TRAFNIDIAETH CYMRU
TRANSPORT FOR WALES

Climate Adaptation and Resilience at Transport for Wales

Aleka Toogood – Climate Adaptation and Resilience Lead

Mae Trafnidiaeth Cymru yn eiddo i **Lywodraeth Cymru**
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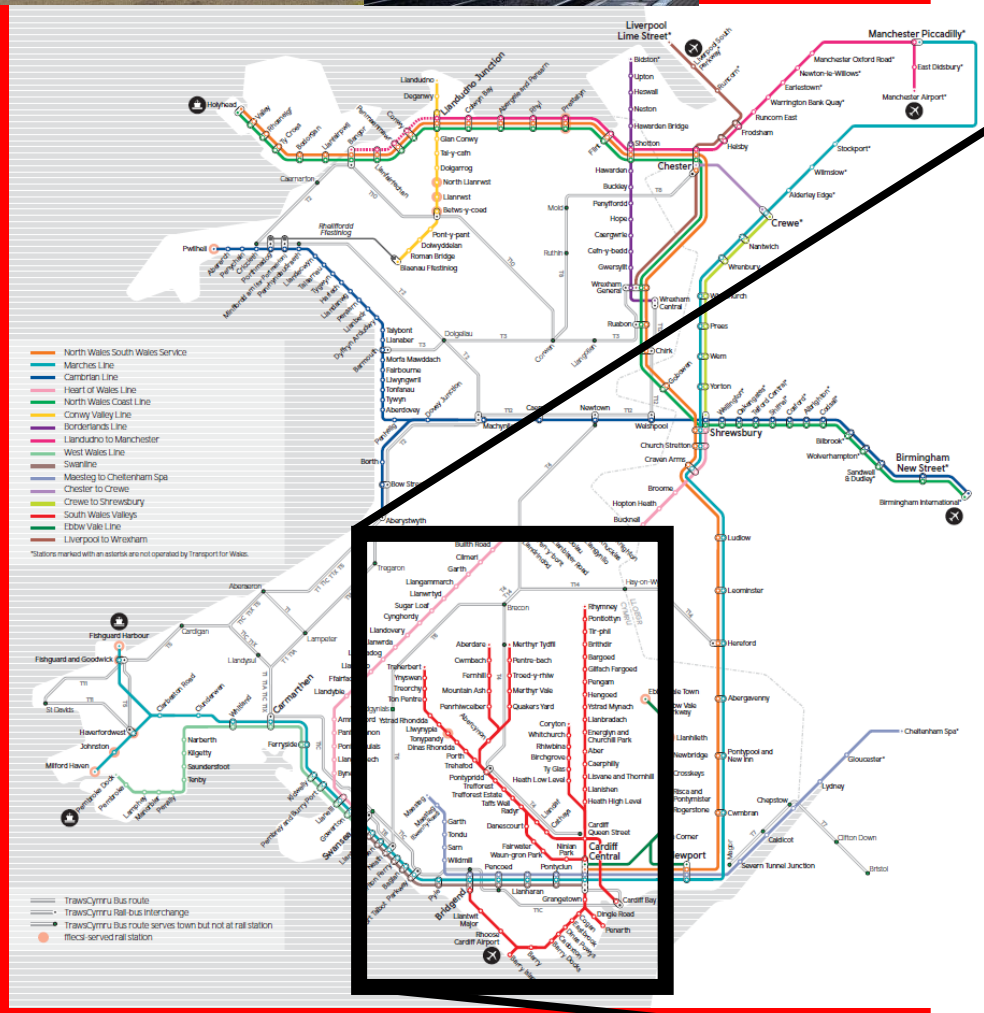

