

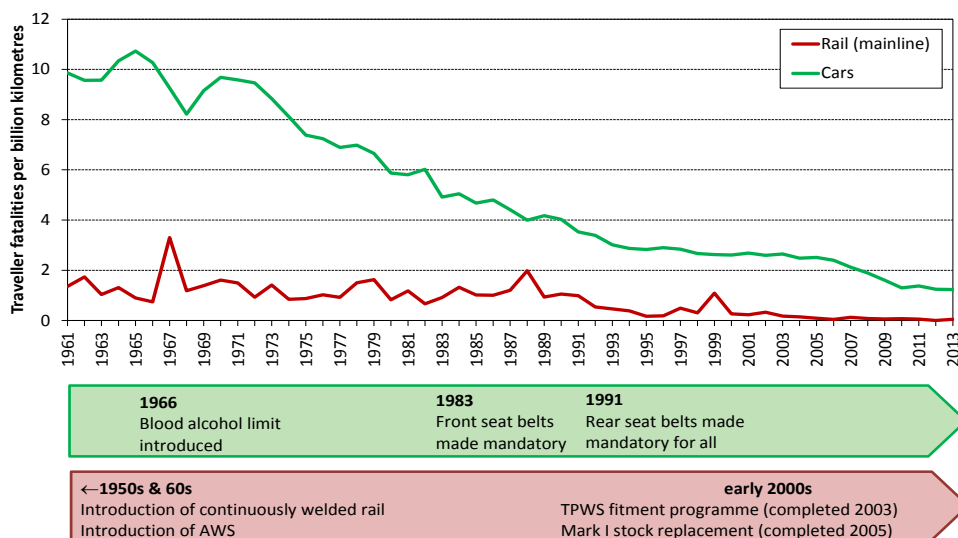
# Overview of health and safety performance on Britain's railways in 2014-15

## Introduction

We use a range of data from various sources together with our inspectors' assessments, observations and findings to develop a full picture of the state of health and safety. This section sets out some of this data in the context of historical trends.

## Passenger safety – mainline railway versus cars, 1961-2013

Safety on Britain's mainline railways continues to improve. It remains a safer form of transport than road, although both are growing ever safer as risk is designed out, new technologies and processes are applied, and lessons are learnt from other industries. Road safety fatality rates reduced 49% between 2006 and 2013.

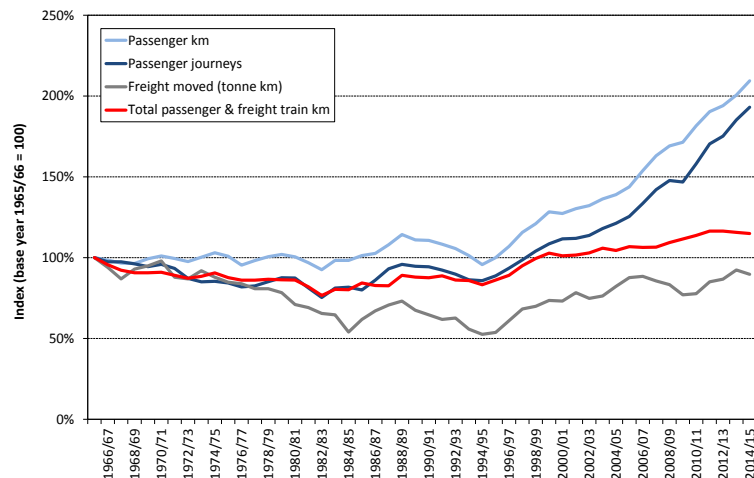


Source: RSB analysis based on data from DfT, ORR and RSB

# The mainline passenger growth challenge

## Mainline passenger and freight railway usage between 1966-67 and 2014-15

Passenger kilometres travelled (light blue line) and journeys made (dark blue line) have increased steeply since 1994-95. Freight tonnage and kilometres hauled (grey line) has increased more gradually over the last 20 years. Overall passenger and freight 'activity' (red line) has continued to grow gradually since the early 1980s.



Source: RSSB, based on ORR's National Rail Trends<sup>1</sup> and DfT's Transport Statistics Great Britain<sup>2</sup>

## Difference between modelled risk and actual harm

We use many different ways to assess the relative safety performance of Britain's railways. Two key measures often cited in this report do distinctly different things:

- *actual harm* caused to individuals, which is measured on the mainline using the fatalities and weighted injury index. For example, the actual fatality and injuries incidents to passengers, workers and the public caused by the operation of Britain's mainline railway; and
- *modelled risk*, which uses historic mainline data to periodically quantify the frequency and potential average consequence from a particular set of circumstances that could lead to a safety incident. The Safety Risk Model (SRM) periodically takes a snapshot of all significant risks on the mainline and the monthly Precursor Indicator Model (PIM) tracks trends in key catastrophic precursor train accident risk.

In 2014-15 modelled risk decreased, which shows that the mainline industry is reducing the potential for circumstances that lead to a catastrophic incident with multiple fatalities. However, some levels of actual harm to individuals increased. This highlights an important aspect of the potential randomness of events. For example, similar passenger train derailments may potentially cause a catastrophic incident with multi-fatalities in one set of circumstances, or cause minimal damage and no injuries or harm in another.

In 2014-15, the likelihood of harm from lower levels of risk was realised, but the higher levels of catastrophic harm was not. Ultimately, our interventions are aimed at ensuring duty holders prevent the potential risks from harm-causing incidents - particularly those that can cause catastrophic harm - by the provision of effective safety controls or risk elimination.

<sup>1</sup> <https://dataportal.orr.gov.uk/>

<sup>2</sup> <https://www.gov.uk/government/statistics/transport-statistics-great-britain-2014>

## Mainline passenger and public fatalities and weighted injuries

39 passengers, workers and members of the public were killed on the mainline railway and one on the non-mainline, in 2014-15, up 5% on 2013-14. These involved 22 trespassers, the same as 2013-14; 10 level crossing fatalities, down two; three passenger fatalities; four worker fatalities; and one public assault fatality at a station. The passenger fatalities involved falls at stations, one on to the third rail, one in front of a train and one down station stairs. None were industry-caused. The fourth station fatality was classified as a 'public assault' and involved the tragic death of a young boy in a suicide event involving his mother.

