Protection of critical transport infrastructure – a network management perspective

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Infrastructure

What do we mean by infrastructure?

- Simply - anything man made that is necessary to sustain society as we now know it today.
  - Utilities
    - Water, electricity, gas, sewerage, telephone, district heating
  - Transport
    - Roads, railways, airports, ports, commercial waterways
  - Buildings
    - Housing, shops, offices, factories

GB Transport Infrastructure

Network Rail (Great Britain)	16,000km of railway with 40,000 bridges, 17,000 retaining walls, 700 tunnels and 2,500 stations
London Underground (London)	400km of railway with 270 stations and 180km of tunnels
Highways England	7,754km of trunk road and motorway with 17,000 structures including 8,800 bridges
Local roads (Great Britain)	380,000km of roads with around 80,000 bridges
Canal & River Trust (Great Britain)	3,540km of canal with 1,654 locks, 54 tunnels, 3,115 bridges, 417 aqueducts and 91 reservoirs

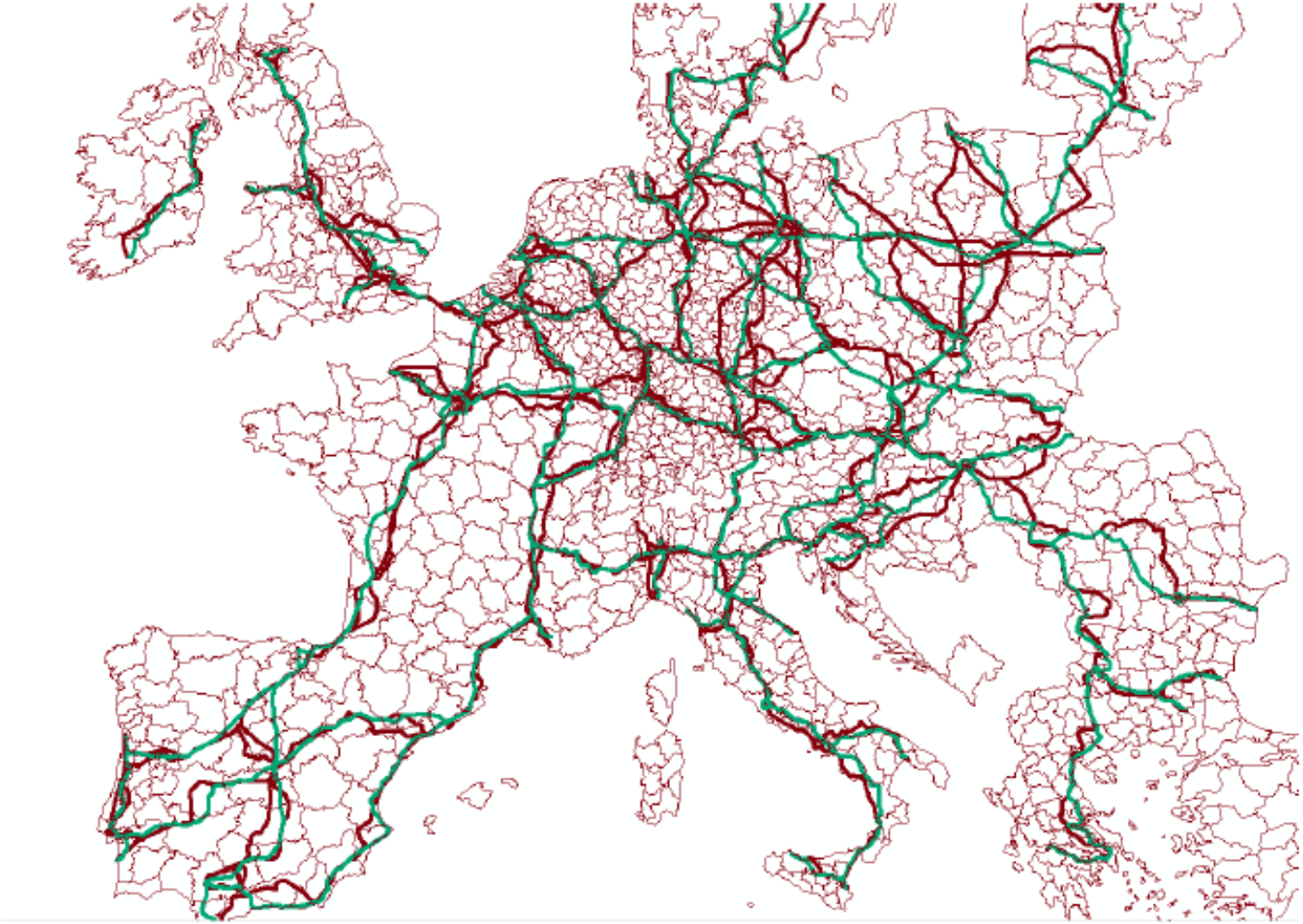
Transport infrastructure networks are complex and bring together diverse disciplines and components

