



# Keeping London's transport system resilient to extreme weather and climate change

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## Slide list (wont show)

### Long Term Climate Change

- 1. What TfL Does
- 2. UK Government (Adaptation Reporting Power (and reviews), National Adaptation Plan)
- 3. Environment Agency (Thames Estuary 2100 and threshold approach, Infrastructure Operators' Adaptation Forum), ClimateWise
- 4. Regional – Greater London Authority - A London Plan, Mayor's Climate Change Adaptation Strategy, Drain London, London Climate Change Partnership, Green Streets, Ecosystem Services
- 5. TfL Risk Identification (Analyse climate projections)
- 6. LU Comprehensive Flood Risk Review
- 7. Communicating and assessing key risks in workshops
- 8. Communicating risks – heat maps
- 9. Mitigating Risks (Design)
- 10. Mitigating Risks (Design) Examples from Northern Line Extension
- 11. Mitigating Risks – The Power of Procurement
- 12. Mitigating Risks (Asset management, PAS 2050)
- 13. Mitigating Risks (Cooling the Tube Programme)
- 14. Identifying inter-dependencies

### Managing Today's Extreme Weather

- 15. 54321
- 16. Communications/manage expectations
- 17. Positive Impacts and Opportunities

# What Transport for London Does



# UK Government Initiatives for Managing Impacts of Climate Change

Climate Change Act 2008



UK Climate Projections 2009

## Adaptation Reporting Power

- Key sectors and companies
- Legal duty to report on risk assessment and mitigation

## UK Climate Change Risk Assessment

- Detailed analysis of 100 potential impacts of climate change

## National Adaptation Programme

- Published w/c 24 June!

## Regulator's Initiatives - Environment Agency



### Thames Estuary 2100 Project

- A long-term flood risk management plan for London
- Options identified for first 25 years, middle 15 years and final 50 years



### Uses Flexible 'Threshold' Planning Approach

- How effective would options be against current projections?
- How effective would options be if projections were to worsen?