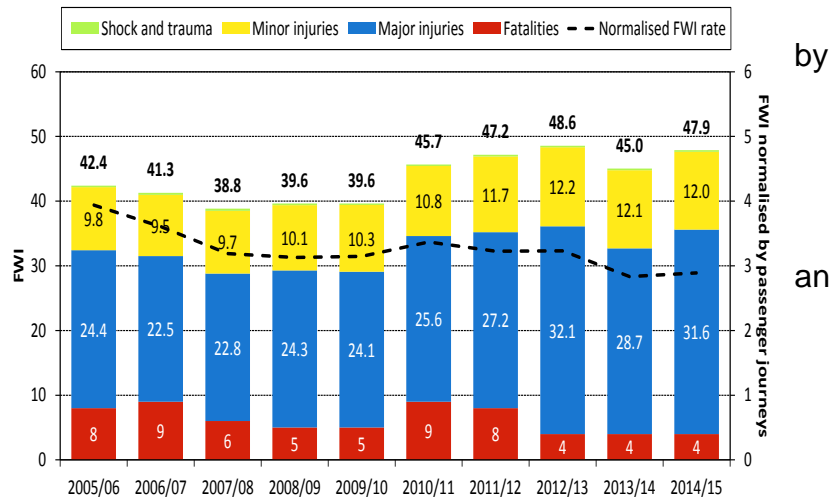
Passenger major injuries increased 7%. When normalised increases in passenger journeys, passenger and public slips, trips and falls, which represent the largest harm to passengers at stations, increased 1%. This was due to additional passenger trip fatality.

Of those incidents, 37% occurred on station stairs and 27% on platforms. Harm to passengers from boarding trains reduced 10% and from alighting trains reduced 32%, but harm to passengers on board trains increased 22% and those at stations increased 53%, mostly because of increases in major injuries.

Of those, 66% were caused by collisions with objects and people on railway property. Overall harm at the PTI reduced 21%, or 24% when normalised by increases in passenger journeys.

Trends in class 1 minor injury harm to passengers (when the person is taken to the hospital) reduced 10% and by 24% when normalised by the rise in passenger journeys. Major injuries caused by falls and 'contact with objects' accounted for 63% of the total harm recorded in 2014-15. Harm to passengers and the public at stations increased 53% due to increases in major injuries.

Overall harm to the public increased 10% because of the slight increase in level crossing fatalities. Assaults on the public and passengers increased 10%, but by 6% when normalised by the growth in passenger journeys. A total of 2,888 assaults were recorded by the BTP on trains and stations.

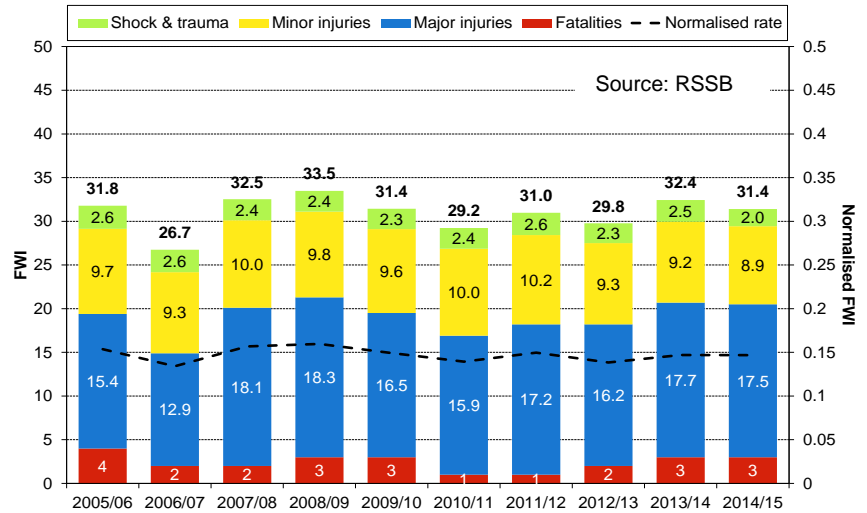


## Mainline workforce fatalities and weighted injuries

Overall mainline industry workforce fatalities and injuries harm declined 3%, but when normalised by the 3% reduction in workers' hours worked (0.21 billion workforce hours worked), showed no significant change on 2013-14.

There were 80 major injuries to workers, the same as in 2013-14, of which 45% involved slips, trips or falls and 32% involved contact with objects or persons.

There were minor reductions in overall non-fatal workforce injuries. Of those, 53% occurred at stations and 40% on board trains. On-train workforce harm increased slightly, but is the second lowest since 2005-06.



Source: RSSB

Harm to workers reduced 9% because of a 14% reduction in all workforce major injuries. Harm due to slips, trips and falls reduced 50%, but harm at the platform-train interface increased 53% (mostly drivers and train crew). There were 37 major injuries to the workforce, of which 76% occurred at stations. Slips, trips and falls account for 29% of major injury risk and 19% of the overall risk to the workforce.

The small improvements in workforce harm have only kept pace with the rises in workforce hours worked over the year. As the chart above shows, the trend in overall mainline workforce harm has remained broadly unchanged with only slight variations since 2005-06.

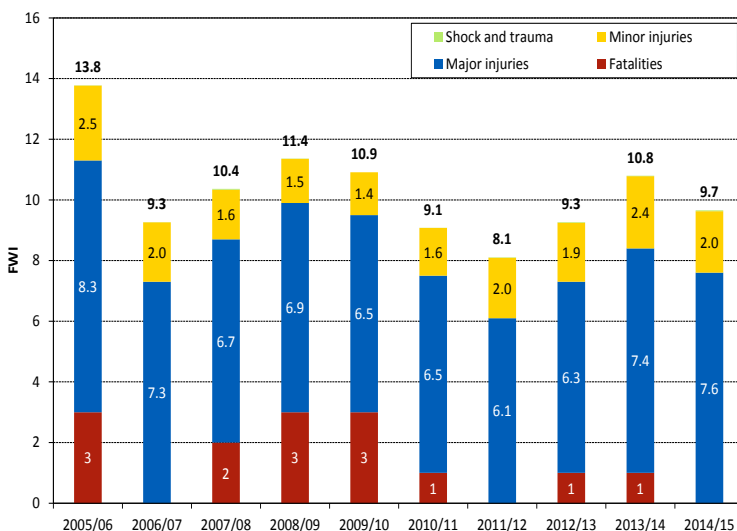
The key harm causing workforce injuries were slips, trips and falls, the PTI, contact with objects, on board injuries, struck and/or crushed by train and risks from electrical sources.