Liverpool Lime Street*
Manchester Piccadilly*
Holyhead
Llandudno Junction
Chester
Crewe*
Shrewsbury
Birmingham New Street*
Wrexham Central
Rhyl
Prestatyn
Bangor
Llandudno
Colwyn Bay
Llandrindod
Aberystwyth
Machynlleth
Newtown
Welshpool
Ludlow
Hereford
Leominster
Abergavenny
Cheltenham Spa
Gloucester*
Bristol
Fishguard Harbour
Fishguard and Goodwick
Carmarthen
Swansea
Milford Haven
Pembroke Dock
Cardiff Central
Cardiff Bay
Newport
Pye Corner
Ebbw Vale Town
Ebbw Vale Parkway
Rhymney
Pontlottyn
Tir-phil
Brithdir
Bargoed
Gilfach Fargoed
Pengam
Hengoed
Ystrad Mynach
Llanbradach
Energlyn and Churchill Park
Aber
Caerphilly
Lisvane and Thornhill
Llanishen
Heath High Level
Coryton
Whitchurch
Rhiwbina
Birchgrove
Ty Glas
Heath Low Level
Aberdare
Cwmbach
Fernhill
Mountain Ash
Penrhiwceiber
Merthyr Tydfil
Pentre-bach
Troed-y-rhiw
Merthyr Vale
Quakers Yard
Abercynon
Pontypridd
Trefforest
Trefforest Estate
Taffs Well
Radyr
Llandaf
Cathays
Danescourt
Fairwater
Waun-gron Park
Ninian Park
Maesteg
Maesteg (Ewenny Road)
Garth
Tondu
Sarn
Wildmill
Pencoed
Pontyclun
Llanharan
Pyle
Bridgend
Grangetown
Llantwit Major
Rhoose Cardiff Airport
Barry
Barry Island
Barry Docks
Cadoxton
Dinas Powys
Eastbrook
Cogan
Dingle Road
Penarth
Sugar Loaf
Brecon
Llwynypia
Tonypandy
Dinas Rhondda
Porth
Trehafod
Treorchy
Ynyswen
Treherbert
T6
T4
T1C
North Wales South Wales Service
Marches Line
Cambrian Line
Heart of Wales Line
North Wales Coast Line
Conwy Valley Line
Borderlands Line
Llandudno to Manchester
West Wales Line
Swanline
Maesteg to Cheltenham Spa
Chester to Crewe
Crewe to Shrewsbury
South Wales Valleys
Ebbw Vale Line
Liverpool to Wrexham
TrawsCymru Bus route
TrawsCymru Rail-bus interchange
TrawsCymru Bus route serves town but not at rail station
fflecsi-served rail station

Changing to the climate in Wales affecting transport

- Results from CCRA3 indicate that all rail track assets in Wales will face increased exposure to surface water risk.
- The number of days per year over 26°C – which currently poses a risk to transport networks – will increase by around seven times under a 4°C scenario.
- Projections indicate that the railway length in Wales at significant flood risk would increase by 53% by the 2050s under a 2°C global warming scenario

Why is TfW Adapting by climate change?

- TfW's Climate Adaptation and Resilience Plan has been directed by our remit from the Welsh Government which is to "ensure all TfW operations delivered on behalf of the Welsh Ministers are designed and delivered based upon the latest data on climate change risk and impacts, and that robust climate change adaptation plans are in place".

•The TfW Climate Change Adaptation Plan has been informed by a suite of relevant climate change policies, including

- Environment (Wales) Act 2015
- Prosperity for All: A Climate Conscious Wales (2019)

•The plan has been produced in accordance with the latest scientific advice and documents which are referenced throughout, for example

