Adapting the Railway for Improved Resilience against Future Weather Conditions as a Result of Climate Change

Priority problems

Weather-related impacts have caused, on average, 1.5million delay minutes per year since 2006.

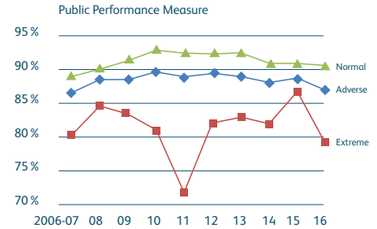
Wind and flooding have by far the biggest impact on the railway. Addressing the problems outlined below will reduce delay minutes and associated costs, cancellations, repairs now and in the future.

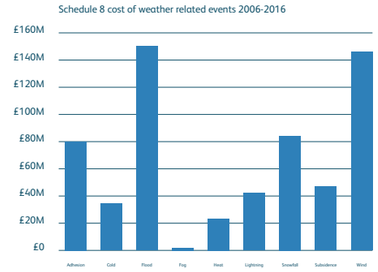
Specific priority problems	Related goals
• Vegetation growth and biodiversity Climate change will alter growth and distribution of vegetation, biodiversity and pests/diseases. This could make managing vegetation growth more challenging and have both negative and positive impacts upon efforts to support biodiversity. Delay minutes 2006 – 2016 Wind: 19.3m; Adhesion: 9.1m	• Understand how changes in species/vegetation could affect current lineside management approaches. Identify new ways of using vegetation to enhance safety and performance. • Understand how climate change might impact our current efforts to manage biodiversity.
• Flooding Winter rainfall is projected to increase significantly as a result of climate change with peak river flows increasing from 5 - >100 % depending on catchment. 40 % of track is already at high/medium risk of flooding. Delay minutes 2006 – 2016: Flooding 18.3m	• Identify new technologies and approaches to enhance the resilience of the railway system. Including reducing the impacts of flooding upon individual assets.
• Frequency of storms The cumulative impact of wind, heavy rain and lightning has a significant impact on the railway. The intensity and frequency of storms may change in the future, this could amplify risks to an already vulnerable system. Delay minutes 2006 – 2016 combined lightning, flood and wind: 40.7m. Storm Doris on 23 February 2017 cost £7.4m in Schedule 8 delays in one day.	• Enhance forecasting and planning in advance of storms. • Identify new approaches to managing cumulative impact to assets during storm events (e.g. remote monitoring).
• Lightning Lightning can cause significant disruption to signalling and electrical equipment. Climate change is likely to affect the frequency and intensity of storm events although the impact on the incidence of lightning strikes is uncertain. Delay minutes 2006 – 2016 Lightning 3.1m	• Understand where and how the frequency and intensity of lightning strikes might change in the future. • Ensure that the Digital Railway is not impacted by lightning and changing electrical/magnetic atmospheric conditions (e.g. GPS and other non-hardwired assets). • Increase resilience of signalling, electrical and other assets to impact of direct strikes and surges and other secondary impacts from lightning strikes elsewhere.
• High temperatures An increase in mean temperatures, including hot and very hot conditions, and reduction in the diurnal temperature range will amplify impacts already experienced during high temperatures and reduce the time available for maintenance activities (due to workforce heat stress, rails being too hot to handle for longer periods etc). Delay minutes 2006 – 2016: Heat 0.6m	• Reduce mechanical and asset failures in high temperatures looking at the whole system including track, switches, clips, OLE, signalling rolling stock etc. • Develop more efficient and innovative approaches to maintenance to reduce the impact of heat stress on maintenance activities.

What is the situation?

Adverse and extreme weather conditions have a significant impact on the reliability of assets and on the performance and safety of the railway. Weather impacts cost us £50-£100m per year in delays and cancellations alone. However, the overall cost is much higher when weather-specific maintenance and repair costs are included. Adverse weather conditions have resulted in an average 2-3 % reduction in Public Performance Measure (PPM) performance across the railway network compared with normal weather conditions over the past decade. The impact of extreme weather can vary significantly year-by-year.

Climate change is projected to increase temperature and precipitation and deliver more disruptive weather events such as storms. It will affect our understanding of risk as historic patterns of likelihood and severity shift, thereby amplifying the impact of weather on the railway. As coping thresholds are breached, risk levels may reach unacceptable levels and becoming resilient will be more challenging. Extensive knowledge of assets and awareness of weather vulnerabilities and the long-life nature of the majority of assets means that we know broadly how climate change is likely to impact the railway. The challenge is to adapt by finding new ways of working, potentially radically shifting what has been standard practice, in order to maintain an acceptable level of risk when faced with increasingly extreme weather conditions. We need to identify and test new asset designs, technologies and approaches. Future proofing the renewals, enhancements and infrastructure projects that we are building today and provide life-cycles that span many years.





Specific research needs

This challenge seeks research into new ways of designing assets (infrastructure, rolling stock etc), operating the railway, undertaking maintenance and inspections etc. which would result in a measurable improvement in resilience.

Network Rail holds significant data relating to costs and delays from past weather incidents and asset reliability which can be made available to support analysis. Pilot projects to trial new approaches and technologies can also be arranged.

Specific Research and Technology Questions

With consideration as to how climate change will affect the frequency, severity, and potential location of adverse and extreme weather events, and the associated cost benefit of adaptation:

- How can assets/ infrastructure be redesigned to enhance reliability, prevent and reduce weather-related impacts?
- What technology can enable a shift in the way things have been done in the past to prevent/reduce the impact of weather on operations and assets?
- What can be done to enhance preparation for extreme weather events as well as prevent incidents from occurring?
- What can be done to improve response and recovery times following incidents to reduce delays and cancellations?
- What operational changes can be made to reduce the impact of climate change (e.g. new approaches to maintenance, timetabling, track stressing etc).
- Considering the railway as a system of systems, what changes can we make in one area which might have knock-on benefits in the resilience of others?
- What is the cost benefit of the above measures including the value of the loss avoided in perpetuity and payback?

This challenge is intentionally broad in order to facilitate innovation. Network Rail is willing to discuss and consider additional research and technology questions based on the merits of the idea and potential associated benefit.

Expected impact & benefits

Enhancing resilience of the railway will have a significant long-term positive impact on safety, performance and finances. Unlocking new ways to prevent or significantly reduce particular weather-related impacts on the railway could eliminate the need for Temporary Speed Restrictions and prevent incidents causing delay and damage to infrastructure. Current costs are in excess of £50-100m per year and without adaptation, costs will increase as assets struggle to operate under extreme conditions.