## Mainline infrastructure worker fatalities and weighted injuries

There were two mainline infrastructure worker fatalities in occupational traffic accidents. One involved a construction worker on the new Borders Railway in Scotland and the other involved a Network Rail office worker in central London.

There were two other worker fatalities, one on the mainline caused by a cleaner coming into contact with the third rail at a depot and one caused by an infrastructure worker coming into

contact with the overhead line on operational metro infrastructure. There were six electric shock major injuries and 21 minor injuries – a higher number than usual.



Source: RSSB

## **Mainline infrastructure worker fatalities and weighted injuries on the running line**

Overall harm to mainline infrastructure workers on the running line declined 10%, because there were no worker fatalities on the running line. However, with the 3% reduction in mainline workforce hours (0.21 billion workforce hours worked), the infrastructure worker harm level was very similar to 2013-14.

Harm to infrastructure workers from major injuries increased slightly because of rises in electric shocks (six), and collisions with objects or people (22).

Harm to infrastructure workers from minor injuries that required hospitalisation reduced 23%, after the higher level of 2013-14.

The Safety Risk Model (SRM) v.8.1 suggests that slips, trips and falls harm represent 37% of the overall harm to infrastructure workers. Over the last decade, nine of the 14 infrastructure worker fatalities involved being struck by a train, which accounts for 10% of the overall harm to workers, but 64% of the fatality harm. Harm to infrastructure workers on the running line is around twice that of harm to the rest of the overall workforce.

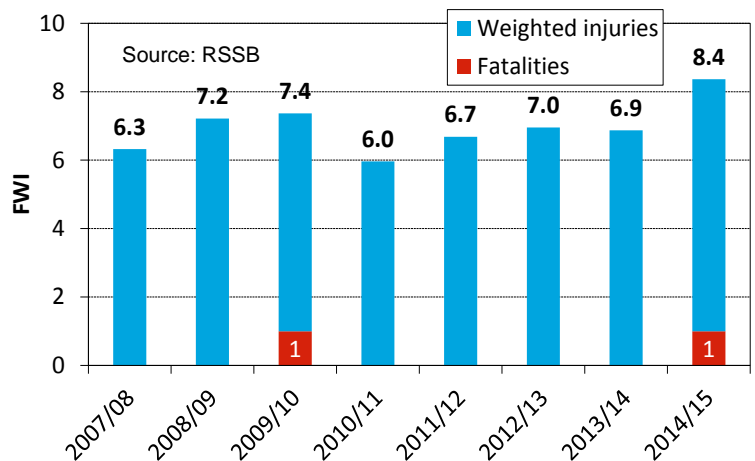
## Yards, depots and sidings

Harm to mostly workers in yards, depots and sidings increased 17% in 2014-15, with slips, trips and falls accounting for around half of this.

The fatality involved a train cleaner who was electrocuted on the third rail at a depot. It is not included in the dataset, but it is suspected that an off-duty worker committed suicide in 2014-15. There were five major and 1,354 minor injuries. The depot electrocution fatality and increase in major injury harm were the key drivers of the rise in harm.

Harm in yards, depots and sidings represents around 22% of harm to the whole workforce. Of that 43% is caused by slips, trips and falls and 32% is from 'contact with objects'.

## Trends in harm to workers in yards, depots and sidings



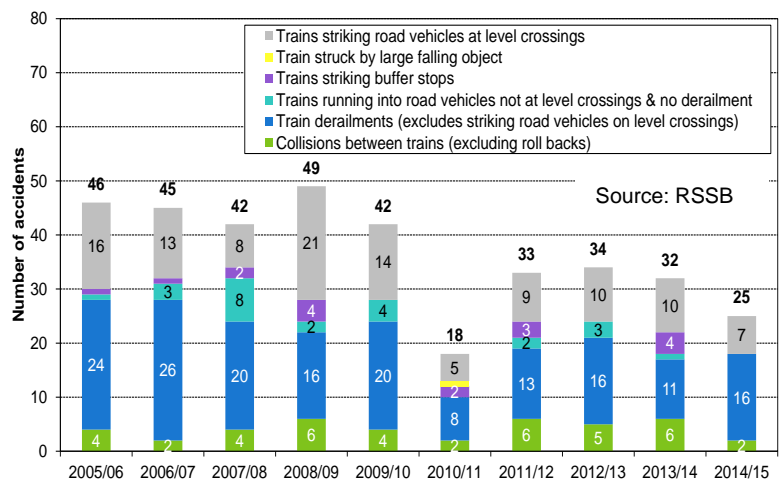
## Trends in potentially high risk train accidents

Potentially High Risk Train Accidents (PHRTAs) represent 6% of incidents on the railway but 93% of the potential train accident risk, which is why we monitor it closely. PHRTA events include derailments, train collisions, buffer-stop collisions, train collisions with road vehicles and large objects blocking the running line.

The 25 PHRTAs, down seven (15%) on 2013-14, form part of a longer-term broadly reducing trend.

These 25 included 14 freight train derailments where track geometry was one of the contributory factors.

The other eleven PHRTAs included two empty passenger rolling stock derailments, one in a shunt movement-caused SPAD and one due to poor track geometry and imbalanced wheel-loading. There were seven collisions between trains and road vehicles at level crossings, which resulted in two fatalities, and two low-speed train collisions between passenger trains and empty passenger trains at Glasgow Central high level station. For the second year in a row, there were no passenger train derailments – an unprecedented record. Most mainline passenger train collisions occur at low speed at stations, 26 of the 30 occurred there over the last decade.



## Mainline railway accident precursor risk as measured by the precursor indicator model

The precursor indicator model (PIM) provides an indication of changes in PHRTA risk by tracking incident frequency based on their average consequence. It does this using the results of the safety risk model (SRM). The PIM acts as a proxy to the SRM to quantify the

potential risk from the 51 high risk train incidents it monitors. The PIM covers most but not all mainline risks, for example, it does not include risks to passengers at stations.