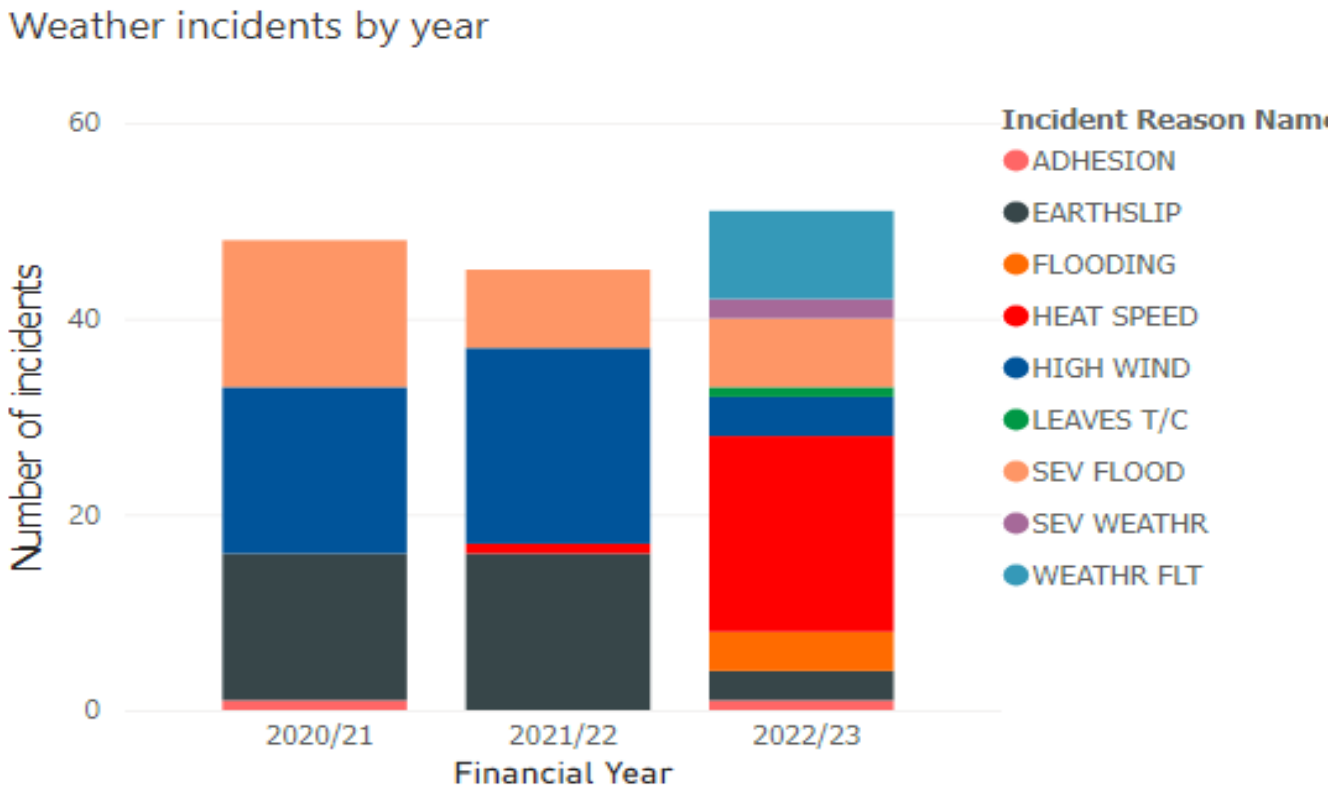
- Climate Change 2021, The Physical Science Basis - Intergovernmental Panel on Climate Change
- UK Climate Projections (UKCP18), Met Office Hadley Centre Programme – The Met Office

Wellbeing of Future Generations (Wales) Act 2015

- The Plan aims to support Welsh Government deliver on the "Resilient Wales" pillar of the Wellbeing of Future Generations (Wales) Act 2015 by creating a climate-resilient transport network that supports community mobility via accessible, sustainable travel modes in Wales.
- Fostering resilience will underpin the successful delivery of the six other, well-being goals.