- Civil
  - Earthworks (embankments & cuttings), structures (bridges tunnels & retaining walls), road pavements/railway tracks, drainage, gantries, docks, locks
- Building
  - Stations, airports, depots, signal boxes, sub stations
- Mechanical
  - Pumps
- Electrical
  - Signals, power supplies, lighting
- Telecommunication
  - Fixed links (copper & fibre optic), mobile networks, radio systems

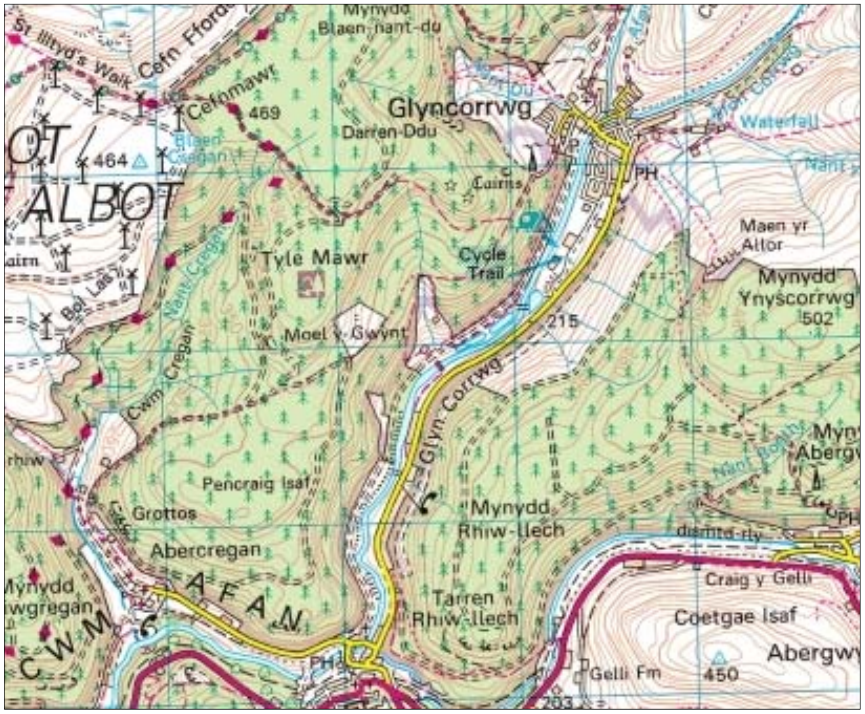
Critical Transport Infrastructure

The INFRARISK project team has identified the TEN-T Trans European Road and Rail Networks as being critical to the economic and social health of Europe

The TEN-T Network (Road shown blue, rail shown red)