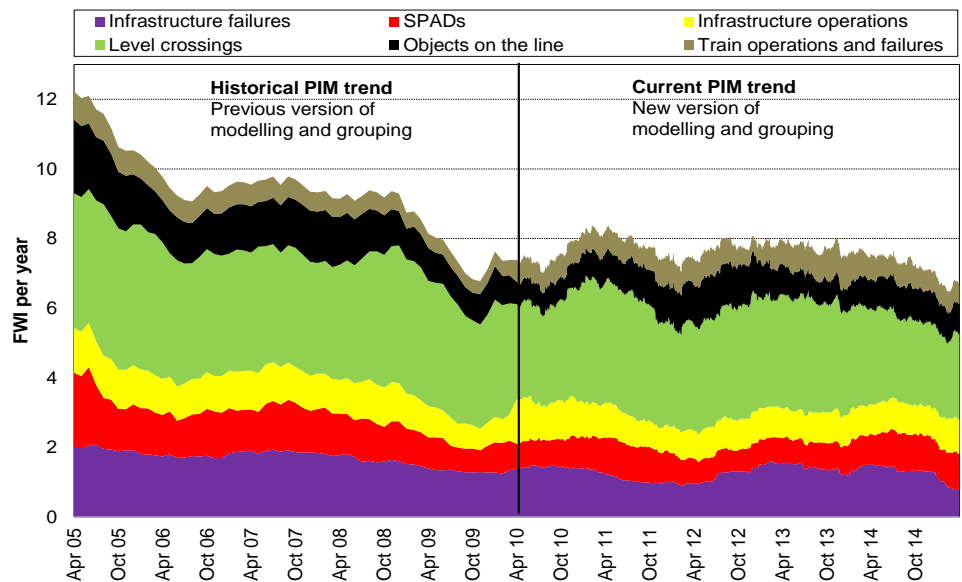
The SRM provides a snapshot estimate of all significant mainline railway risk, based on a detailed analysis of likely harm caused by 23 hazards in around 1,700 risk events. It includes those ‘near miss’ incidents that had the potential, but did not, cause harm. It uses a longer dataset to avoid the potential for short-term volatility, and a common fatalities and weighted injuries index. RSSB recalibrates the SRM every 18-24 months to revise the assumptions on potential likelihood of risks using data from more recent incidents and incident precursors. It was last done in August 2014.

Britain’s mainline network has made good progress in gradually reducing catastrophic train accident risk – partly through regulated improvement driven by law and via investments in new rolling stock and technologies. The SRM v. 8.1 predicted a serious train accident on Britain’s mainline network once every 21 years; a significant improvement on where we were a decade ago.

## Ten year trend in the overall PIM v. 8.1 (August 2014)

The PIM’s risk group categorisations changed slightly in 2014-15 to align them more closely with those risk areas monitored by Network Rail on the mainline – see *PIM chart opposite*.

Improvements to the PIM’s risk modelling over time mean that the trends shown in the chart between April 2005 and 2010 are only approximations of those processed by the new PIM modelled risk.



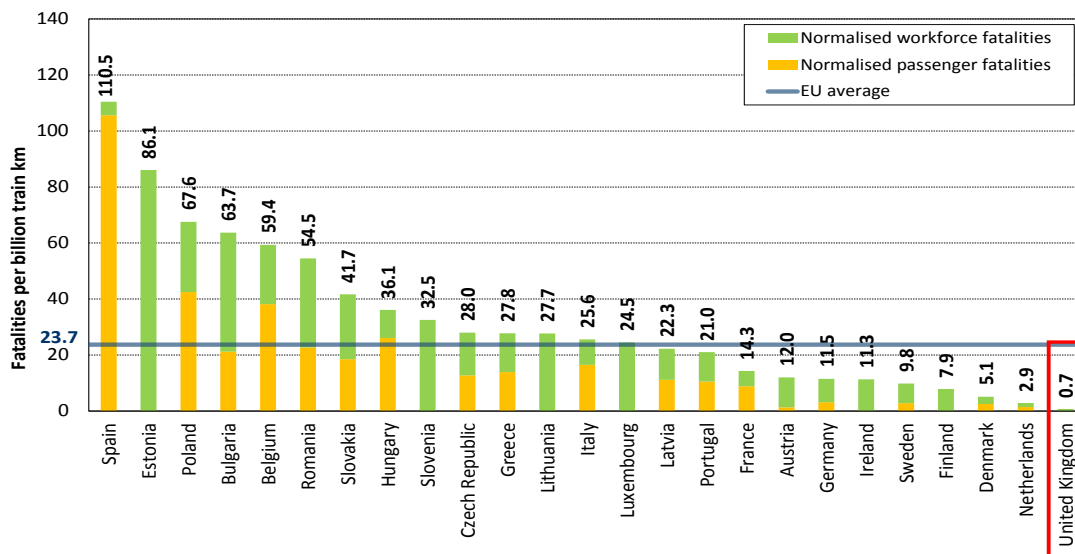
Source: RSSB.

PIM-measured train accident risk declined 15% and risks to passengers declined 16% in 2014-15. Currently, fatal train accident risk for passengers is at the lowest level ever achieved. Public behaviour at level crossings forms the biggest element of overall train accident risk modelled by the PIM, but most of that risk is to the crossing users themselves.

## Comparison with European Union’s railways

Passenger and workforce fatality rates on Britain’s mainline railway involving moving trains remained well below the European Union (EU) average between 2009 and 2013 – the most recently available dataset. This was mainly because of the low levels of passenger and worker fatalities. The last passenger fatality in a train accident was in the Grayrigg derailment in 2007. Britain’s mainline railways are currently the safest in the EU at managing overall risk to passengers and workers and at managing level crossing safety, and second best at managing public safety.