Analysis of existing vulnerability to adverse/extreme weather

- The Climate Change team have analysed weather incident data to understand existing vulnerability of our CVL assets to adverse/extreme weather. This has provided insight into:
  - The categories of weather incidents throughout the year
  - Seasonal vulnerability and variability
  - Costs to the business from weather-related service disruption
  - Vulnerability by section of the network



Vulnerability to future climate change

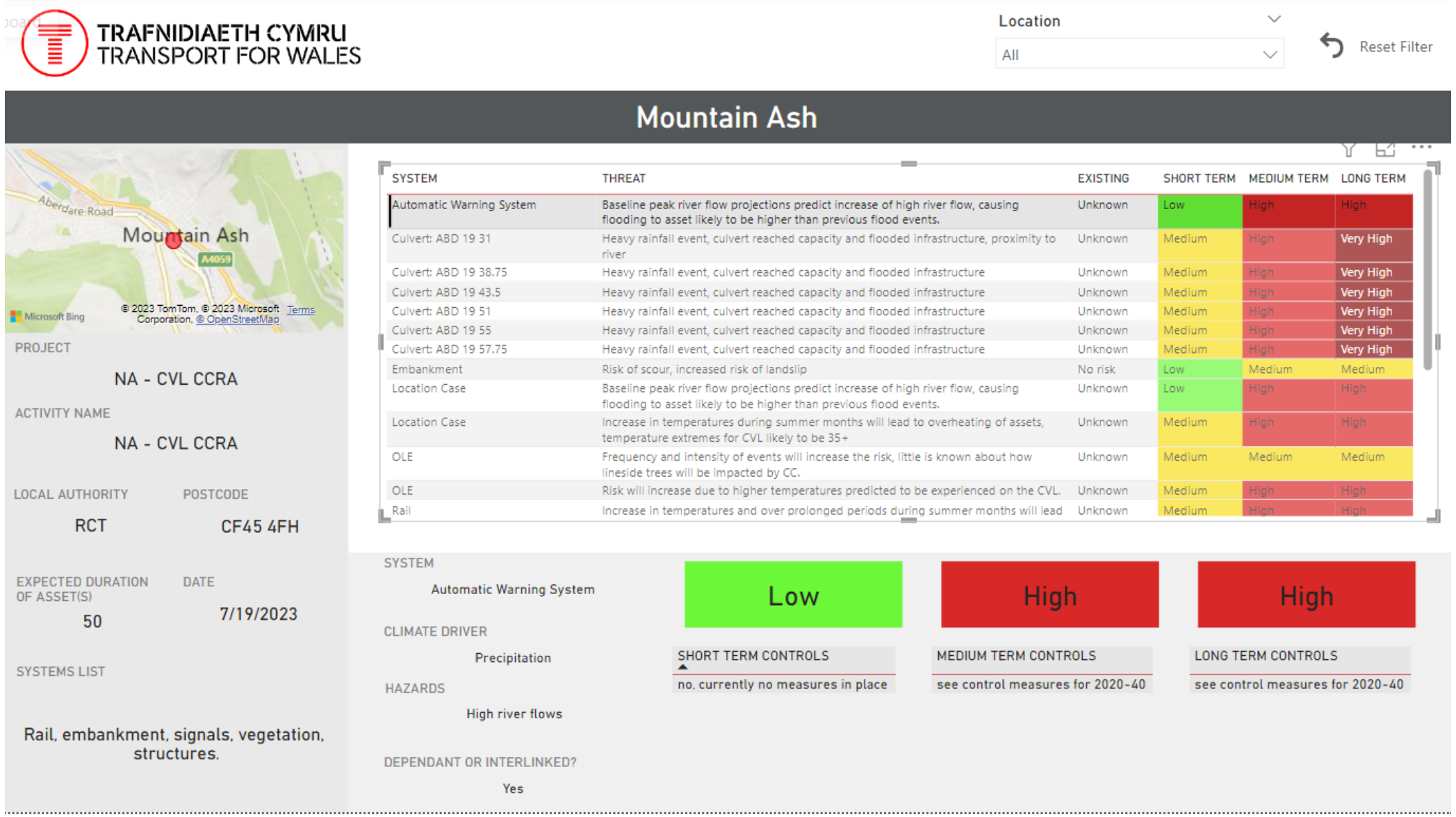
- The Plan includes a summary of the latest Met Office (UKCP18) climate scenarios for the CVL region to indicate how climate change will likely affect our owned assets.
- Maintaining current and future passenger safety is the primary objective of climate adaptation. As such, we will assess climate risk across our assets and services on the CVL for high and very high levels of global warming scenarios:

  RCP6.0 (high global warming scenario). This pathway is roughly equivalent to +2°C warming.

