Recommendation 2

Update to RAIB

Recommendation 2

The intent of the recommendation is to better understand all safety risk associated with tramway operation and then provide updated guidance for the design and operation of tramways (this could be achieved by issuing an updated version of the 'Guidance on tramways' with expanded coverage of operational matters). Particular attention will be required to recognise risks from low frequency / high consequence events which may not be apparent from precursor incidents on existing UK tramways. Identifying such events is likely to require input from specialists outside the UK tram community, including specialists with knowledge of main line rail and bus environments. Consideration of main line rail and bus issues is intended to inform evaluation of tramway risks; it does not imply that all heavy rail and bus requirements should be applied to tramways.

UK tram operators, owners and infrastructure managers should jointly conduct a systematic review of operational risks and control measures associated with the design, maintenance and operation of tramways. The review should include:

i. examination of the differing risk profiles of on-street, segregated and off-street running;
ii. safety issues associated with driving at relatively high speeds in accordance with the line-of-sight principle in segregated and off-street areas, particularly during darkness and when visibility is poor;
iii. current practice world-wide and the potential of recent technological advances to help manage residual risk;
iv. safety learning from bus and train sectors that may be applicable to the design and operation of tramways;
v. consideration of the factors that affect driver attention and alertness across all tram driving scenarios in comparison to driving buses and trains; and
vi. guidance on timescales for implementing new control measures (eg whether retrospective or only for new equipment).

Using the output of this review UK tram operators, owners and infrastructure managers should then, in consultation with ORR, publish updated guidance on ways of mitigating the risk associated with design, maintenance and operation of UK tramways.

ORR decision

1. We note the significant progress made by Light Rail Safety & Standards Board (LRSSB) working with the sector in creating and implementing an industry risk model.

2. To fully satisfy the requirements of the recommendation each tram network requires an agreed risk profile, supplemented by a sector wide risk profile. The risk profiles for individual networks are currently under development. Five systems (Manchester, Blackpool, Edinburgh, Sheffield and Croydon) have had their final report issued, with training provided. Development work is on-going for Nottingham & West Midlands.

Recommendation 2

3. The output of the industry risk profile will inform the work of the LRSSB and the need for further review or creation of guidance to reflect the scale of risks identified.

4. Noting that LRSSB expect to have completed the sector risk profile by March 2020, we have asked them to clarify the expected timescales for reviewing their guidance and finalising the mechanism for producing new guidance. LRSSB have committed to present the outputs from the risk modelling to ORR's Health & Safety Regulation Committee (HSRC) on 23 March 2020.

5. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, UK tram owners, operators and infrastructure managers, working in conjunction with LRSSB have:

- taken the recommendation into consideration; and
- have risk profiles in place for each tram network by March 2020, which will then inform the development of an industry risk model and LRSSB guidance.

Status: Implementation on-going. **ORR will advise RAIB when further information is available regarding actions being taken to address this recommendation.**

Previously reported to RAIB

6. See Annex C para 1 to 6.

Update

7. See Annex B para 1-11.

Recommendation 3

Recommendation 3

The intent of this recommendation is to prevent serious accidents due to excessive speed at higher risk locations on tramways. These locations are likely to include all locations where a substantial speed reduction is required for trams approaching at relatively high speed. Implementation of this recommendation may be assisted by work in this area already underway by Croydon tramway organisations.

UK tram operators, owners and infrastructure managers should work together to review, develop, and provide a programme for installing suitable measures to automatically reduce tram speeds if they approach higher risk locations at speeds which could result in derailment or overturning

ORR decision

8. UKTram initiated work on behalf of the sector to research the availability of automatic vehicle speed monitoring systems. The SIMOVE AVSM system was selected for trial on Manchester Metrolink in order to assess its effectiveness and performance. This trial is continuing and other systems (South Yorkshire and Edinburgh) are monitoring progress to assess how this will impact on the solution they choose.

9. The owners, operators and infrastructure managers of the UK's tram networks are implementing a number of different solutions to improve the management of risk associated with over-speeding at high risk locations that they have previously identified. Three systems (West Midlands, Croydon and Edinburgh) have either installed or are planning to install over speed protection arrangements, and a further three (Manchester, Blackpool and Nottingham) continue to develop and trial solutions to inform their final decision. This includes one system that incorporates obstacle detection capability, which has the potential to offer further risk reduction. South Yorkshire are monitoring the trial being carried out on other networks and will use those findings to inform their decision when specifying a prevention of overspeed system for future vehicle fleets. These risk based actions appear appropriate.

10. Where a tram owner, operator or infrastructure manager has not yet determined their final arrangements, we will continue to monitor progress. We expect that final actions will be supported by suitable and sufficient risk assessment, drawing on the output of the sector risk model as necessary and taking account of the effectiveness of other risk controls that are in place.

Summary of end implementer responses

End Implementer	Summary of response	Status

Annex A

Recommendation 3

Tram Operations Ltd	Reported as implemented 5 April 2019. A physical prevention of overspeed system in in place, supplemented by a speed monitoring system.	Implemented
London Trams	Reported as implemented 5 April 2019	Implemented
Transport for West Midlands	WMM will install a Balogh tag based system which will be able to control the speed of a tram at high-risk locations. The system will be fitted to new trams due to be delivered in April 2021 and retrofitted to the existing fleet at the same time.	Implemented
West Midlands Metro	As per TfWM response.	Implemented
Blackpool Borough Council	BTS are currently trialling a GPS based system which is expected to be completed in May 2020. BTS have not yet made a firm commitment to a fleet-wide introduction of the system.	Progressing
Blackpool Transport Services	As per BBC response.	Progressing
Edinburgh Tram	ET have propose either SIMOVE or the CAF engineered overspeed system planned by Midland Metro.	Implementation on going
City of Edinburgh Council	As per ET response.	Implementation on going
Manchester Metrolink	As a result of LRSSB's research work, TfGM/KAM are trialling SIMOVE, a hybrid GPS/wheel turn location based system. With this trial and lessons learnt, TfGM/KAM are moving towards defining their requirements and hazard identification phase (being carried out in conjunction with recommendation 4) to determine the eventual risk control system. They expect to begin the procurement phase in Q1/Q2 2020.	Implementation on going
Transport for Greater Manchester	As per Metrolink response.	Implementation on going
Nottingham Council/ Tramlink Nottingham Ltd	NTL/TNL are developing the AVLS system fitted to both of their tram fleets to automatically apply the brakes if overspeed is detected.	Implementation on going

Recommendation 3

Nottingham Trams	As per Nottingham Council/TNL response.	Implementation on going
South Yorkshire PTE	SYSL/SYPTE are monitoring the development of systems on the Croydon and Manchester networks before making a firm decision on what action to take with the existing vehicle fleet. If SYPTE secure DfT funding for a new tram fleet, it would be specified with a prevention of overspeed system.	Progressing
South Yorkshire Supertram Ltd	As per SYPTE response.	Progressing

Previously reported to RAIB

11. See Annex C para 7.

Updates from end implementers

12. See Annex B para 12 to 24.

Recommendation 4

The intent of this recommendation is to reduce the likelihood of serious accidents due to tram drivers becoming inattentive because of fatigue or other effects. Existing tram systems relying on drivers applying forces to driving controls (driver safety devices) do not necessarily detect an inattentive driver. Implementation of this recommendation may be assisted by work in this area already underway by Croydon tramway organisations.

UK tram operators, owners and infrastructure managers should work together to research and evaluate systems capable of reliably detecting driver attention state and initiating appropriate automatic responses if a low level of alertness is identified. Such responses might include an alarm to alert the tram driver and/or the application of the tram brakes. The research and evaluation should include considering use of in-cab CCTV to facilitate the investigation of incidents.

If found to be effective, a time-bound plan should be developed for such devices to be introduced onto UK tramway.

ORR decision

13. LRSSB commissioned work on behalf of the sector to research potential systems that could have the capability to monitor driver attentiveness, and reduce the likelihood of a Croydon overturning type incident occurring. This report[1] was published in January 2020 concluding that three systems performed reasonably well under normal operating conditions. Currently none offered the capability to be linked to the tram braking system. The report also concluded that a well-adjusted driver vigilance device (DVD) linked to the tram braking system offered similar levels of risk control in a tramway environment to prevent the type of accident that occurred at Sandilands.

14. In parallel to this research, a number of tramway systems investigated or are investigating solutions specific to their own networks that reflect the characteristics of their tram fleets, safety systems already fitted, and tramway route profile. This approach is resulting in positive action to improve the management of risk where driver actions are a key risk control, including refining the well understood DVD systems where fitted. We continue to discuss with tramway operators the timing for implementing proposed actions.

15. We recognise that the emerging technologies intended to monitor driver attentiveness and driver fatigue management arrangements offer potential benefits that will improve the management of risk but may also present new risks that could reduce those benefits if the change is not properly controlled. The scale of these pros and cons are currently unquantified, but that emerging evidence from the Croydon tram network and other transport sectors indicates that such solutions show potential for the rail sector.

