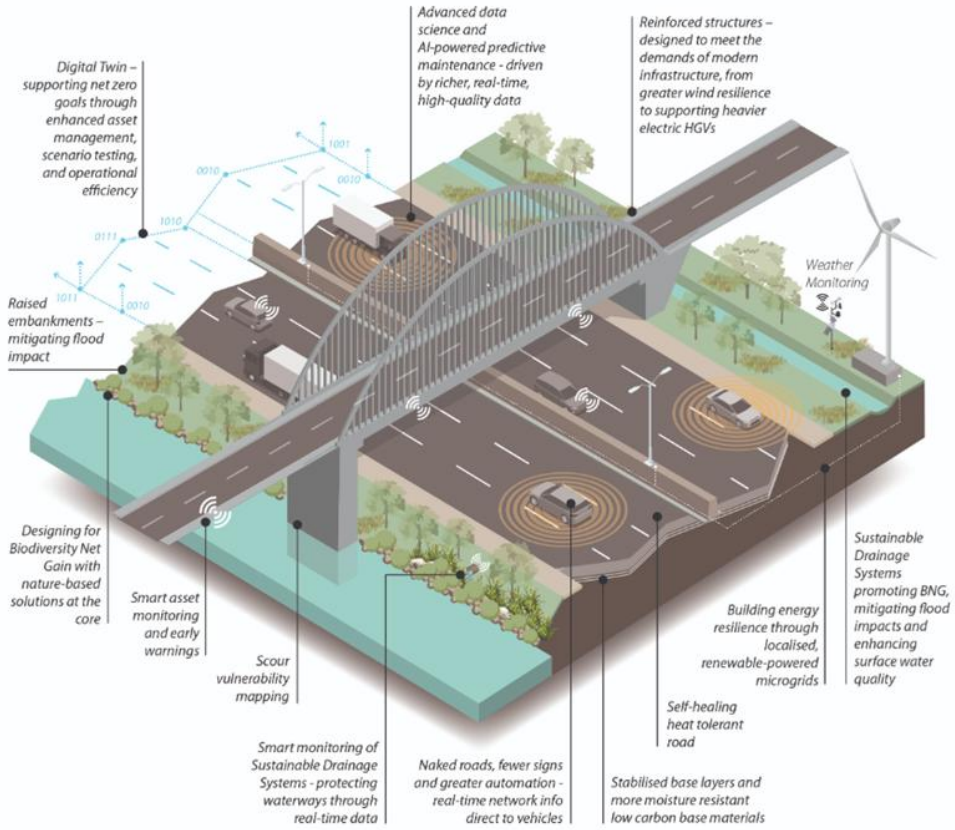
Climate resilience: the opportunities of the soft estate



Infographic created by Buro Happold for NCE

- Opportunity to combine climate resilience with biodiversity enhancement - LNRS
- Nature needs resilient ecosystems - healthy soils, clean air and water all help nature work for us
- Highways networks promote habitat connectivity and wildlife corridors
- Nature-based solutions relevant from design to maintenance
- Additional opportunities to improve sense of place through green and blue infrastructure and nature as part of active travel – community benefits
- A suite of solutions will be needed - the soft estate plays a key role in low cost, nature-based solutions

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What solutions could help reduce flooding risks on highways maintenance operations or design projects?

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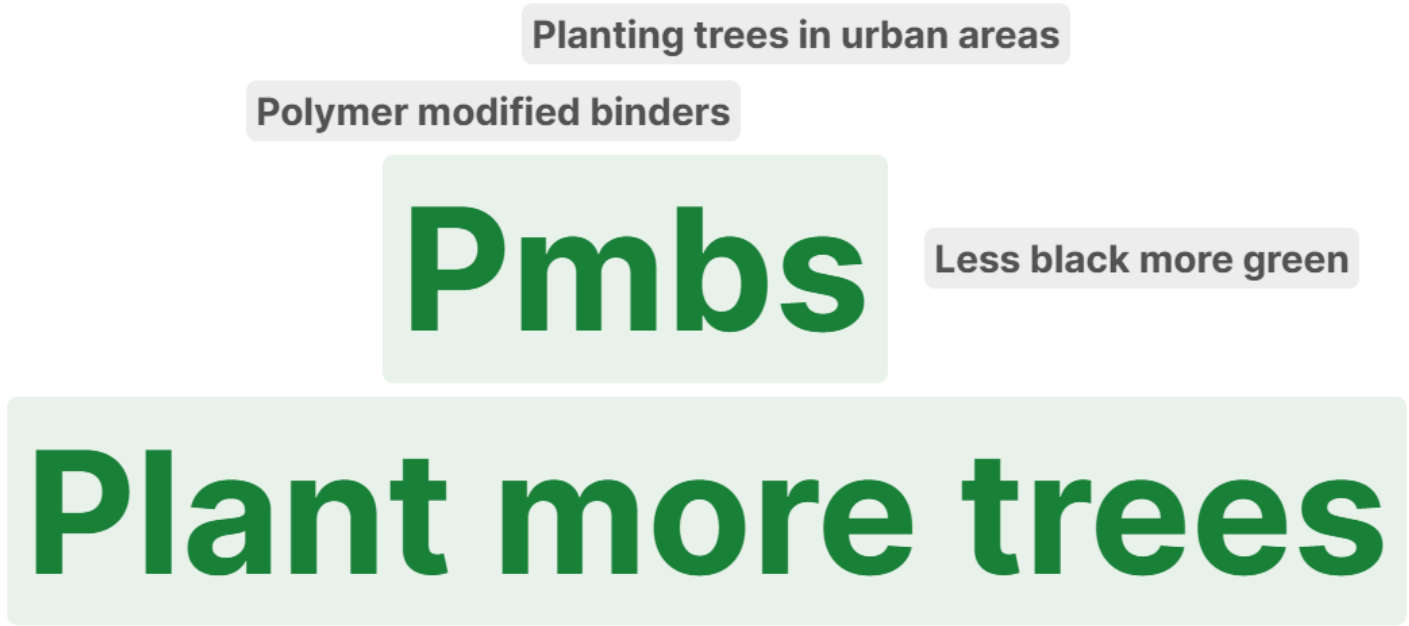
What solutions could help reduce heat stress risks on highways maintenance operations or design projects?



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ASSET PROFILE

MAINTENANCE REQUIREMENT

ASSET PROFILE

ASSET REQUIREMENTS

Nature-based solutions

ADJUST MAINTENANCE FREQUENCIES

CALCULATE RISK OF MAINTENANCE SCENARIO

VISUALISE RISK, COST, PERFORMANCE

REFINE MAINTENANCE PLAN

OUTPUT

OPTIMUM MAINTENANCE PLAN

USER INTERFACE

Conclusions & Call to Action

- MHA Regional Knowledge - Quality Data <> Elicitation
- Ageing Workforce
- Good climate science needed to underpin projections and inform the adaptation, mitigation and maintenance decisions
- Consider Nature Based solutions within your design brief & maintenance planning
- Changing the Net Zero trajectory importance

Questions…