  RCP8.5 (very high global warming scenario). This pathway is roughly equivalent to +4°C warming.

RCP	Change in temperature (°C) by 2081-2100
RCP2.6	1.6 (0.9-2.3)
RCP4.5	2.4 (1.7-3.2)
RCP6.0	2.8 (2.0-3.7)
RCP8.5	4.3 (3.2-5.4)

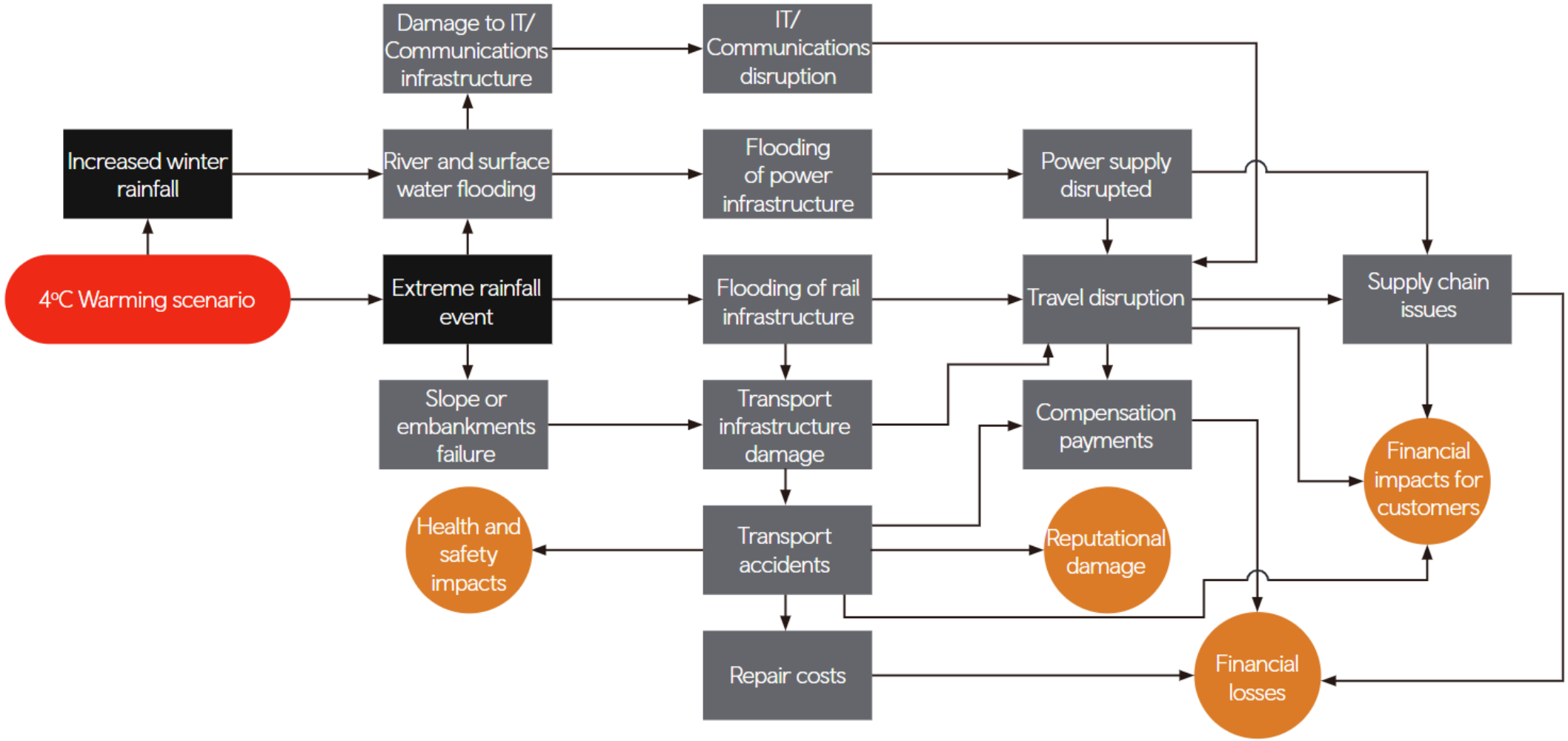
Example: Climate Change Risk Assessment



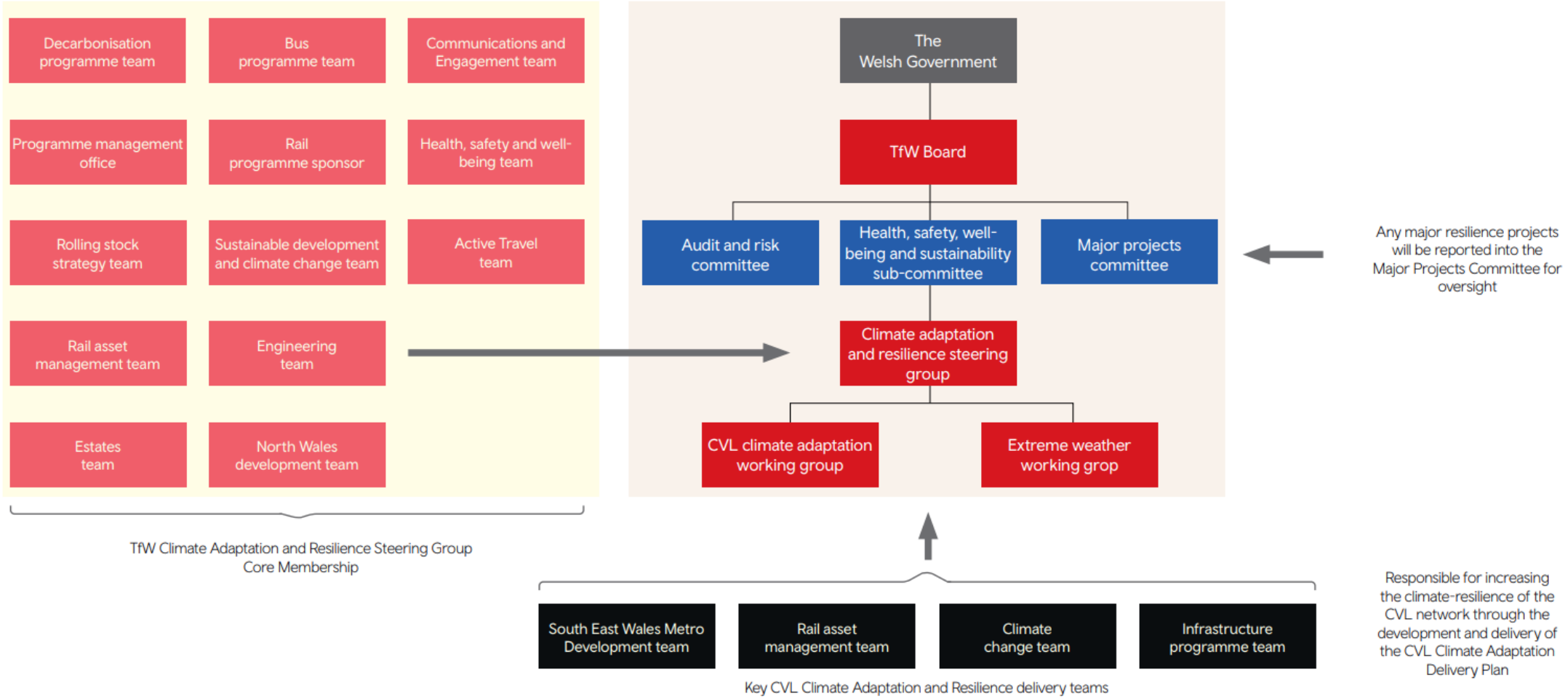
SYSTEM	THREAT	EXISTING	SHORT TERM	MEDIUM TERM	LONG TERM
Automatic Warning System	Baseline peak river flow projections predict increase of high river flow, causing flooding to asset likely to be higher than previous flood events.	Unknown	Low	High	High
Culvert: ABD 19 31	Heavy rainfall event, culvert reached capacity and flooded infrastructure, proximity to river	Unknown	Medium	High	Very High
Culvert: ABD 19 38.75	Heavy rainfall event, culvert reached capacity and flooded infrastructure	Unknown	Medium	High	Very High
Culvert: ABD 19 43.5	Heavy rainfall event, culvert reached capacity and flooded infrastructure	Unknown	Medium	High	Very High
Culvert: ABD 19 51	Heavy rainfall event, culvert reached capacity and flooded infrastructure	Unknown	Medium	High	Very High
Culvert: ABD 19 55	Heavy rainfall event, culvert reached capacity and flooded infrastructure	Unknown	Medium	High	Very High
Culvert: ABD 19 57.75	Heavy rainfall event, culvert reached capacity and flooded infrastructure	Unknown	Medium	High	Very High
Embankment	Risk of scour, increased risk of landslip	No risk	Low	Medium	Medium
Location Case	Baseline peak river flow projections predict increase of high river flow, causing flooding to asset likely to be higher than previous flood events.	Unknown	Low	High	High
Location Case	Increase in temperatures during summer months will lead to overheating of assets, temperature extremes for CVL likely to be 35+	Unknown	Medium	High	High
OLE	Frequency and intensity of events will increase the risk, little is known about how lineside trees will be impacted by CC.	Unknown	Medium	Medium	Medium
OLE	Risk will increase due to higher temperatures predicted to be experienced on the CVL.	Unknown	Medium	High	High
Rail	Increase in temperatures and over prolonged periods during summer months will lead	Unknown	Medium	High	High