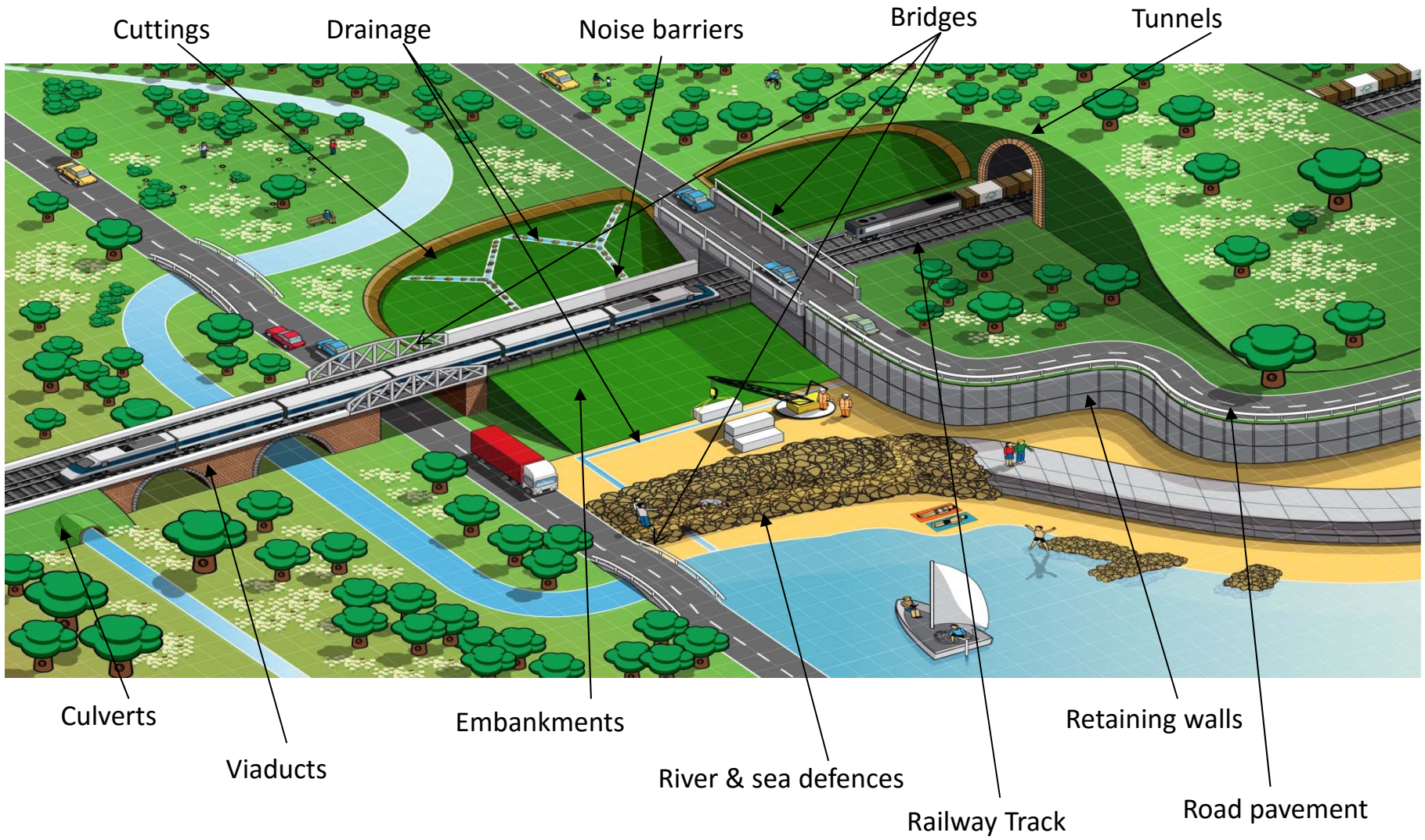
Nevertheless to infrastructure network managers and local communities almost all other road and rail routes are critical, as their loss will inhibit free movement and may isolate communities



So the developments achieved within INFRARISK need to be capable of deployment at different levels