## Passenger and workforce fatality rates across the European Union's railways, 2009-13



Source: RSSB analysis based on Eurostat data

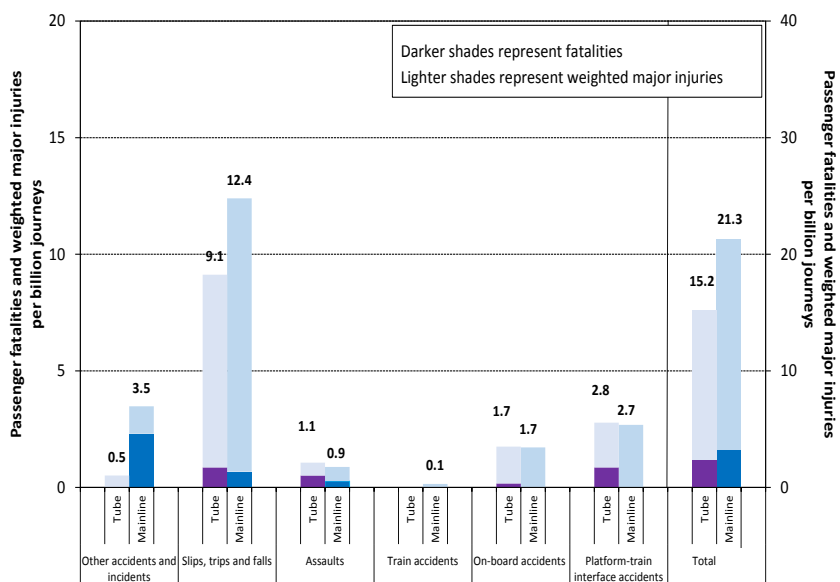
## Comparing the mainline railway to London Underground

Direct and meaningful comparisons between the harm profiles on the mainline railway and LU require care due to the different style of mass transport systems involved. One is a national network and the other provides a very high frequency service in greater London.

However, both networks are facing big challenges from year-on-year passenger growth and vast, simultaneous infrastructure investment programmes.

There are similarities in the levels of passenger harm - there were no passenger fatalities in train accidents and similar levels of assaults on passengers, train accidents and on-board incidents – see chart opposite.

However, there were higher levels of ‘other incidents’ on the mainline, likely due to the larger potential harm scenarios, such as a higher level of non-fatal slips, trips and falls, as a result of the scale of the mainline infrastructure and its exposure to weather.



Source: RSSB.

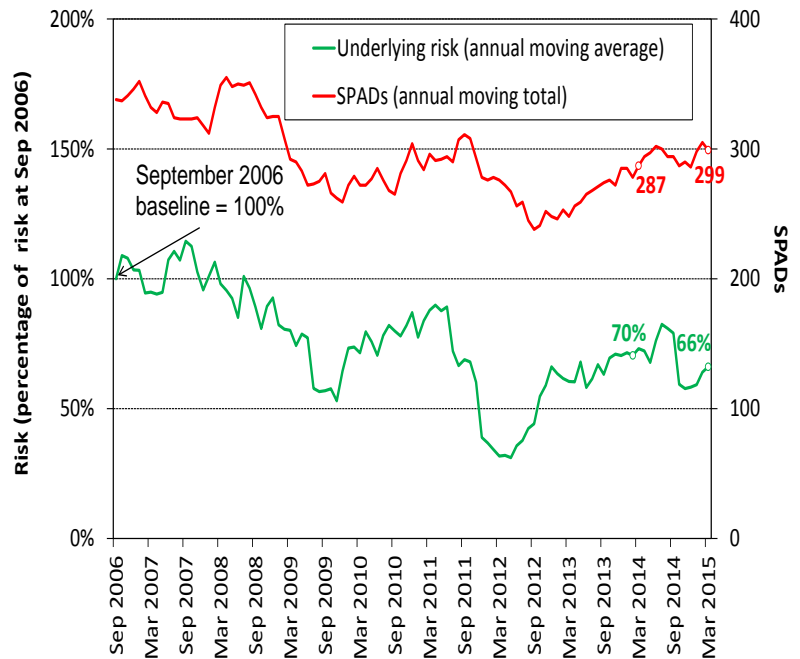
Levels of PTI harm are higher on LU, due to the higher intensity of crowding and service frequency. A comparison of the harm on all mainline and LU workers are also similar once the higher level of slips, falls and other incidents harm levels on LU are sifted out.



# Trends in SPAD number and underlying risk, September 2006 to March 2015

There were 299 mainline signals passed at danger (SPAD), an increase of 4%, but risk from SPADs that had the potential to cause train collisions reduced 7%. Nevertheless, SPADs form the single largest risk to passengers from train accidents.

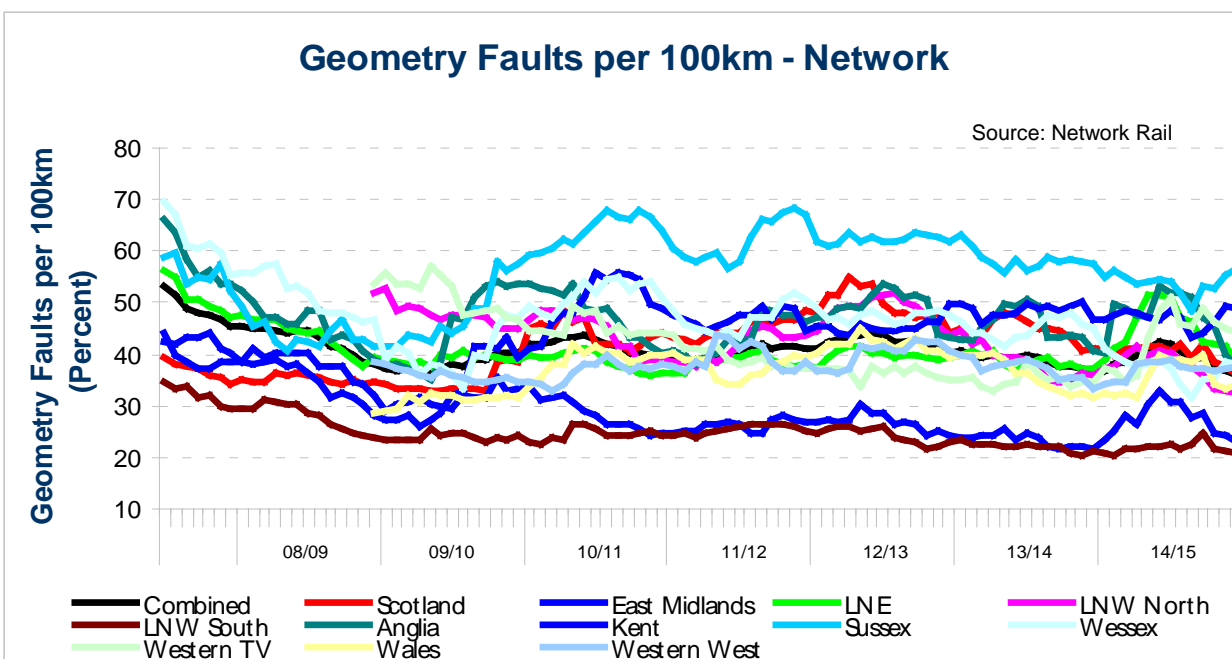
The industry is developing a strategy to reduce SPAD risk, as the mainline moves towards automatic train control, with the implementation of the European Train Control System (ETCS). We will monitor this closely to ensure SPAD risk and service growth is managed safely.