### Communication

- Infrastructure Operators' Adaptation Forum
- Climate Ready

# London Regional Initiatives – the Greater London Authority

London Plan –  
spatial planning  
with adaptation  
rules for  
developments

Drain London  
Partnership to  
map and  
manage surface  
water flooding

Mayor's Climate  
Change  
Adaptation  
Strategy

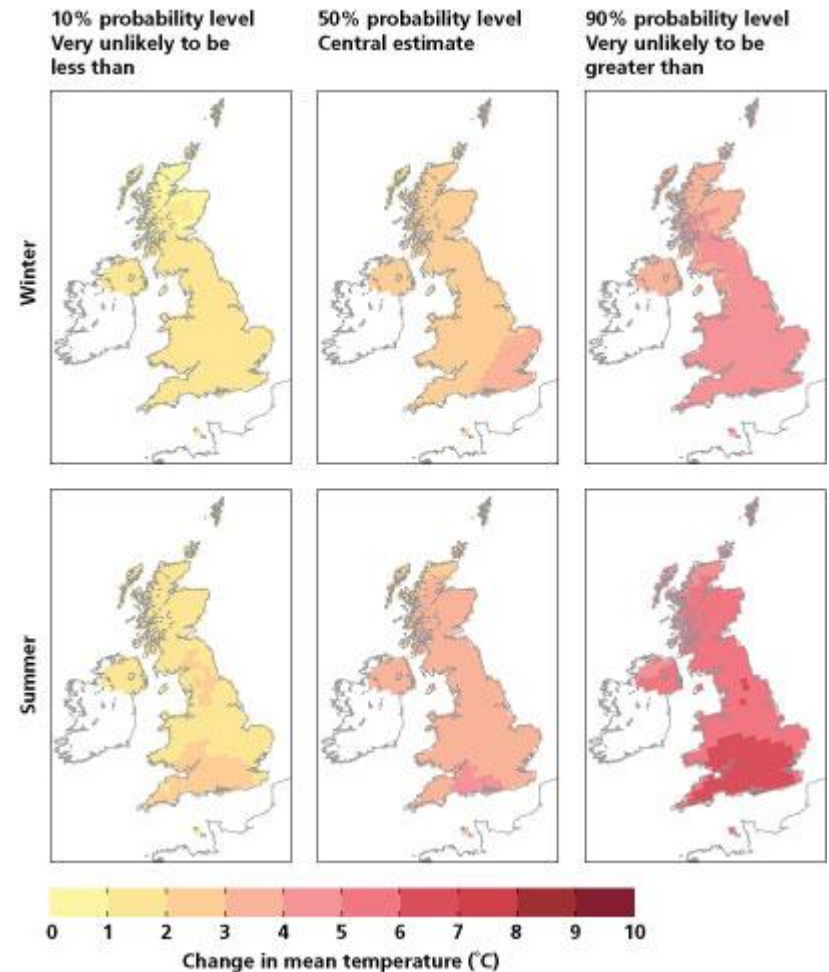


Ecosystem  
services – policy  
behind green  
streets, sustainable  
drainage

London Climate  
Change Partnership  
– forum of key  
sector  
representatives

## TfL Risk Identification (Analyse climate projections)

- A series of probabilistic scenarios based on all latest research
- Regional data for temperature, rainfall
- Different emissions scenarios
- Analysed and presented numbers to engineers
- Used Greater London region, liaised with GLA
- Checked consistency with existing TfL models eg Tunnel Cooling Programme



## London Underground's Comprehensive Flood Risk Review

- Traditionally our flood risk methods measured the risk of loss of life
- Resulted in identifying low probability, high frequency events
- Now also valuing the risk of loss to business
- Capturing many more vulnerabilities with lower impacts but higher probability





# Communicating and Assessing Key Risks in Workshops

- Warmer wetter winters, rainfall becomes more seasonal- Winter 2050's (high emissions)
  - +1.5 -2 3°C
  - + 25-30% rainfall
- Hotter drier summers - Summer 2050's (high emissions)
  - +3°C
  - 
  - 
  - 
  -
- More frequent extreme weather
- Rising sea levels - increased river flooding
- Poorer air quality - increase in PM10 concentrations in hotter weather

Identify the risks and their impacts on

Tracks  
Drainage  
Bridges  
Embankments  
Signaling  
Stations  
Green spaces  
Surfaces  
pavement  
Transport

TfL's  
assets and  
services

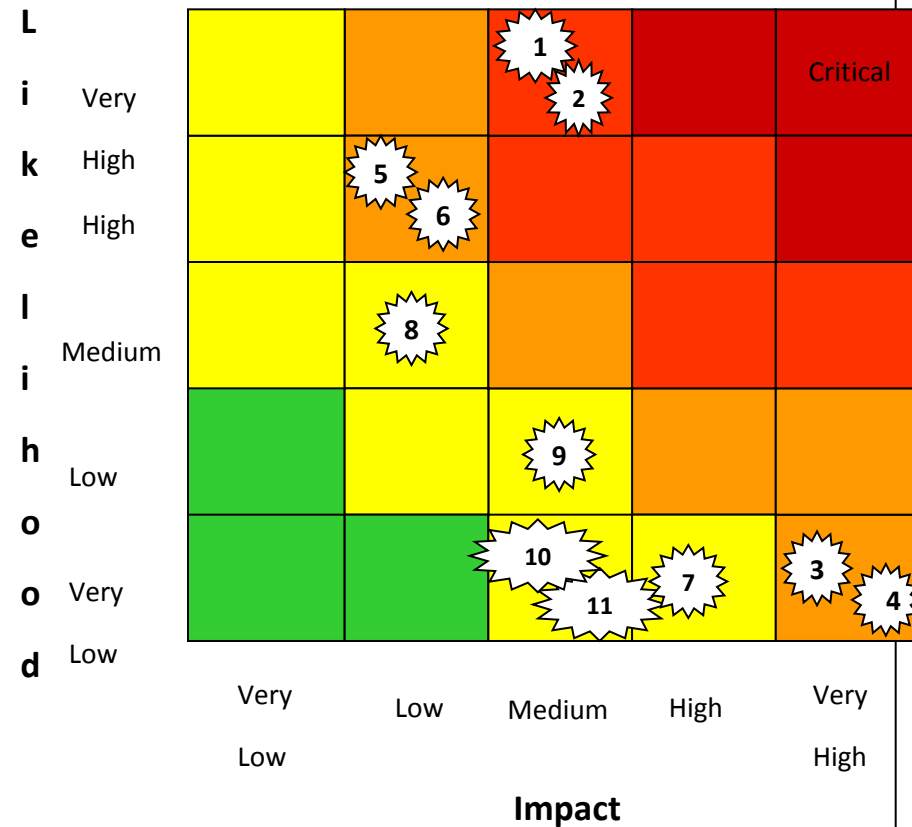
Capital investment  
Station upgrades  
Asset Management  
Service issues  
frequency  
Communication