[1] Driver Inattention System Trials; IRAL, Jan 2020

Recommendation 4

16. We consider that the tram sector should undertake further research to explore the pros and cons of supplementing current arrangements. This will assist the sector and individual duty holders in quantifying the potential advantages and disadvantages, and demonstrate whether it is reasonably practicable to enhance current control arrangements. LRSSB recognise this and are considering how further research work on this topic could be delivered as part of their business plan for 2020/21, and the impact on other planned work. LRSSB are also investigating the potential to work more closely with RSSB who are undertaking similar research work.

17. We have concluded, (based on the current evidence available), that a DVD system linked to the braking system, or a facial monitoring system improves the level of risk control against driver inattentiveness and goes towards satisfying the recommendation's requirements. However, in accordance with our Health and Safety Strategy for Tramways[2], we expect the tramway sector to continue to investigative emerging technologies to identify reasonable practicable solutions to improve the management of risk, particularly associated with line of sight operation, as discussed in paragraph 15 above. In considering the outcome of such research, operators should be taking account of other available technological controls that they may have in place or are considering, such as overspeed prevention (recommendation 3) and obstacle detection. The output of the newly introduced risk model should help inform these assessments.

Summary of end implementer responses statuses

End Implementer	Summary of response	Status
Tram Operations Ltd	TOL have fitted the 'Guardian' eye closure detection system to their tram fleet that detects driver inattentiveness and provides an alert. It is not linked to the tram brake system. On 26/02/2020 TOL provided a copy of their risk assessment which concluded that, when taking into account the *physical prevention of over speed controls (rec 3)*, the risk of driver inattentiveness was reduced as low as reasonably practicable. ORR is considering this additional information and will provide an update in April 2020.	Implementation ongoing
London Trams	As per TOL response.	Implementation ongoing
Transport for West Midlands	Informed by human factors analysis, WMM have optimised the existing Driver Vigilance Device (DVD) so the intervention frequency is 15 rather than 30 seconds.	Implementation ongoing

[2] Strategy for regulation of health and safety risks – chapter 14: Tramways: https://orr.gov.uk/__data/assets/pdf_file/0010/40888/tramways-health-and-safety-risks-strategy.pdf

Recommendation 4

West Midlands Metro	As per TfWM response.	Implementation ongoing
Blackpool Transport Services	BTS have a DVD system that applies the tram brakes if driver inattention is detected. They are also supporting the Edinburgh Trams DISC initiative.	Implementation ongoing
Blackpool Borough Council	As per BTS response.	Implementation ongoing
Edinburgh Tram	ET has enhanced the settings of their DVD to mitigate the risks from driver inattentiveness. We have asked ET to provide risk-based evidence of how the timings of the DVD fitted to their fleet have been optimised. ET also continues to progress its Driver Innovation Safety Challenge (DISC) to produce an active monitoring and alarm provision solution, with a solution expected by December 2020.	Implementation on going
City of Edinburgh Council	As per ET response.	Implementation on going
Manchester Metrolink	TfGM/KAM have outlined the approach they will be taking address this recommendation, and have a proposal from their rolling stock supplier for a vigilance system. They have attended trials of various facial analysis systems looked at as part of the LRSSB research work, and on completion of a requirements phase (being carried out in conjunction with recommendation 3) expect to confirm their requirements for a system in Q1/2 of 2020, and then proceed to a procurement phase.	Implementation on going
Transport for Greater Manchester	As per KAM response.	Implementation on going
Nottingham Trams	NET have a programme in place to reinstall and adjust the timings of the DVD system on the Citadis fleet. For the older Incentro fleet a new DVD system will need to be fitted. The timescales for this project have not yet been confirmed.	Implementation on going
Nottingham Council/ Tramlink	As per NET response.	Implementation on going

Recommendation 4

Nottingham Ltd		
South Yorkshire Supertram Ltd	SYPTE and SYSL have been monitoring progress with the LRSSB research work and plan to review the output to assist informing the business case for the fleet renewal project. In the interim SYSL plan to install a DVD system across the Siemens fleet with completion by the end of 2020. If SYPTE secure DfT funding for a new tram fleet, it would be specified with a prevention of a driver alertness detection system.	Implementation on going
South Yorkshire PTE	As per SYSL response.	Implementation on going

Previously reported to RAIB

18. See Annex C para 8.

Update

19. See Annex B para 25 to 34.

Recommendation 5

The recommendation is intended to provide tram drivers operating on line-of-sight with signage giving visual information cues comparable to those for bus drivers. This recommendation builds on the RAIB's Urgent Safety Advice issued in November 2016 and recognises that driving a tram on line-of-sight has considerable similarities with driving a bus on a public road.

UK tram operators, owners and infrastructure managers, in consultation with the DfT, should work together to review signage, lighting and other visual information cues available on segregated and off-track areas based on an understanding of the information required by drivers on the approach to high risk locations such as tight curves. Comparison should be made with the cues provided to road vehicle drivers on highways that are designed in accordance with current UK highway standards. Prior to the installation of suitable measures to automatically reduce tram speeds at higher risk locations (Recommendation 3) consideration should also be given to providing in-cab warnings to tram drivers on the approach to high risk locations.

The findings of this review should then be used by UK tram operators and tramway owners to improve the information and/or warnings provided to drivers at high risk locations in segregated and off-track areas.

ORR decision

20. We note that all the tram infrastructure managers we addressed this recommendation to have taken action to review existing signage, and made improvements where necessary. The effect of this is visible on many networks. However, we are not yet in a position to report that the recommendation has been implemented as the action taken on individual networks did not include consultation with DfT.

21. We are aware that the LRSSB is working to produce new guidance on signage for the tram industry and is consulting DfT as part of that process. We have asked LRSSB to clarify the timescales for producing the guidance and once it has been published we would expect to be in a position to report the recommendation as implemented. The status of the recommendation remains 'implementation on going' until then.

Previously reported to RAIB

22. See Annex C para 9.

Update

23. See Annex B para 35 to 45.

Recommendation 6

The intent of this recommendation is to reduce the likelihood of people being seriously injured or killed by being ejected through tram doors and windows (i.e. to provide better containment). Although it is not expected that ejection can always be prevented in case of overturning, the improvement of containment will deliver improved safety in a range of different scenarios such as collision with road vehicles. Any improvement to containment is dependent on the ability of passengers to easily open doors in an emergency. It is expected that implementation will build on similar research already undertaken by RSSB in respect of railway carriage windows.

UK tram operators and owners should, in consultation with appropriate tram manufacturers and other European tramways, review existing research and, if necessary, undertake further research to identify means of improving the passenger containment provided by tram windows and doors. The findings should then be used to:

i. provide a time-bound plan to modify doors and windows on existing trams when practical to do so (e.g. during planned refurbishment);

ii. promote changes to the specifications and standards governing the doors and windows of new trams; and

iii. inform the Department for Transport of the findings to allow implementation of the safety advice at paragraph 492.

ORR decision

24. The level of additional risk reduction achieved by increasing tram vehicle containment capability will be influenced by other engineering / technological controls that reduce the need for a high level of containment; and impact on evacuation arrangements.

25. TfL commissioned research into the containment provided by the glazing on the two models of tram they operate, using main line railway standards. The research also considered the containment performance of glazing with internal and/or external film applied, as well as laminated glazing. Whilst the tram fleet operating in Croydon is not identical to fleets across the rest the UK, the research's findings is likely to be representative for other systems.

26. The research concluded that laminated glass is the only form of window glazing that offers suitable levels of containment, but that retro fitting such glazing into existing tramway vehicles is problematic due to structural capability and size of window rebate available. The research also identified that whilst fitting film to the external side of windows does not offer any improvements in containment, it does offer other safety benefits, such as mitigating the effect of projectiles being thrown at the tram window pane.

Recommendation 6

27. In addition to this research, LRSSB conducted a review of the requirements of recommendation 6, concluding that any action to improve containment would be fleet dependent due to varying vehicle design characteristics. LRSSB also identified a potential conflict between containment and evacuation. LRSSB's review concluded that operators should carry out their own review aiming to balance containment, escape and rescue. LRSSB plans to develop tram sector guidance covering escape and rescue requirements in consultation with the emergency services and identified a need to establish enhanced performance requirements for window and door system integrity within new and future vehicle design specifications.

28. In parallel tram operators have discussed the requirements of this recommendation with vehicle manufactures and have each concluded that it is not practicable to make modifications to the glazing for doors and windows on current tram fleets. Several are investigating the reasonable practicability of fitting laminated glass to new fleets.

29. Manchester have followed Croydon's initiative and plan to fit thicker film to tram windows. Nottingham and Blackpool have already fitted thicker films; and Edinburgh, Sheffield, and West Midlands plan no further immediate action. All current tram fleets remain compliant with industry standards for containment.

30. Current standards for windows fitted to tramways operating in the UK follow EU requirements and are similar to road vehicles. It remains unclear to ORR if the film fitted by some operators will increase the level of passenger containment and decrease the likelihood that the glazing will be ripped from the window frame / tram structure.