## Track geometry

While not necessarily a direct safety indicator, we monitor immediate action levels and intervention track geometry faults as they provide a useful indicator of track condition. Network Rail's 'good' and 'poor' track geometry measures both improved - they are at their second best levels under the current measuring process.

### Mainline track geometry faults per 100kms, 2008-9 to 2014-15



Source: Network Rail.

Train derailment risk is also influenced by discrete track geometry faults that present site-specific potential derailment risks if not properly managed. Their performance has been relatively stable since 2009-10 – see *chart above*.

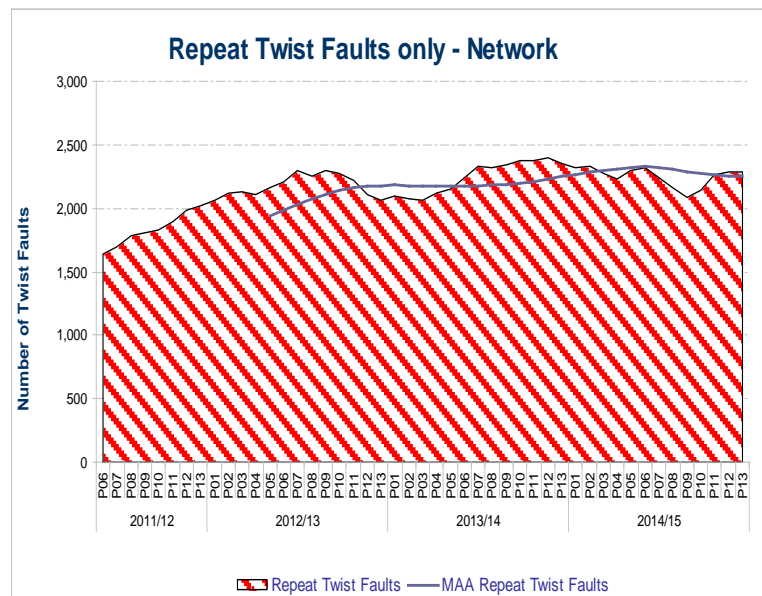
Numbers of intervention and immediate action level track geometry faults were at their lowest levels under the current recording process. The trend is now below the end of CP4 (2009-14) target we set. However, absolute levels between some routes have varied. The overall trend has remained broadly stable: it peaked around period 6 and then declined.

## Mainline repeat track twist faults, 2011-12 to 2014-15

The trend in track twist faults, a particular type of higher risk track geometry fault, declined 12% nationally. It increased marginally on Kent, Sussex, and Western routes. Levels of ‘repeat twist fault’ - where initial work to rectify track twist faults failed - were stable, but varied between routes. We took targeted enforcement on this in 2013.

Levels of repeat twist faults increased slightly. Nearly half of all track twist faults involved repeat track twist events.

Source: Network Rail



Network Rail has reduced the number of track twist faults and other track geometry faults, but has struggled to reduce repeat twist fault numbers – see *chart above*.

The under-delivery of maintenance and renewal activities and continued focus on short-term fixes, rather than longer term solutions can lead to increasing maintenance and renewal backlogs. These increase pressures on degraded assets, on potential catastrophic risk and on people to reliably and repeatedly implement processes to identify and correct faults.

Over Control Period 5 (2014-19), Network Rail has set itself efficiency target challenges which require significant annual savings - maintenance savings greater than have ever been required. Any further infrastructure renewal deferrals, plus the pressures from a growing railway, will only add to the demands on maintenance arrangements and the potential to increase risk.

We are challenging Network Rail to provide us with assurance of how their delivery units plan to manage the potentially elevated levels of risk, including any appropriate remedial action. Our multi-disciplinary track safety team continue to monitor track geometry trends closely. We will enforce if we find evidence of deteriorating risk control.

# Suicide and trespass

## Suicides

Dealing with suicides is a difficult and sensitive matter for all involved. There were 293 suicides, a 5% increase on 2013-14, the highest number ever recorded and 38 major injuries. These caused 600,000k delay minutes. The trend aligns broadly with 4% increase in the suicide rate nationally compared to 2012. Around 4% of all suicides in Britain occur on our railways and involve a high number of men aged 30-55. Around 11% of railway suicides occur at level crossings. There were 21 suicides on London Underground, down four on 2013-14.

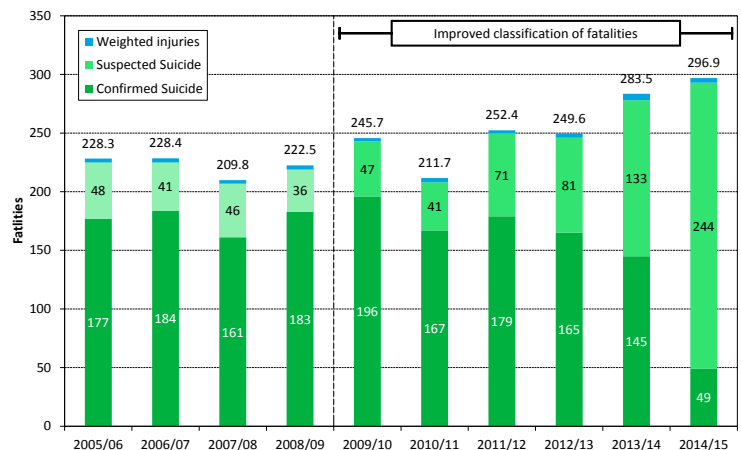
Workforce days lost due to the impact on staff from dealing with suicides reduced to around 26,000 days lost.

The mainline industry has shown considerable and commendable leadership and concerted efforts, including working closely with the Samaritans<sup>3</sup>, to prevent railways suicide and reduce their impact on the workforce and other witnesses.

This has included front-line staff being trained in active suicide prevention work, enhanced post-incident support for the railways workforce and other witnesses, and responsible media reporting. For example, 848 interventions were made by the railway workforce, including BTP officers, in 2014-15 to prevent events that may have led to a suicide.