Options

# TfL's Risk Identification and communication

- 1- Extreme Hot Weather - Key track, signals, & communications assets and staff & passengers.
- 2- Rain & Flooding - Track & signal drainage
- 3- Cold & Freeze - Impact on track integrity
- 4- Rain & Flooding – Key infrastructure drainage
- 5- Drought - Vegetation impact
- 6- Snow – track, signalling and depot operations
- 7- Cold & Freeze - Train system components
- 8- Cold & Freeze – Slips/trips for staff and customers.
- 9- Rain, Flooding and snow - Damage to inside of carriages
- 10- Wind- Damage to infrastructure, track and vegetation.
- 11- Drought - Ground stability impacts

## London Underground Weather-Related Risks



# Lessons Learned from Managing Previous 'Extreme Weather' Events

- **Partnership working**

With boroughs on plans

- Key routes for buses, access roads to bus garages gritted
- Plans agreed on how partners should co-ordinate priorities
- TfL ran trains through the night to keep the tracks open

- **Clear communication strategy**

- Important to have early multi-agency meetings as soon as first severe weather alert received.
- Ensured mechanisms to deliver clear and consistent messages to media, business partners, customers



# Design Included in developing assets which have long design life

- Crossrail build and operation
  - Train and tunnel temperature
  - Station design
  - Operator specifications
- London Overground capacity improvement
  - Included in sustainability appraisal
  - Sustainable design aims
  - Sustainable Drainage Plan
- Sustainable Drainage in maintenance and upgrades
  - Station enhancements eg Harrow on the Hill
  - Depot enhancements



# Managing Risks - Design (Detailed Example from Northern Line Extension)

- Northern Line extension
  - Included in sustainability appraisal for seeking Planning Permission via a Transport and Works Act Order
  - Climate change plan in Environmental Statement of Environmental Impact Assessment
- Covers heat management
- Tunnel ventilation plan



# The Power of Procurement Specifications

- Procurement specifications
  - Eg white bus roofs
- Programme delivery
  - Crossrail build and operation
  - Northern Line extension
  - London Overground capacity improvement
  - SUDS in maintenance and upgrades
- Comprehensive Flood Risk Review
- Tunnel Cooling programme
- Resilience, Business Continuity, Emergency Planning, Risk Assessments and management
- Drain London programme
- Environment Agency Sustainable Drainage Partnership
- Drain London