31. ORR concludes that the status of this recommendation for London Trams is 'Implementation ongoing' as they have investigated solutions to improve the level of containment in their existing fleet; and have taken risk based action to reduce the risk as low as reasonably practicable based on current information and other actions they have taken. We note that the other operators have undertaken exploratory work to investigate potential solutions to improve containment and are acting, as necessary, on their conclusions. However the effectiveness of these actions in improving containment and whether further actions are reasonably practicable are unclear. The status of this recommendation for the remaining operators is 'progressing'. We have asked tram operators to explain how they used the findings of the TfL research to justify their decision.

32. We note that a core requirement of this recommendation is a sector-led review of, and as necessary, delivery of further research as a basis for further action. It is apparent that further work is required to develop performance requirements for new vehicles to bring a consistent level of risk control as fleets are renewed or refurbished. We note that LRSSB has identified this as an action from their own review.

33. We have written to LRSSB seeking further details regarding their intentions regarding establishing enhanced performance requirements associated with window and door system integrity within new vehicle specifications, how this takes account of the TfL research and the output from the industry risk model. The findings of the

Annex A

Recommendation 6

LRSSB research should then be shared with DfT as identified by the recommendation.

Summary of end implementer responses statuses

End Implementer	Summary of response	Status
Tram Operations Ltd	TOL is supporting LT's work to implement this rec. It has fitted enhanced strength film to glazing across their fleet.	Implementation ongoing
London Trams	TfL commissioned testing of prototype windows to establish containment levels achieved, and explored practicability of various solutions with their existing fleet. Informed by their risk assessment, they concluded it was not possible to fit laminated glazing to their existing tram fleet. TOL has fitted enhanced strength film to glazing across their fleet	Implementation ongoing
West Midlands Metro	TfWM have investigated with a number of tram manufacturers the practicability of fitting laminated glass into new tram vehicles. They remain of the opinion that clear industry guidance, based on empirical research, that specifies containment requirements is required if these are to vary from existing international standards.	Progressing
Transport for West Midlands	WMM are awaiting the outcome of industry risk assessment and research before considering any changes to existing fleets or new ones.	Progressing
Blackpool Transport Services	BTS concluded that implementation of recs 3 – 5 greatly reduce the likelihood of overturning and therefore no requirement for greater levels of containment. Anti-vandal film is fitted to inside of all tram saloon glass. BTS will consider practicality of any improvements identified by industry	Progressing
Blackpool Borough Council	AS BTS	Progressing
Edinburgh Trams	ET reviewed their tram alignment where loss of containment risk is increased. ET investigated the practicality of improving passenger containment with their tram manufacturer; and state they will	Progressing

Recommendation 6

	continue to work with LRSSB in development of guidance.	
City of Edinburgh Council	As Edinburgh Trams	Progressing
Transport for Greater Manchester	TfL shared their testing work with TfGM; who is proposing to fit an additional laminate film to the glazing.	Progressing
Manchester Metrolink	AS TfGM	Progressing
Nottingham Trams	Tram fleet glazing is fitted with safety film mitigating the effects of glazing breakage. Further modification, such as increased glazing thickness is not possible without significant redesign structure and has been discounted. NTL's risk assessment concludes this is sufficient to reduce risk ALARP.	Progressing
Nottingham Council/ Tramlink Nottingham Ltd	As NET.	Progressing
South Yorkshire Supertram Ltd	The Citylink fleet is fitted with laminated glass; and concluded that it is not possible to retrofit laminated glass to the Siemens fleet.	Progressing
South Yorkshire PTE	As SYSL	Progressing

Previously reported to RAIB

34. See Annex C para 10.

Update

35. See Annex B para 46 to 56.

Recommendation 7

The intent of this recommendation is to provide emergency lighting which will operate without connection to remote power supplies such as the tram's main batteries and the overhead electrical supply. Implementation may involve tram operators seeking input from appropriate tram manufacturers.

UK tram operators and owners should install (or modify existing) emergency lighting so that the lighting cannot be unintentionally switched off or disconnected during an emergency.

ORR decision

36. All tram operators and owners have either modified emergency lighting to operate without connection to the main power supply or have a plan in place to do so.

Summary of end implementer responses statuses

End Implementer	Summary of response	Status
Tram Operations Ltd	TOL is supporting LT's work to implement this rec.	Implemented
London Trams	LT have a plan to fit emergency lighting which meets the requirements of the recommendation by the end of March 2020. As per TOL response.	Implemented
West Midlands Metro	WMM are making enquiries about making a modification to the wiring of the emergency lighting to enable the OESS batteries to be a backup power supply for the emergency lighting on the tram, should the connection to the tram auxiliary batteries be lost in the event of an accident.	Progressing
Transport for West Midlands	As per WMM response.	Progressing
Blackpool Transport Services	BTS modify the emergency lighting in the current fleet of trams to ensure that the lighting cannot be unintentionally switched off or disconnected. This modification will be carried out with the planned refurbishment of the trams beginning November 2020.	Implemented

Recommendation 7

Blackpool Borough Council	As per BTS response.	Implemented
Edinburgh Trams	ET have a plan to provide additional lighting in their tram fleet during 2020/21. We have asked ET to confirm that the emergency lighting proposed is independent from the main power supply.	Implementation on going
City of Edinburgh Council	As per ET response.	Implementation on going
Transport for Greater Manchester	Reported as implemented 5 April 2019	Implemented
Manchester Metrolink	Reported as implemented 5 April 2019	Implemented
Nottingham Trams	NTL are proposing to fit emergency lighting at saloon vestibules, which has a supply independent of the main tram batteries.	Implementation on going
Nottingham Council/ Tramlink Nottingham Ltd	As per NTL response.	Implementation on going
South Yorkshire Supertram Ltd	SYSL have developed a secondary wiring loop to provide emergency lighting above exit doors in the saloon in the event of power disconnection from the battery. Following trials, SYSL intend to retrofit the tram fleet in 2020/21. On Citylink vehicles, the risk of interruption to the emergency lighting is considered less likely, so no modifications are planned.	Implemented
South Yorkshire PTE	As per SYSL response.	Implemented

Previously reported to RAIB

37. See Annex C para 11.

Update

38. See Annex B para 57 to 69.

Recommendation 8

The intent of this recommendation is to minimise the risk of people being trapped in an overturned tram where side windows and doors are either facing the ground or facing the sky. Solutions could include the use of removable windscreens at the ends of trams. Implementation may involve tram operators seeking input from appropriate tram manufacturers.

UK tram operators and owners should review options for enabling the rapid evacuation of a tram which is lying on its side after an accident. If the review identifies practical measures which would provide significant benefit to trapped passengers, UK tram operators and owners should:

i. implement these measures on existing trams if practical to do so in the short term; or

ii. provide a time-bound plan to implement these measures on existing trams when practical to do so (e.g. during planned refurbishment).

Such measures should then be promoted for inclusion in the specifications and standards governing the new builds of trams.

ORR decision

39. UK Tram Subcommittee 1 carried out a review of rapid evacuation options for a tram lying on its side after an accident, concluding that installing escape hatches in the floor or roof of a tram vehicle would import significant risk. Any changes to the glazing in the cab window could compromise its performance of its primary function of protecting the driver.

40. Tramway operators consulted with their fleet manufacturers on options to improve evacuation from an overturned tramway, concluding there were no practicable additional steps that could be taken to amend vehicle design.

41. LRSSB is producing new guidance on evacuation of tramways in consultation with the emergency services. This should clarify minimum arrangements and best best practice.

42. The mainline railway policy is in the overwhelming majority of cases and circumstances to not evacuate a train unless it is on fire, as set out in T066a: Development of a train evacuation risk model (‘Stay or Go’). This approach, together with the likely response times for the emergency services to tramway incidents means that the safety risk to passengers in the event of a tram accident is likely to be greater if they self-evacuate from the tram rather than waiting for the emergency services.

Recommendation 8

43. We are satisfied that industry has carried out the review sought by the recommendation and we consider that the review's conclusions are reasonable. As such we consider this recommendation to be implemented.