The safety and availability of land transport infrastructure depends principally on well maintained civil engineering assets:

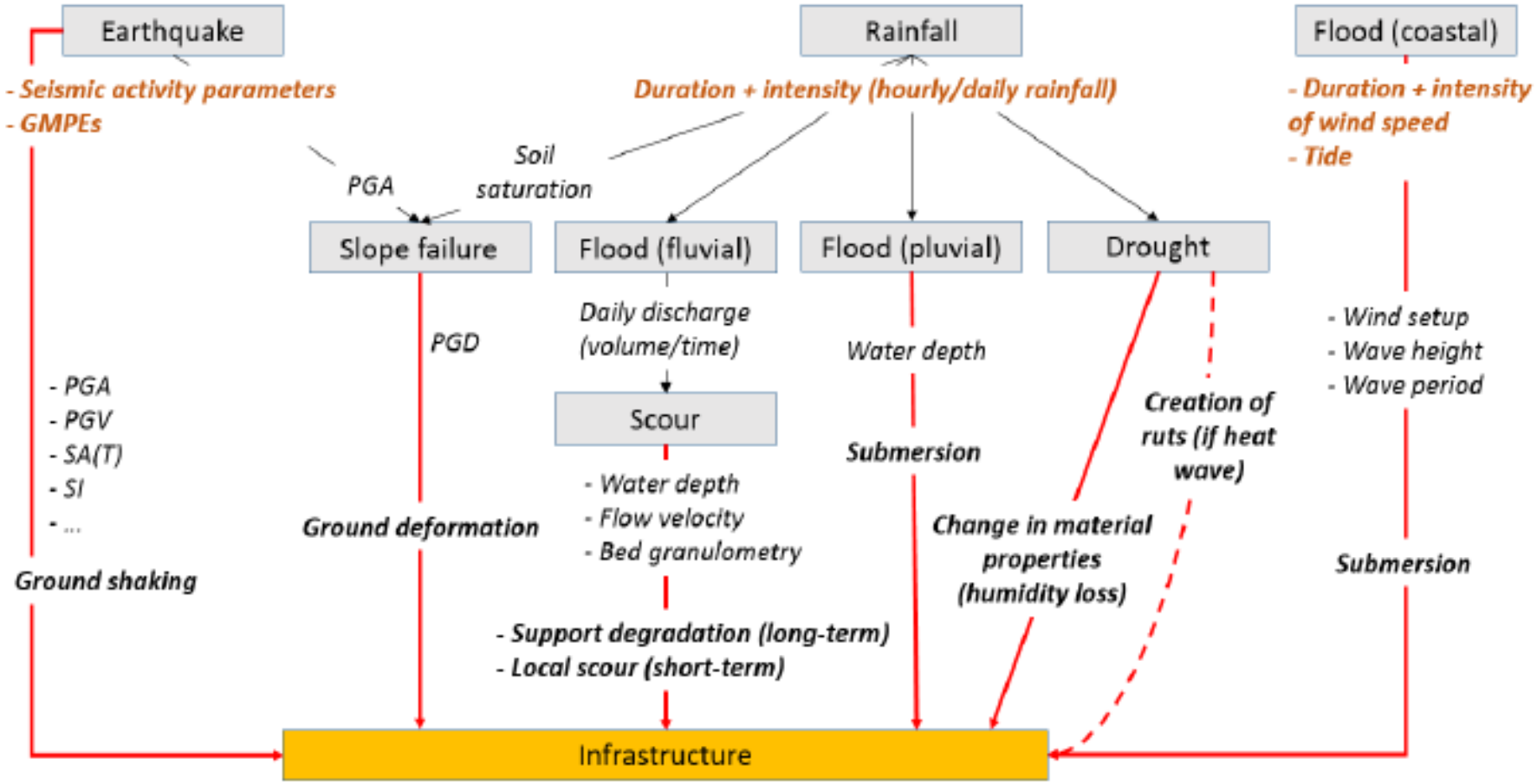
- bridges, tunnels, earthworks (embankments and cuttings), retaining walls, road pavements, railway tracks and drainage systems as shown on the next slide