# Asset Management (PAS 2050)

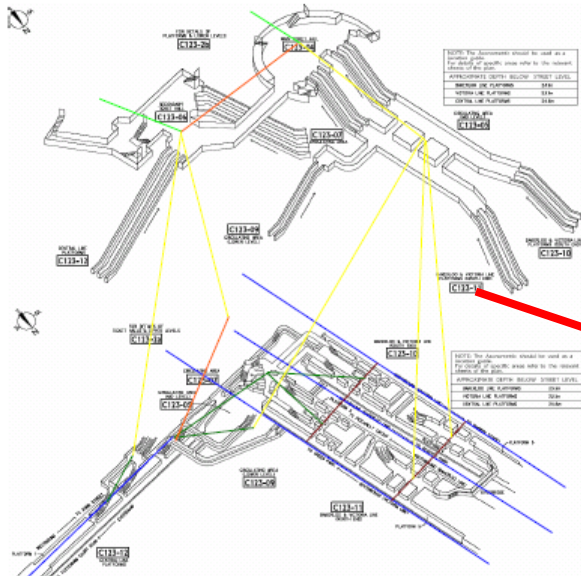


# Mitigating Risk - Cooling the Tube Programme

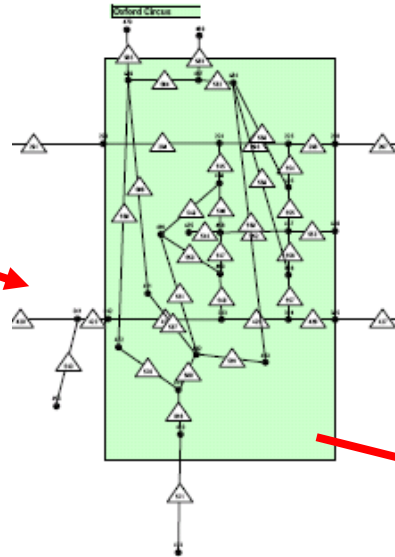
67TS  
28TPH

Total = 3.74E+06 kWh (sensible)

## Station Geometry



## Network Model

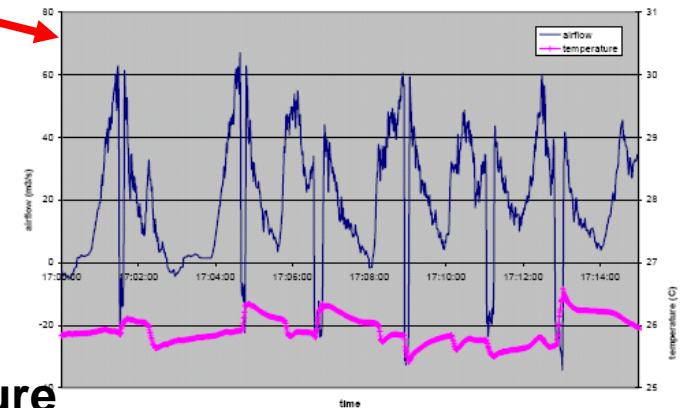


- Passengers Aboard Train 3%
- Train Auxillaries 13%
- Tunnel Systems 4%
- Station Systems & Passengers 4%

38% Braking Losses

16% Drive Losses

22% Mechanical Losses



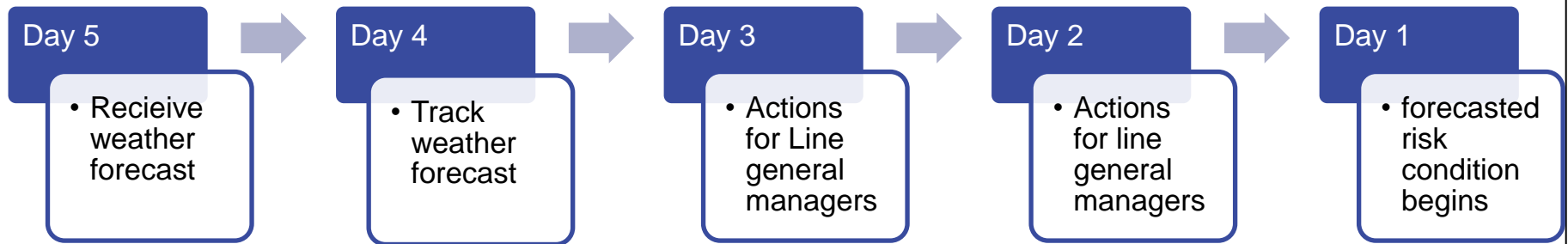
## Flow and Temperature Predictions





# 54321 Extreme Weather Readiness Plans

- Learning from Olympics Planning, network wide overview for first time



# Communications, Managing Expectations

- Importance of communication, with customers, partners, businesses
- Employees' and contractors' skills, health and safety and quality of work
  - Currently no legal upper temperature limit for workers
- Services, timetables, frequency, emergency planning
- Customer comfort and information (eg snow alerts, Stay Cool LU campaign)



**Staycool**  
in the heat

For the summer we have installed fans at this station to increase air circulation and to help improve your comfort.

For more information visit [tfl.gov.uk/tube](http://tfl.gov.uk/tube)

MAYOR OF LONDON

Transport for London

# Positive Impacts and Opportunities