Summary of end implementer responses statuses

End Implementer	Summary of response	Status
Tram Operations Ltd	TOL is supporting LT's work to implement this rec.	Implementation on going
London Trams	TOL/LT are awaiting the outcome of the risk model development (rec 2) before making any changes to evacuation arrangements. As per TOL response.	Implementation on going
Transport for West Midlands	TfWM/WMM have reviewed options for enabling the rapid evacuation of a tram which is lying on its side after an accident and concluded that none of the options are practicable.	Implemented
West Midlands Metro	As per TfWM response.	Implemented
Blackpool Borough Council	BBC/BTS have reviewed options for enabling the rapid evacuation of a tram which is lying on its side after an accident and concluded that none of the options are practicable.	Implemented
Blackpool Transport Services	As per BCC response.	Implemented
City of Edinburgh Council	CofEC/ET have reviewed options for enabling the rapid evacuation of a tram which is lying on its side after an accident and concluded that none of the options are practicable.	Implemented
Edinburgh Tram	As per CofEC response.	Implemented
Transport for Greater Manchester	TfGM/KAM have reviewed options for enabling the rapid evacuation of a tram which is lying on its side after an accident and concluded that none of the options are practicable.	Implemented
Manchester Metrolink	As per TfGM response.	Implemented

Recommendation 8

Nottingham Trams	NET have reviewed options for enabling the rapid evacuation of a tram which is lying on its side after an accident and concluded that none of the options are practicable.	Implemented
Nottingham Council/ Tramlink Nottingham Ltd	As per NET response.	Implemented
South Yorkshire PTE	SYPTE/SYSL have reviewed options for enabling the rapid evacuation of a tram which is lying on its side after an accident and concluded that none of the options are practicable.	Implemented
South Yorkshire Supertram Ltd	As per SYPTE response.	Implemented

Previously reported to RAIB

44. See Annex C para 12.

Update

45. See Annex B para 70 to 81.

Recommendation 2

End Implementer Responses

Recommendation 2

1. On 3 January 2020 London Trams provided the following update:

We continue to support the implementation of the Industry Risk Model and working with TOL have taken an active part in the development of the specific model for London Trams. However, as mentioned in our update in March, we continue to use our own Trams Safety Risk Model until the Industry Risk Model is finalised for our network. This model was fully reviewed at the start of 2019 with all relevant incident and accident data updated and this will be reviewed again during the first quarter of 2020. In addition, the Preventative Controls contained within the model are reviewed every three months to make sure they are still relevant.

2. On 9 December 2019 Tram Operations Ltd provided the following update:

Route Risk Assessment

- *TOL has fully reviewed its Route Risk Assessment, the findings of which are reflected in the London Trams Network Risk Model.*
- *All trainers and assessors have been briefed on the Route Risk Assessment content and TOL's driver training materials; route DVD's and tram simulator have been updated to ensure currency and sufficiency.*

London Trams Risk Model

Work on the London Trams Risk Model has now been completed and TOL and LT have integrated use of the Model into their safety management processes. A single process that describes the model and its use has been developed by London Trams.

UK Tram Network Risk Model

Additionally, TOL and London Trams, in partnership with LRSSB and Atkins have populated the Joint Industry Risk Model with data specific to the Croydon Tramlink Network. Hazardous event types, precursor information and risk analysis outputs have been checked, agreed and fed back to Atkins for inclusion in the final version of the model.

3. On 19 December 2019 West Midlands Metro and Transport for West Midlands provided the following joint update:

On 28 August 2018 MML hosted a visit by ORR representatives to demonstrate the functionality of the WMM risk model. The event was supported by UKTram and Atkins Rail who developed the risk model for WMM. This risk model has now been confirmed as the preferred model to be developed by the LRSSB as a national standard model to meet RAIB's recommendation 2. WMM along with all other UK tram operators have provided five years of historic safety data to populate the industry risk model and update the newly formed hazardous and precursor event profiles.

Recommendation 2

4. On 12 December 2019 Blackpool Council provided the following update:

Blackpool Council and Blackpool Transport will be meeting with the UKTram commissioned Atkins in January 2020 with regards to the risk model. We are committed to work reducing all risks as far as practicable.

5. On 16 December 2019 Blackpool Transport provided the following update:

UKTram commissioned Atkins to produce a safety risk model. Although the model will be a common tool used across the UK's Light Rail Transit (LRT) Systems, Atkins have worked with all operator to create a bespoke model for their systems. The model is based on the judgement of qualified experts from individual systems. The analysis of historical data, categorised by hazardous events and precursors, was used to aid these conclusions. The risk model can help to prioritise risk management effort and provide a framework for the identification and assessment of further risk control measures. When periodically updated and reviewed, the model can play a role in demonstrating risk levels are maintained as low as reasonably practicable (ALARP).

Estimates of the collective risk to passengers, staff and the public are included in the risk model. For the known quantified populations of Blackpool Tram's passengers and staff, individual risk of fatality is also calculated.

As the same profile tool is being applied across UK LRT systems it provides an opportunity for sharing good practice such as control measures, leading to further risk reduction.

BTS and BBC are meeting with Atkins in January 2020 to look at next steps with a plan to work on reducing the risks as far as reasonably practicable.

6. On 30 December 2019 Edinburgh Trams provided the following update:

ET fully supports the UKTram approach in responding to this recommendation, including representation on

- *The industry steering group for constitution and funding of the LRSSB*
- *UKTram's Safety and Assurance Group (Heads of Safety).*
- *ET has provided expertise to support the systematic review of industry operational risks and provided historical incident data for the industry risk model to support development and rollout of the Tramway Accident & Incident Reporting (TAIR) database*
- *Initial TAIR training has been delivered to ET and a number of optimisation improvements have been identified to the consultants implementing TAIR.*
- *ET has received the final version of its Risk Model for the TAIR and will receive further training from the UKTram consultants implementing TAIR.*
- *ET has completed a full review of Off-Street crossing risk assessments in accordance with the new LRG 2.0 - Non-Motorised Tramway Crossing Guidance and is implementing a suite of identified enhancements to existing*

control measures. These enhancements will be fully implemented by end of December 2019.

7. On 20 December 2019 Transport for Greater Manchester and Keolis Amey Metrolink provided the following joint update:

The first industry risk model was completed on Manchester Metrolink with the output published in August 2019.

The results in the model make a distinction between risk that is considered not directly controllable and events classified as directly controllable or having an interface with Manchester Metrolink and the control measures included. The output from 60 Hazardous Events relevant to Metrolink have identified our top ten Hazardous Events by both Total Collective Risk (TCR) and Controllable Collective Risk. Six of the top ten events by controllable risk also appear in the top ten hazardous events by TCR.

This is a useful model and is being fully embedded into Metrolink. We are now providing safety incident data to UK Tram to populate the TAIR database. By September 2020 we will have provided 12 months of data and we will then review our risk model to assess currency of risk.

We are concentrating our attention on the precursors which share most of the TCR, together with the specific risks that staff are exposed to. To that extent we have instigated the following actions.

Completed and Ongoing Actions

- *We have reviewed the network to identify high-risk locations, including curves, with additional controls implemented including drop down speeds, chevron markers, and variable speed boards.*
- *During the ongoing assessment of our drivers we have targeted our analysis of the On-Tram Monitoring Recorder to assess drivers whilst navigating any high risk curves.*
- *We have introduced two joint Operational Incident Reduction Groups. The first is to review Road Traffic Collisions collaborating with local councils using data to target hotspot areas. The second is to review Signals Passed at Stop to understand the root cause and then recommend corrective actions.*
- *We have aligned our current HSE Master Log categories to the hazardous events and pre-cursors identified in the Industry risk model. This will allow for the joint industry model to be re-run and easily integrated with our safety management system.*
- *We will be assessing all non-motorised crossings on the network to understand where any additional control measures will be required in accordance with the new guidance document recently published by LRSSB.*
- *We have introduced a tier of Driver Team Managers and a Driver Standards manager within the Service Delivery department to provide closer accountability and to better manage and assess smaller driver teams.*
- *We have reviewed the Metrolink Rule Book and the first module, which is*

specifically written for drivers. This will be published soon.

- *We have undertaken a complete review of our fatigue management processes. We have developed a business working instruction utilising both the Working Time Directive and the ORR guidance on the subject.*
- *An implementation plan is currently being populated, comprising an internal communication article, toolbox talks and safety briefing documentation.*
- *We will be implementing an electronic competence management system initially focussing on safety critical staff.*

8. On 30 September 2019 Nottingham City Council, Tramlink Nottingham Limited and Nottingham Trams Limited (as duty holder for the operations of the Nottingham Express Transit (NET) system) provided the following joint update:

NTL is working with the LRSSB and its consultants Atkins to mitigate risks associated with design, maintenance and operations of the tram network.

SRM workshops have been held in September with Atkins SRM specialists, an LRSSB representative, together with NTL Operations, Engineering, HR and Safety functions to populate and develop the NTL specific risk profile.

The resulting model will be used as required by the ORR to map the overall safety risk profile, to identify low frequency and potential high impact hazards prioritising the implementation of control measures. Specifically, as required by the ORR in Point 9 of their letter dated 30th August, NTL will use the outputs from this model in relation to decisions regarding the recommendations from the Sandilands inquiry. Following training NTL will commence using the SRM from ist October 2019. Priority will be given to evaluating the risks identified in the Sandilands report. (End Oct '19).

NTL will continue developing "bow-tie" models for light rail application, and have proposed further development of this aspect with LRSSB.

NTL will utilise the RSSB Taking Safe Decisions approach in assessing proposed vehicle and system changes.

Initial risk assessments for all Sandilands recommendations have been undertaken and are attached. These will be reviewed against the outputs of the LRSSB SRM by the end of October 2019.