Cuttings
Drainage
Noise barriers
Bridges
Tunnels
Culverts
Viaducts
Embankments
River & sea defences
Railway Track
Retaining walls
Road pavement

All of these assets are at risk from natural hazards such as earthquakes, landslides, rainfall and flooding.

The INFRARISK project has chosen to concentrate on earthquakes and flooding, including earthquake induced landslides and scouring
as outlined on the next slide.

Hazards considered by INFRARISK



So let's look at some of the effects of these hazards on transport infrastructure

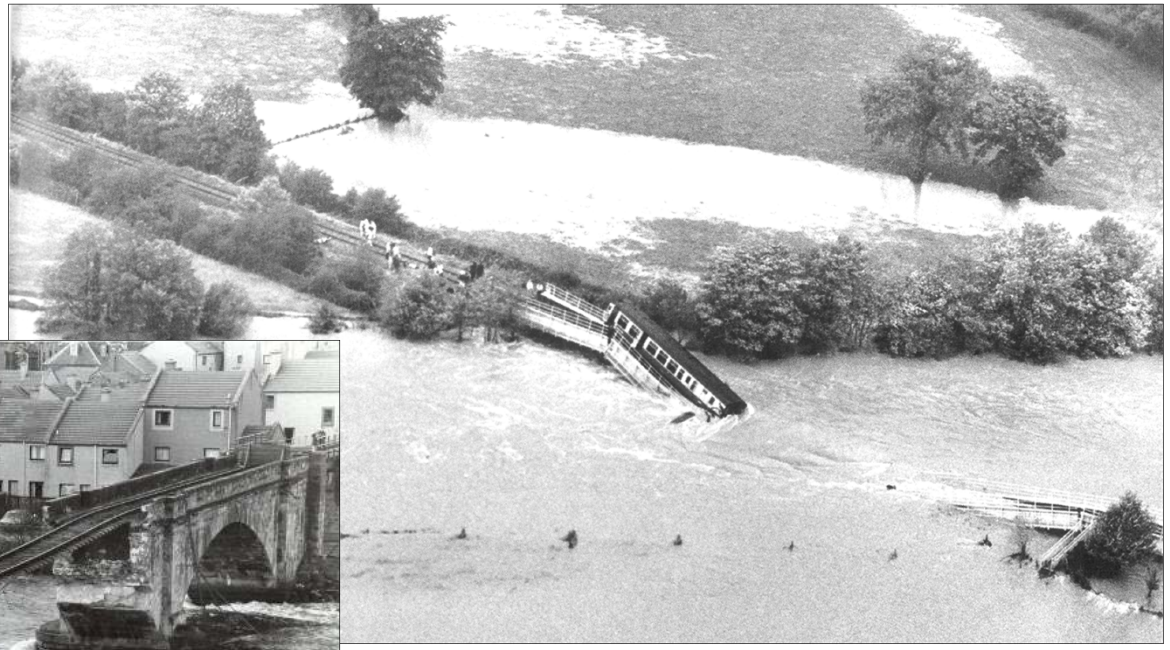
Earthquakes

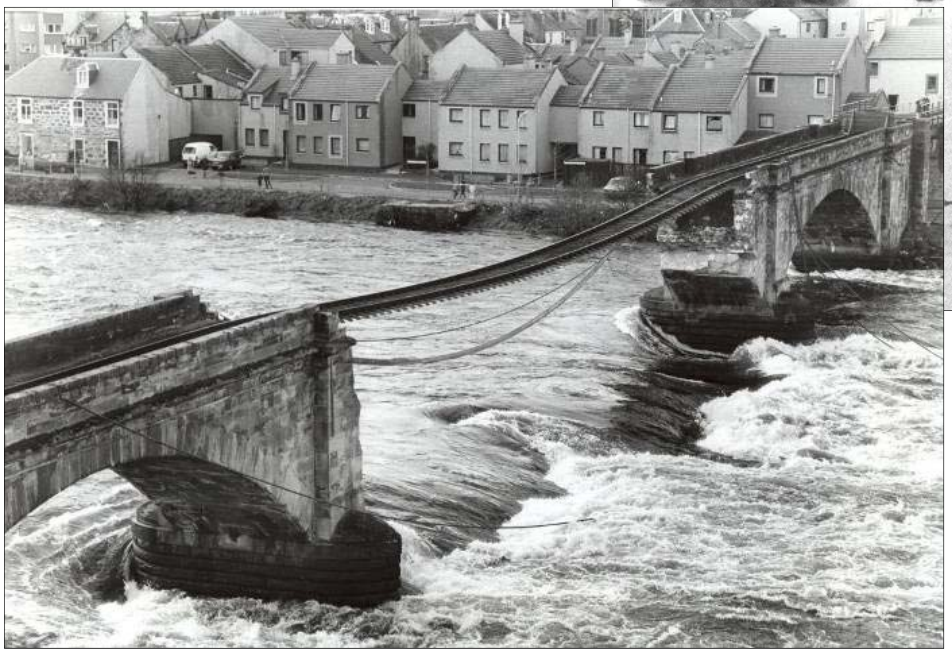
Rain induced slope failures

Fluvial flooding

Bridges damaged by scour

Bridge collapses due to scour





Pluvial flooding

Drought & heat

Coastal storms and flooding

Indicators

From a Network Management perspective

- Maintaining safety is paramount
- Maintaining a service to the public is the second most important priority

This means that transport infrastructure assets such as embankments, tunnels and major bridges are hyper critical and need to be treated as if they have an infinite life so they need to be protected against natural hazards alongside the normal maintenance interventions to inhibit deterioration.

- Indicators of susceptibility can offer benefits for network management by suggesting priorities for action

What indicators currently exist for trigger events?

- Earthquakes
  - None for an actual event but we have knowledge of earthquake prone areas
- Pluvial flooding
  - Principally weather forecasts, but these are only really accurate over one or two days and may not highlight very localised events which tend to be the main source of hazards to infrastructure
- Fluvial flooding
  - Knowledge of rain events in relevant catchment areas
  - Distance from rain event to asset location
  - Relative importance of tributary affected
- Drought & heat
  - Again, principally weather forecasts for the big picture
  - Knowledge of micro-climates which could lead to localised hot spots
- Coastal events
  - Once again, weather forecasts. However those predicting severe storms are more likely to be accurate over longer time periods.
  - Tide tables to judge the effect of storm surges

What indicators currently exist for infrastructure at risk?

- Natural slopes
  - Knowledge of local geology
  - Height above the infrastructure under consideration
  - History of landslides
- Earthworks (man made slopes)
  - Age of the earthwork
  - Examination reports and knowledge of local geology
  - Proximity of rivers and streams
  - History of failures in the area
- Structures
  - Knowledge of foundation depths
  - Cross section available for the passage of water
  - Examination reports recording current physical condition
  - Any records of previous floods survived

The INFRARISK project has developed new indicators that we will learn about today

I just hope that they are a bit more sophisticated than this…

Thank you for listening

Novel Indicators for identifying critical **INFRA**structure at **RISK** from Natural Hazards

Website

www.infrarisk-fp7.eu

Acknowledgement

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