Source: RSSB

## Trends in suspected/confirmed suicides since 2005-06



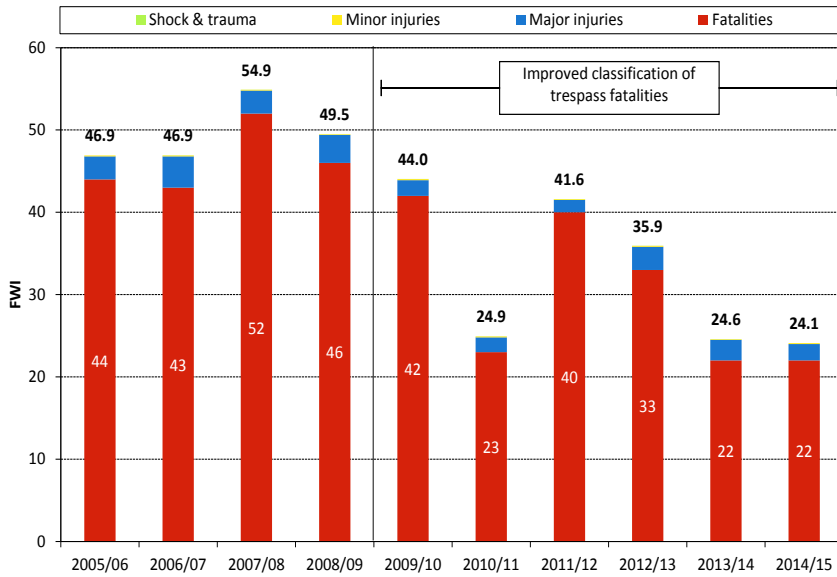
## Trespass

There were 22 trespass fatalities, the same as in 2013-14 - the second lowest total for a decade. Two of these included passengers who went on to the track to change station platforms, one was electrocuted and one was hit and killed by a train.

Trespass represents around 30% of the overall harm to the public on the mainline railway. Reported levels of trespass increased slightly in 2014-15. The categories and proportion of harm to railway trespassers over the last five years are 70% being hit by a train, 15% by electrocution and 10% involved a fall from height.

<sup>3</sup> <http://www.samaritans.org/your-community/reducing-railway-deaths-0/samaritans-and-network-rail-partnership>

## Trends in trespass harm since 2005-06



As reported in our 2013-14 report, at least part of the lower level of trespass incident reporting is due to the provision of enhanced incident data from the BTP going back to 2009-10.

Nonetheless, this highlights that the industry's more recent work to better control infrastructure access is proving effective.

Source: RSSB

## Vandalism

Reported vandalism levels have declined 62% over the last decade. It continued to decline over 2014-15, but there were increases in 'obstructions on the line' and 'missiles thrown or fired' at trains in early 2015. The costs of dealing with cable theft are now at their lowest for six years. Cable theft costs the industry around £2.5m and 37,000 service delay minutes – a significant reduction on the peaks of 2010-12.

## Level crossings

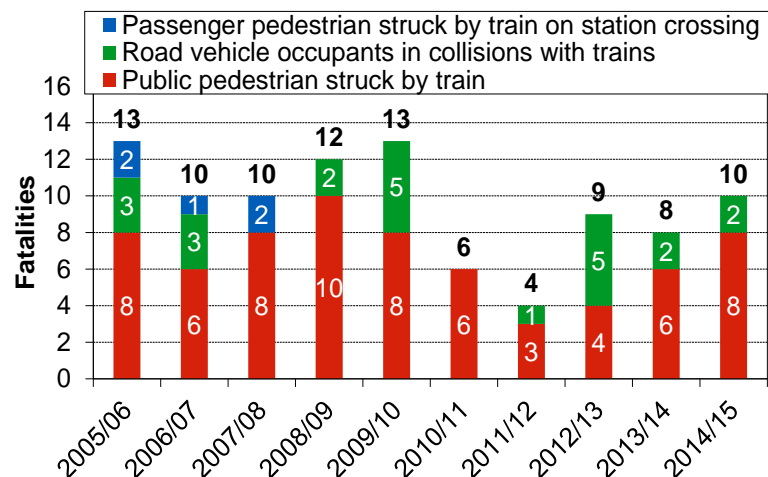
To date, Network Rail has closed 25 crossings using approximately £1m of the CP5 allocation funding to achieve approximately 4% risk reduction. Network Rail closed a total of 118 level crossings and made nine crossing downgrades in 2014-15 using its own funding.

There have been lower rates of level crossing fatalities since 2010. There were 10 level crossing fatalities, up two on 2013-14. They included seven pedestrians, one cyclist and two road vehicle users at footpath, automatic half-barrier and user-worked crossings. None of these events led to enforcement. There were also five major injuries and 52 minor injuries reports at level crossings.

### The trend in level crossing fatalities, 2005-06 and 2014-15 (excluding suicides)

There were seven collisions between trains and cars at level crossings over 2014-15, down three. As a proportion, pedestrian level crossing fatalities have increased over the last decade, 75% of crossing fatalities have involved pedestrians.

Source: RSSB.



## Vehicles and objects on the line

There were 57 recorded vehicles on the line, an increase of 13 reports. Of those, 65% involved vehicles crashing through railway boundary fences; a trend that increased 61% in 2014-15. None of the 57 incidents resulted in a collision between the vehicle and a train. There was a significant increase in objects obstructing the railway line with 696 incidents, up over 150%. There was an increase in train collisions with animals with 304 incidents, up 13% on 2013-14.

## Bridge strikes

There were 46 serious and potentially serious bridge strikes, up 11 or 24% on 2013-14. This is likely to form part of a wider trend in large vehicles using inappropriate routes.

## Our assessment of the mainline SMIS data and its quality

### Our use of mainline data

Some of the data in this report is provisional and may be subject to future change. For example, the cut off point for the Safety Management Information System (SMIS) data provided by RSSB was 28 April 2015. SMIS is the mainline railway's national database to collect safety-related events. It is mandatory for mainline railway infrastructure managers and train operators and others to record relevant safety incidents. Where available, data has been provided using both actual and normalised harm formats.

### Our safety statistical release

Data within this report may differ from those due to be published within our safety statistical release<sup>4</sup> in September 2015. This also combines data from both mainline and non-mainline operators.