Action: NTL- start using LRSSB SRM after training from pt October 2019, review after 6 months. Completion expected: April 2020

9. On 23 December 2019 Stagecoach Supertram provided the following update:

Since our last update, SYSL have hosted a workshop with the support of UK Tram and Atkins to populate the risk profile of the hazardous events agreed on by the

industry. The workshop attendees included a range of experienced staff across Operations and Engineering and included input from South Yorkshire Passenger Transport Executive (SYPTE) taking into consideration historical incident data and professional judgement. Atkins have since produced the final safety risk model for SYSL which has given focus and priority to particular areas of risk. SYSL has chosen to align with our Stagecoach Bus counterparts in procuring bow tie modelling software to risk assess our top priority risk areas. This software is being procured in January 2020 with a supporting workshop being delivered in February 2020.

Progress on individual safety risk models preliminary results from each light rail network have been discussed at the most recent Heads of Safety meeting held on 31st October 2019, the output of individual network safety risk models is due to be compared by Operators at the next Heads of Safety meeting on 9th January. SYSL and SYPTE will also be receiving further training from Atkins in January 2020 on maintaining an up to date safety risk model for Sheffield.

10. On 20 December 2019 South Yorkshire Passenger Transport Executive provided the following update:

A SYPTE representative attended the SYSL risk workshop held by ATKINS. Following this workshop SYPTE has received a copy of the outputs from the model.

At the last UKTram Heads of Safety Meeting on the 31October2019 it was requested by SYSL that a future Heads of Safety meeting discuss the individual system risks identified to compare results from the modelling across the systems.

ATKINS are planning to visit Sheffield on the 14 January 2020 to provide training on the model.

SYPTE understand that SYSL are actively using the Tram Accident Incident Reporting Database (TAIR). SYPTE are still in discussion with the LRSSB regarding read only access for SYPTE, it is hoped that this access will be available early in 2020.

11. On 8 January 2020 LRSSB provided the following update:

Introduction of Tramway Accident and Incident Reporting Database (TAIR) and Industry Risk Model

The TAIR Database UKTram/LRSSB has been provided to Duty Holders with some systems starting to utilise the system and input data. Interface work is being undertaken with some systems that already use a reporting system and require an interface between the two systems.

At present several additional modules are currently in the process of development that will be incorporated into the TAIR platform. Their current status is as follows:

- *Industry Safety Alert (Completion anticipated mid-January 2020)*
- *Risk Assessment (Completed initial test platform added to system)*

Recommendation 2

- *Documents and Standards Development and Approval (Completion anticipated mid-January 2020) pending modifications raised at October HOS meeting.*
- *Project Tracker (In Progress)*
- *RAIB Report index and industry response tracker (In Progress)*

In addition, following requests from a number of individual operators associated to Bowtie risk analysis. LRSSB have reviewed a dedicated software package to facilitate this PROCES and have confirmed the feasibility of the integration of the software within a portal situated within the TAIR platform.

The Bowtie XP software will provide:

- *Main template index*
- *Generic template upload / download*
- *Discipline categorisations*
- *Actions*

Industry Risk Model

Three systems (Manchester, Blackpool, Edinburgh) have final report issued, with intentions for a further 2 (Sheffield, London) by end of 2019. The intention for these 5 to have received training session by end of Jan 2020.

Nottingham & West Midlands have provided further information w/c 25th November. Drafts will be progressed however priority shall be on finalising systems mentioned above, but still remains within the work programme as planned.

Continued engagement with DLR, including request for their Fault & Event Trees

Enhanced engagement with international systems (via UKTram's UITP Light Rail Committee Membership) to complete survey for High Consequence, Low Frequency events.

Initial draft fault trees have been developed but work is currently on hold with focus on model roll-out and completion of survey.

Continued engagement with systems on TAIR with some using directly others providing data for input by UKTram. Requests for changes continue, reporting approach of incidents/near misses a key issue to resolve. As model & TAIR is rolled out, focus is turning to embedding into BAU as well as industry change management.

Recommendation 3

12. On 3 January 2020 London Trams provided the following update:

As mentioned in our last update, we have been working this year to install a Physical Prevention of Over-speeding system onto the London Tram network. Engineering Support Group (ESG), (a subsidiary of Deutsche Bahn, working with Sella) were selected to design and deploy a variant of their Sella's Tracklink 3 product to meet this need. The system, which we believe will be a first for the UK Tram network, will be set to activate at a safe margin above the posted speed limits at high risk locations. On activation the PPOS will brake a tram to a stop on the basis that a clear over speed violation has occurred.

Work to install this system on the London Tram fleet has now been completed and it is now in its final stages of safety assurance before going live in January 2020.

Note: This recommendation was reported as 'Implemented' for London Trams on 5 April 2019. Link to letter: https://orr.app.box.com/file/434372200639

13. On 9 December 2019 Tram Operations Ltd provided the following update:

TOL has implemented this recommendation to the satisfaction of ORR and continues to monitor for any change.

Note: This recommendation was reported as 'Implemented' for Tram Operations Ltd on 5 April 2019. Link to letter: https://orr.app.box.com/file/434372200639

14. On 19 December 2019 West Midlands Metro and Transport for West Midlands provided the following joint update:

As previously advised WMM has received information from CAF relating to their proposal to adapt an automated tram speed monitoring system, the system is a Balogh tag based active control system that has the means of setting and dynamically controlling maximum tram speeds at critical locations.

This system will be installed at construction stage to the new CAF Urbos 100 fleet due for delivery in April 2021 and coincide with retrofit to the current MML operated CAF Urbos 3 tram fleet.

15. On 12 December 2019 Blackpool Council provided the following update:

The entire system has recently been appraised regarding speed/risk and signage has been installed accordingly. BTS are currently trialling the Bombardier Collision

and Overspeed Monitoring and Prevention Assistance System (COMPAS). This system is still undergoing trials. Once fully operational, this sytem will undergo a benefit/cost/risk analysis model to determine its practicability. Subject to the results, it is our intention to utilize this system if proven to be of benefit to the safe operation of the system.

16. On 16 December 2019 Blackpool Transport provided the following update:

BTS are currently trialling the Bombardier Collision and Overspeed Monitoring and Prevention Assistance System. The system is designed to geo-fence areas and ensure that the tram does not overspeed. In addition to overspeed there is also object detection that will, where practicable, ensure a tram does not strike an object.

The Trial has been running passively for a number of months with a high number of false positives being reported. A modification has been made to the window wiper and a further modification to the GPS system will be made in January 2020.

The passive trial will then continue until May 2020 with two active tests being carried out, without passengers, in Mar and May 2020. On successful completion of the trial BTS will consider the practicability of installing on the tram fleet.

17. On 30 December 2019 Edinburgh Trams provided the following update:

ET reviewed the tram alignment for areas where substantial speed reduction exists with the risk of derailment or overturning of the tram vehicle. There are 2 locations where line speed limits reduce from 70 kph by more than 40 kph (Locations 1 & 2) and 1 where line speed reduces by 30 kph (Location 3).

> *Location 1. Inbound from Airport at Ingliston Park & Ride Tramstop (West) - 70kph*
> *to 15kph*
> *Location 2. Inbound at Gogarburn Underbridge - 70kph to 25kph*
> *Location 3. Inbound & Outbound at Carricknowe Underbridge - 70kph to 40kph were also assessed despite not meeting the criteria for >40kph speed reduction.*

Mitigation measures implemented are:

- *At Location 1 a new speed sign with an 'Attention Plate' has been installed to mandate a reduced speed limit of 15 kph (with a RED border) to assist the driver*
  on approach to the curve leading into the tramstop. Since the tram is preparing to
  stop at the tramstop, with the vehicle on approach to Location 1, there is no chevron signage required at location 1.
- *At location 2, Chevron signage, with a reflective yellow border, has been added to provide a visual indication of a tight bend to the driver.*

Recommendation 3

To further reduce the risk of a tram negotiating a curve at an uncontrolled speed due to a driver becoming incapacitated or inattentive, ET has also optimised the settings of the Driver Vigilance and Driver Safety Device on board the trams to mitigate that every 400 metres the driver must take a positive action to reset the hardware or an automatically controlled, emergency braking of the vehicle will occur.

This will reduce SFAIRP a tram driven by an incapacitated or inattentive driver to negotiate a curve in a controlled reduction of speed, without toppling or derailing.

Once the tram has come to a stop the driver will contact control (if possible) for further instructions. The event will be treated as an unwanted Emergency Brake and result in review of the tram event recorder, following which the driver may be referred back to refresher training.

Additionally to these automatic settings, ET carries out sample review of the vehicle data recorder to ensure drivers are driving to the correct speed limit and appropriate use of traction demand and braking is being followed in accordance with our Professional Driving Policy and driver training.

ET will continue to engage with our vehicle manufacturer to explore further enhancements for automatic means of mitigation for the risk of over speed. Any enhancements will be considered at lifecycle replacement of the tram systems.

18. On 29 January 2020 Edinburgh Trams provided the following update:

As discussed over the phone please accept this further clarification for our response to Rec 3 of the Sandilands report
ET has liaised with our vehicle supplier and received information on systems capable of providing the alarm and automatic braking function required by Rec 3.