Interacting risks

The infographic below illustrates an example of the types of cascading failures that TfW could experience due to increased winter rainfall in a very high warming scenario.



Our governance framework for climate resilience



Action plan for climate resilience

Action	Target Completion Date
Conduct research into Nature-based Solution schemes and develop implementation guidance	Spring 2024
Develop climate change adaptation pathways (supported by BS 8631: Adaptation to climate change - Using adaptation pathways for decision making) for the CVL	Winter 2023
Develop a vegetation management plan	Autumn 2024
Develop a Climate Adaptation and Resilience Delivery Plan for the CVL network, including drainage and earthworks	Summer 2023
Conduct a comprehensive assessment of climate risk across the CVL network, including stations and depots	Summer 2023
Embed the requirement climate change risk assessments into all TfW major projects (such as North Wales Metro) and existing policies Spring 2024	Spring 2024
Produce weather-related impact assessments for the CVL, focusing on: Flooding, landslips, heat, lightning, sea-level rise, wind, extreme cold, heat and fog	Autumn 2023
Develop a framework and climate projections guidance document to support the assessment of climate risk	Autumn 2022
Facilitate the coordination of a cross-discipline Climate Change Adaptation Working Group for Welsh Infrastructure Owners to support the development of management for cascading failures	Summer 2023
Develop management and response plans for extreme weather events and outbreaks of invasive species/emerging pests and diseases	Winter 2023
Embed the climate change adaptation standard ISO 14090:2019.	Summer 2023
Set up an overarching TfW Climate Change Adaptation Steering Group and a CVL-focussed Climate Change Adaptation Working Group.	Spring 2022

Questions or comments?

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