### Data quality

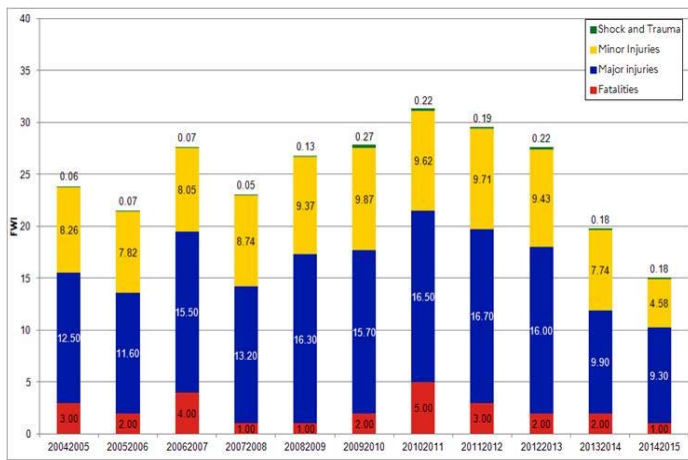
In 2014, the mainline industry's national data quality score was 92%, up from 88% in 2013. This reflects a general improvement in the quality and timeliness of SMIS data entry across the industry. We monitor RSSB's annual quality health check closely to make sure the quality of data it collects and uses, including for its safety risk modelling, is reliable and robust.

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<sup>4</sup> <http://orr.gov.uk/statistics/published-stats/statistical-releases>

# Transport for London

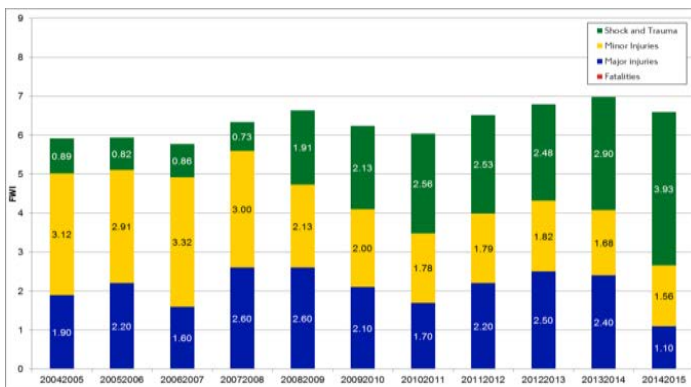
## Passenger harm on London Underground



Harm to London Underground (LU) passengers continued to decline, due to slight reductions in fatality and major injury harm; and a more significant 41% reduction in minor injuries to passengers.

Source: London Underground

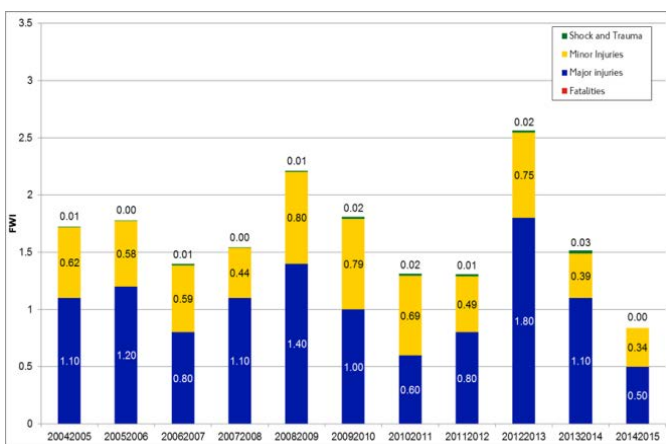
## Trend in harm to London Underground's workers since 2004-05



Overall harm to LU workers declined slightly. A notable increase in the 'shock and trauma' category (in green) reflects specific LU's staff roles. For example, revenue protection officers' experiences of assaults by passengers and train operators' experiences of suicides and suicide attempts involving their trains.

Source: London Underground

## Trend in harm to London Underground's infrastructure workers since 2004-05



Major and minor harm to LU infrastructure workers harm is at historic lows, but compared to the mainline, the risks are different. It only manages 420kms of track, which is maintained and renewed during its 1am-5am engineering hours, when it is closed to passenger.

Source: London Underground.

# Tramways

## Tram operator collisions with motor vehicles, 2010-11 to 2014-15

Tram operator	2010-11	2011-12	2012-13	2013-14	2014-15	Totals
<b>Blackpool Tramway</b>	-	-	1	-	1	2
<b>Croydon Tramlink</b>	-	1	1	2	11	15
<b>Edinburgh Trams**</b>	n/a	n/a	n/a	n/a	7	7
<b>Manchester Metrolink</b>	1(*)	-	1	6	29	37
<b>Midland Metro</b>	-	-	1	-	1	2
<b>Nottingham Express Transit</b>	-	1	6	-	18	25
<b>Sheffield Supertram</b>	-	2	-	-	14	16

\*Edinburgh Trams opened for services on 31 May 2014.

\*\*plus one low-speed collision with another tram at a platform. Slippery rails were believed to have been a causal factor.

For a detailed discussion of the reason underlying the apparent rise in reported train collisions with cars are see pages 21-22.

## On-tram passenger incidents

There's a low levels of incidents causing harm to passengers on board trams. There were 11 on Sheffield Super Tram, two on Croydon Tramlink, one on Manchester Metronet and one on Midland Metro in 2014-15.

## Tram operator collisions with pedestrians, 2010-11 to 2014-15

Tram operator	2010-11	2011-12	2012-13	2013-14	2014-15	Totals
<b>Blackpool Tramway</b>	-	-	-	-	1	1
<b>Croydon Tramlink</b>	1	2	1(*)	-	-	4
<b>Edinburgh Trams</b>	n/a	n/a	n/a	n/a	-	0
<b>Manchester Metrolink</b>	1	-	1	-	6	8
<b>Midland Metro</b>	-	-	-	-	1	1
<b>Nottingham Express Transit</b>	1	1	-	-	4	6
<b>Sheffield Supertram</b>	1	-	1	-	1	3

\*plus a relatively low-speed buffer-stop collision which damaged the tram's nose cone.

As noted earlier, UKTram is working with its members to improve the sector's data collection and standardisation around incidents and accidents. As this work progresses, we anticipate seeing more reliable data emerging from the sector.

Use of the name, the Office of Rail and Road, reflects the new highways monitor functions conferred on ORR by the Infrastructure Act 2015. Until this name change is confirmed by legislation, the Office of Rail Regulation will continue to be used in all documents, decisions and matters having legal effects or consequences.



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