CAF COSMOS System (CAS-E)

- *Requires on board antenna for reading on track beacons.*
- *This system acts on alarms and brakes.*
- *Currently on trial in Midland Metro*

SIMOVE

- *It is a consolidated system.*
- *Located system with GPS.*
- *Independent system from the rest of systems on board.*
- *This system acts on alarms and brakes.*
- *Different operation modes.*
- *Currently on trial in Manchester Metrolink*

We await the outcome of these trials and will include the optimum solution with our early mid-life update of our vehicles. We have discussed this with City of Edinburgh Council and they have indicated their support.

We would target the following program

- *Q3 2020 – Design/Procurement*
- *Q3 2021 – Start of implementation*

Recommendation 3

- *Q4 2022 – Acceptance*
- *Q1 2023 – Project Review*

19. On 20 December 2019 Transport for Greater Manchester and Keolis Amey Metrolink provided the following joint update:

TfGM and KAM are working closely together to progress this recommendation. We recognise that a joint approach is required to ensure the solution we employ is effective.

The industry, through UK Tram and LRSSB, commissioned a study into the options available that may support addressing this recommendation. A report was published on the 20th January 2019 and identified several systems grouped into two categories, Belize based and tram only GPS systems.

We have continued to support this work on behalf of the industry and so we have allowed our network to host a trial of a hybrid GPS and wheel turn location-based system. This is allowing both us and the industry to learn about a technology that is not used on any network in the UK but does have some take up in continental Europe.

With this trial and the lessons learnt from other operators, our work is now progressing to a requirement setting exercise and subsequent hazard identification work. We aim to complete this by Q1/Q2 2020 to then begin a procurement phase.

20. On 30 September 2019 Nottingham City Council, Tramlink Nottingham Limited and Nottingham Trams Limited (as duty holder for the operations of the Nottingham Express Transit (NET) system) provided the following joint update:

In the light of the Sandilands recommendations NTL's review has identified that to achieve a risk that is ALARP the fitment of an overspeed alert system is required. This review has also identified that fitment of a brake activation system in conjunction with an overspeed alert system does not significantly decrease risk and so this feature is not proposed.

We are developing a solution based on the Automatic Vehicle Location System that is fitted to both Citadis and Incentro tram fleets. This will provide 100% coverage in real time. This will provide both driver and Control Room with warnings of overspeeding. Driver alerts will be via the driver display monitor and will require acknowledging. Full reporting functionality will be available enabling us to review both driver and location risks.

A programme for development and installation of a solution is expected to take 30 weeks once agreed.

Action: NTL - Completion expected: August 2020

Recommendation 3

21. *On* 21 *February 2020 NTL provided the following update:*

NTL have assessed the new requirement for over speed monitoring and control arising from this recommendation.

We are developing a solution based on the Automatic Vehicle Location System that is fitted to both the Citadis and Incentro tram fleets. This will provide both driver and Control Room warnings in the case of critical over-speeding. The over speed monitoring system will automatically apply the vehicle brakes should the driver not acknowledge the warning and reduce the vehicle speed appropriately.

Together with the AVLS supplier NTL are continuing to develop and test the over speeding application.

Assess system risks from over speeding and then implement the appropriate control measures (driver warning, automatic brake application and level of brake application as appropriate.).

NTL are utilising current Light Rail research on speed monitoring and automatic brake application to inform the final solution.

Action: NTL

22. On 23 December 2019 Stagecoach Supertram provided the following update:

As mentioned in previous updates SYSL have initially considered the feasibility of installing TPWS overspeed technology on the Sheffield network. We are continuing to monitor progress of the UK Tram Working Group researching suitable technologies and are particularly watching with interest the trials underway in Manchester.

We are aware of the SYPTE position to specify suitable technology to meet the requirements of recommendation 3 within the outline business case for fleet renewal or replacement that will be made to the DfT in March 2020. In the interim SYSL will continue to follow closely the developments from overspeed control trials at Manchester and Croydon and consider relevance and suitability for the Sheffield network when more details are made public, which we expect to be in early 2020.

In the meantime SYSL have assessed our network for overturn risk on curves and continue to review this assessment on a regular basis. We have also reduced the maximum speed on the tramway network (not including tram trains running on Network Rail Managed Infrastructure) from 50mph to 40mph, as well as other visual cues previously reported under recommendation 5.

23. On 20 December 2019 South Yorkshire Passenger Transport Executive provided the following update:

SYPTE continue to monitor progress on the work Ian Rowe Associates are

undertaking on behalf of the industry. SYPTE understand that a trial is currently being undertaken on Metrolink of the Simove system and SYPTE will be looking to understand the result of this trial.

SYSL detail in their response their approach to meeting this recommendation in the short term.

Longer term SYPTE is currently developing an Outline Business Case for submission to the DfT. This Business Case is for funding to renew parts of the Supertram System. This Business Case currently includes replacement of the Siemens tram fleet as the preferred option. As part of the development of this Business Case SYPTE has noted the need to meet the requirements of recommendation 3 and as such has developed outline costings that include the fitting of a speed control system to any new fleet procured.

The current programme for delivery of this Outline Business case is that the Business Case is submitted to the DfT in March 2020. Should the Business Case prove to be successful and the DfT provide their approval it is hoped that procurement of any new fleet can commence in 2023 with delivery of the final new vehicle by April 2027.

24. On 8 January 2020 LRSSB provided the following update:

Driver Inattention and Speed Management Project:

Following the market research report into Automatic Vehicle Speed Monitoring (AVSM) systems and Driver Inattention systems (issued in January 2019), conducted on behalf of UKTram by Ian Rowe Associates Ltd. (IRAL), the SIMOVE AVSM was selected to be trialled in order to establish the efficacy and performance of the system. Manchester Metrolink agreed to participate in the system trial with one of their Bombardier M5000 vehicles being fitted with the SIMOVE system.

The first visit of the SIMOVE team took place between 14th and 16th October 2019. During this visit, two separate work-streams were carried out. The first was to establish the technical feasibility of fitting the on-tram equipment to the vehicle. With the second involving a GPS survey of the East Didsbury to Rochdale Town Centre route to establish GPS coordinates.

A second took place week commencing 11th November 2019. The second visit lasted four or five days and focused on testing the temporary installation, refining topology files, brake loop connection, interference testing and providing assurance for the vehicle to operate in service.

The third visit is took place the commencing 2nd December 2019 and focused on the following:

- *The temporary installation of the SIMOVE equipment*
- *Training for maintenance staff*

Recommendation 3

- *The use of ‘Back-office’ functionality*
- *Driver briefing*
- *Mainline trials*
- *Topology verification*

This visit was successful and the next steps are to permanently fir the equipment to a Tram and commence full service testing in January 2020 with a view to a demonstration session to all Duty Holders in February 2020.

TfL have fully installed their Belize/beacon based speed control system and are in the final stages of safety Verification, they will be sharing the outputs and information data to UKTram/LRSSB to share with members for comparison of performance, installation requirements and costs. This will take place in February 2020.

Recommendation 4

25. On 3 January 2020 London Trams provided the following update:

As per our previous updates, this recommendation was implemented on London trams using available technology [Guardian System] in October 2017. This system is designed to detect driver inattentiveness and provide an alert, but does not apply the brakes, as suggested as an option in the recommendation.

Research carried out by Ian Rowe Associates Limited (IRAL) on behalf of UKTram has identified that no single system currently exists that is capable of fully addressing the requirements of recommendation 4 (by alerting the driver and automatically initiating a brake application if a low level of alertness is identified).

The Guardian System reliably alerts the driver when a low level of alertness is identified; in order to adequately address this recommendation, London Trams have overlaid the proven functionality of this system with Physical Prevention of Overspeed technology (see above) and iTram (which provides continual GPS based speed monitoring and driver alerts when the permanent speed restriction has been exceeded).

Evaluation and assessment of this approach using Common Safety Method principles has been undertaken and is about to be finalised; findings of this assessment will, we believe, support a claim that the risk of a serious accident occurring due to tram driver inattention has been reduced to so far as reasonably practicable (SFARP) levels.

26. On 9 December 2019 Tram Operations Ltd provided the following update:

The Guardian System was installed by London Trams on their tram fleet in October 2017 and is operating effectively.

Research carried out by Ian Rowe Associates Limited (IRAL) on behalf of UKTram has identified that no single system currently exists that is capable of fully addressing the requirements of recommendation 4 (by alerting the driver and automatically initiating a brake application if a low level of alertness is identified).

The Guardian System reliably alerts the driver when a low level of alertness is identified; in order to adequately address this recommendation, London Trams have overlaid the proven functionality of this system with Physical Prevention of Overspeed technology and iTram (which provides continual GPS based speed monitoring and driver alerts when the permanent speed restriction has been exceeded).

Recommendation 4

Evaluation and assessment of this approach using Common Safety Method principles has been undertaken; findings of this assessment support a claim that the risk of a serious accident occurring due to tram driver inattention has been reduced to so far as reasonably practicable (SFARP) levels.

27. On 19 December 2019 West Midlands Metro and Transport for West Midlands provided the following joint update:

MML commissioned Ian Rowe Associates to undertake a human factors analysis of the proposal to reduce the frequency of the Driver Vigilance Device ("DVD") fitted by CAF to the Urbos 3 tram fleet from 30 seconds to 15 seconds. An assessment has been completed which included driver behaviour and workload monitoring and a report has been received. The report supports the proposed reduction in DVD interventions. A technical change was sought and implemented successfully on to our tram fleet on 4t" September 2019, MML has written to the ORR to advise of this change.

28. On 12 December 2019 Blackpool Council provided the following update:

BTs currently operate a vigorous driver vigilance system that requires a positive input every 30 seconds. Failure to provide the positive input results in the service brake being applied until the vehicle comes to a full stop. BTS are also supporting Edinbrugh Trams with their driver Innovation Safety Challenge (DISC). This system proactivily recognises driver fatigue/wellbeing.

29. On 16 December 2019 Blackpool Transport provided the following update:

The fleet of trams operated by BTS is fitted with a driver vigilance device that requires a positive action every 30 seconds. If a positive action is not received the tram will come to a stop using full service brake. If the tram is travelling at maximum speed it will travel approx. 400m before a brake application.

BTS are also supporting Edinburgh Trams with their Driver Innovation Safety Challenge (DISC). The challenge is produce an active monitoring and alarm solution that will pro-actively recognise fatigue and wellbeing of staff. A solution is expected to be delivered by December 2020.

30. On 30 December 2019 Edinburgh Trams provided the following update:

Driver Innovation Safety Challenge (DISC)

ET are looking to enhance our ability to pro-actively recognise fatigue and the wellbeing safety critical workers (including tram drivers) and launched the Driver Innovation Safety Challenge (DISC) to produce an active monitoring and alarm provision solution. The solution will:

Recommendation 4

- *Provide a Red/Amber/Green type of alert to both the safety critical worker (SCW) and the Operation Control Centre (OCC):*
  - *Green Status - SCW is good and no further action required.*
  - *Amber Status - First threshold of fatigue/wellbeing has been exceeded and OCC receives an alert to contact the SCW to confirm they are alright to continue. If not, then the SCW will be relieved at the earliest opportunity*
  - *Red Status - The SCW and OCC receive an alert and the SCW must be relieved at the next safe location to do so.*
- *The solution is expected to be delivered with an integrated sensor set including:*
  - *Infra-Red eye detection*
  - *Biometric measurement*
  - *Interpretation algorithms*
  - *OCC monitoring and reporting suite*
- *ET is working in partnership with UKTram and other tramways to deliver DISC*
- *It is not anticipated that the initial solution will provide a means of applying the tram brakes in the event of a Red Status alert as it is expected that this alert will still provide time for the occ to contact a sew and have them stop safely.*
- *While the Infra-Red sensor is essentially a camera, it is not expected that its outputs will be available under GDPR to facilitate the investigation of incidents.*

A solution is expected to be delivered for DISC by December 2020.

Driver Roster

New driver Roster in place to assist with reduced fatigue rating. The new roster includes training days where drivers will be briefed on managing their own fatigue. All Rosters are developed and implemented in line with ET Management of Fatigue process [Ref.ET/CRM/2.1 version 1].

31. On 20 December 2019 Transport for Greater Manchester and Keolis Amey Metrolink provided the following joint update:

In a similar vein to recommendation 3, TfGM and KAM are working closely together to address this. As detailed already, a study was conducted on behalf of the industry by UK Tram and LRSSB. A report published on the 20th January 2019 identified market ready available systems broadly grouped into two categories, task monitoring / vigilance and facial analysis.

UK Tram has commissioned further work in this area to undertake trials on facial analysis systems. Representatives from across both of our organisations have attended this trial to improve our understanding of the systems available.
With regards to a vigilance system, we have a proposal from our rolling stock supplier to retrofit our fleet.

Recommendation 4

We expect to confirm our requirements for a system in Q1/Q2 of 2020 and then proceed to a procurement phase.

Note on Recommendation 3 and 4

While recommendation 3 and 4 are clear, there are obviously many points that need *to be considered when implementing systems of this nature. For example, if an over speed event occurs and the brakes are applied how is the situation recovered? We are using a requirement-based approach to address these points. This is an important stage of a project as it will ultimately govern what solution is implemented. We are completing this stage methodically using the work completed on behalf of the industry and lessons learnt from other operators.*

Whatever solution is arrived at, it will be a challenge for Metrolink to implement due to the size of our network and fleet. It will not be an overnight fix.

Finally, as we implement these systems a change management process will be followed, together with full consultation with employees.

32. On 30 September 2019 Nottingham City Council, Tramlink Nottingham Limited and Nottingham Trams Limited (as duty holder for the operations of the Nottingham Express Transit (NET) system) provided the following joint update:

NTLs review, taking into account the Sandilands recommendations, concludes that DVDs are required to achieve a risk that is ALARP.

NTL operate two types of trams - the original lncentro trams (15 of) and the Citadis trams introduced as part of the NET Phase 2 extension (22 of).

Both vehicle types are fitted with Driver Safety Devices ("Deadman's Handle") operated by sensors on the Traction Brake Controller but have different control systems and will require different solutions to implement a DVD system.

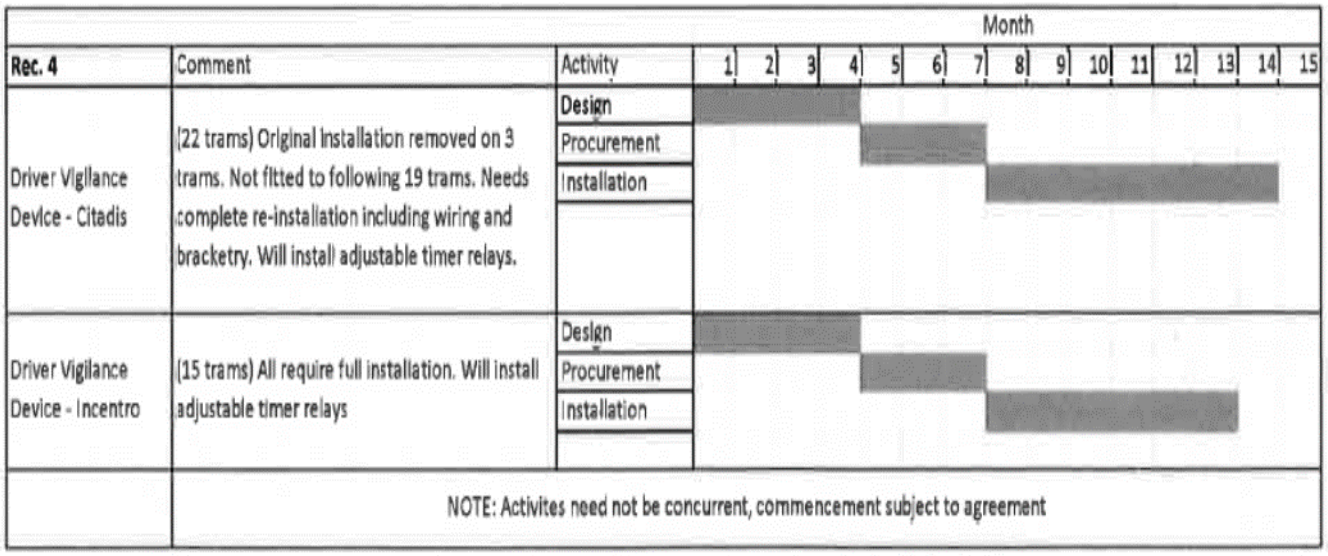
In accordance with the risk assessments Citadis trams will be modified to re-install their DVD systems. The DVD system as originally installed on the Citadis trams had no facility to adjust activation and response times, the proposed modification is proposed to include such features. We are currently working with human factors experts to optimise the DVD timing and alert cycles.

lncentro trams will require an additional DVD system to be designed, tested and retrofitted to the vehicles.

Prior to activation on the Citadis trams the operational aspects of the Vigilance systems will be trained out to all tram drivers using our Citadis driver simulator with particular emphasis on the differences between the trams which have had DVD fitted or not during the phased implementation of the systems.

Recommendation 4

Outline implementation programme: The programme below shows a draft program length for each proposed modification. It is not a demonstration that the various programs can be undertaken in parallel.



During 2020 we will be completing the current Incentro re-fresh through to September and Incentro bogie overhaul through to December 2020. That will be immediately followed by Citadis overhaul through to late 2021. Therefore at all times over the next 24 months there will be 1 tram out of service at all times notwithstanding any new programs. Running these additional programs in parallel would result in 2 additional trams being stopped at any one time making a total of 3 trams. As routine running maintenance requires 2 trams stopped at any one time there would be 5 trams unavailable each day, leaving 32 trams for 32 services with no spares for the duration of the program. Any agreed modifications would need to be planned around existing workload to maintain service availability, or relief from performance requirements may need to be considered.

Action: NTL - Completion expected: Estimated 14 months from agreement

33. On 23 December 2019 Stagecoach Supertram provided the following update:

Further to previous responses, SYSL have visited the testing facilities researching the effectiveness of driver alertness technologies and await the final results and report from the UK Tram Working Group.

We are aware that SYPTE have specified meeting the requirements of recommendation 4 in the outline business case for fleet renewal (or refurbishment) of the Siemens fleet that will be made to the DfT in March 2020.

In the interim SYSL is developing a vigilance device to be retrofitted to the Siemens fleet, similar to the vigilance device already fitted to Citylink trams. SYSL documented its risk-based approach via a Taking Safe Decisions document in which the risks and opportunities of eye monitoring technology and vigilance devices were considered and compared.

Recommendation 4

A vigilance device that activates the brakes in the event of no response has been developed with a preferred supplier which will initially be incorporated into a spare cab dashboard. A working-group of Drivers will then assist in determining the permanent location and type of device used (e.g. button or pedal) and the sighting of alert lights and audible warnings. We intend to have this process completed by 31st January 2020. From February to April 2020 a trial will be run on a Siemens tram to test the solution and allow drivers to experience the device (which will not be connected to the brakes). Following a successful trial our intention is to install vigilance across the entire Siemens fleet with completion by the end of 2020.

34. On 20 December 2019 South Yorkshire Passenger Transport Executive provided the following update:

SYPTE continue to monitor the progress of the UKTram Working Group researching suitable technologies. In order to understand more fully the testing undertaken the test facilities were visited by SYPTE. We are currently awaiting the final results and report from Ian Rowe Associates.

SYSL detail in their response their approach to meeting this recommendation in the short term.

As noted in our response to recommendation 3 SYPTE are in the process of developing an Outline Business Case for the renewal of the existing Siemens fleet. As part of the development of this Business Case SYPTE has noted the need to meet the requirements of recommendation 4 and as such has developed outline costings that include the fitting of a driver vigilance system to any new fleet procured

Recommendation 5

35. On 3 January 2020 London Trams provided the following update:

As noted in our previous update, working with our highway experts within Tfl a specification for enhanced tunnel lighting was developed, adopting best tunnel lighting practice from highways. This new lighting solution will provide comprehensive lighting both- within the Sandilands tunnel and also to the tunnel approach at Sandilands Junction. Adoption of latest technologies will link the tunnel lighting to exterior ambient light conditions and will minimise retinal impact to the drivers' vision on tunnel ingress and egress, allowing them to retain the highest levels of visual acuity throughout the tunnel.

We had hoped to have completed this project by the end of October this year, but a number of challenges with the design process as well as procurement issues have meant that this milestone was not achieved. However, we were able to switch on the new lighting in the tunnel before Christmas and we expect the scheme to be fully complete by the end of March 2020.

The adoption of highways type road studs ("cats eyes") as a sleeper mounted orientation aid within the Sandilands tunnel mentioned in out last update has now been fully rolled out. The studs are deployed in the tunnel Up road only to provide differentiation between directions of travel. The studs are configured to provide visual orientation between the individual tunnel sections.

Note: This recommendation was reported as 'Implemented' for London Trams on 5 April 2019.

36. On 9 December 2019 Tram Operations Ltd provided the following update:

TOL has implemented this recommendation to the satisfaction of ORR and continues to monitor for any change.

Note: This recommendation was reported as 'Implemented' for Tram Operations Ltd on 5 April 2019.

37. On 19 December 2019 West Midlands Metro and Transport for West Midlands provided the following joint update:

As previously advised action was taken to review and provide additional signage following publication of the report. A continual review of signage is ongoing by way of risk assessment, any further recommended changes will be considered in light of this and the results of the active signage trails.

Recommendation 5

38. On 12 December 2019 Blackpool Council provided the following update:

As detailed in our original response, our sytem benefits from genrally being slow speed, flat, straight and with an excellent line of sight. The entire system was recently appraised by BBC and BTS. All speed signs, approaches to curves or other areas of slow speed offer the drivers excelletnt visual advanced notice of the need to reduce speed. The majority of tight curves on our system are located in the termini (low speed areas) or areas of other influences (positive controlled junctions/platforms/compulsory stops) are located nearby thus ensuring of low speeds.

39. On 16 December 2019 Blackpool Transport provided the following update:

BTS in conjunction with BBC have completed a complete system review. A number of step down speed restriction were put in place where the drop in speed was high.

The network geometry and slow speed of the trams means that we are now comfortable that all signs are located sufficiently in advance of curves so as to allow for reaction time and braking to take place in time for the curve.

40. On 30 December 2019 Edinburgh Trams provided the following update:

In late 2016 ET reviewed the locations where trams could potentially need to brake from 70kph to less than 40kph, of which there were three. Of these we were satisfied that existing measures were sufficient at two curves. At the third location (on the approach to IPR tram stop city bound) a red bordered '15 kph' sign with an attention plate above has been added as a visual reminder to slow down to 15 kph before the curve into IPR tram stop.

We are now comfortable that all speed limit signs are located sufficiently in advance of the curves to allow for reaction time and braking distance from the approach speed.

On the Inbound curve east of Gogarburn Underbridge, chevron signage, with a reflective yellow border, has been added to provide a visual indication of a tight bend to the driver.

Additionally, we have also trained and implemented DriveSmart in 2018. This has been developed in partnership with The University of Birmingham Centre for Rail Research and Education innovation project for More Energy Efficient Trams (MEET). MEET uses detailed route modelling analysis to identify optimum movement sequences, identifying points along the route where the driver should coast and brake, or be travelling at an optimum speed. MEET innovation completed successfully and was then taken to market by Ricardo Rail as DriveSmart. All tram drivers have now completed the training in the smart driving techniques and this helps maintain their levels of focus in off-street areas.

Recommendation 5

Finally, ET fully support the work currently being undertaken by LRSSB to produce best practice guidance for Tram signage following their consultation with the Department for Transport and will act on any recommendations accordingly.

41. On 20 December 2019 Transport for Greater Manchester and Keolis Amey Metrolink provided the following joint update:

As detailed in our response from both KAM and TfGM in May 2018, we consider that we have completed the required work to close this recommendation.

The Light Rail and Safety Standards Board {LRSSB) have begun work on a guidance document titled 'Signing and Marking of Tramways and Highway Interface Guidance'. We will support this work and when it is completed we will check if there are any changes we need to make to the Metrolink network.

42. On 30 September 2019 Nottingham City Council, Tramlink Nottingham Limited and Nottingham Trams Limited (as duty holder for the operations of the Nottingham Express Transit (NET) system) provided the following joint update:

NTL have assessed the tramway for tight curves as described in the RAIB recommendation and have implemented countdown Speed Restrictions at three locations.

These locations have been further surveyed, in conjunction with the Highways Authority (HA) where appropriate, with a view to fitting high visibility chevrons to provide drivers with additional warning of low speed curves. The HA is providing advice on suitable roadway designs for these applications.

Action: NTL - Completion expected: March 2020

43. On 23 December 2019 Stagecoach Supertram provided the following update:

SYSL have previously reported the measures taken along the segregated routes to make drivers aware of high risk locations. We have been in conversations with SYPTE who have confirmed that an industrywide approach to DfT consultation was requested through the most recent Duty holders meeting. Having consulted with DfT we are aware that LRSSB intend to publish guidance for off street speed restriction signage which will be available for review by February 2020. SYSL intend to be involved in the consultation process for this guidance document as part of our commitment to recommendation 5.

44. On 20 December 2019 South Yorkshire Passenger Transport Executive provided the following update:

Recommendation 5

SYPTE has previously reported on the measures taken to date. SYPTE raised the issue of DfT consultation at the LRSSB Duty Holders meeting on the 17 October 2019. In this meeting we were advised that the LRSSB were to hold discussion with the DfT on this matter.

LRSSB has since advised that they have discussed recommendation 5 with the DfT. LRSSB has advised that they are working on a guidance document that will cover all tramway signage including the guidance for off highway speed restriction signage. LRSSB have advised that they would be looking to put this out for consultation by February 2020. SYPTE intend to be involved in the consultation process for this guidance document.

SYPTE has also approached Sheffield City Council's road safety auditor to understand their approach to such matters on the highway.

45. On 8 January 2020 LRSSB provided the following update:

Lineside Signage

UKTram and LRSSB advised all Duty Holders to review their lineside signage and shared Industry Best Practice. LRSSB has commission work on a Tramway Signage Standard in collaboration with DfT and supported by UKTram and its members.

Recommendation 6

46. On 3 January 2020 London Trams provided the following update:

You will be aware from previous updates that TfL commissioned the manufacture and testing of several prototype windows that may provide an appropriate level of additional containment. These prototypes were assessed against the conditions likely to have been encountered during the Sandilands incident, and took into account any affect they may have on ease of access for the emergency services. After extensive research and destructive testing to investigate the most appropriate retrospective solution for the London tram fleet, installation of enhanced strength window film was completed earlier this year. This is a new higher specification film that is 75% thicker (from 100 microns to 175 microns).

47. On 9 December 2019 Tram Operations Ltd provided the following update:

Following a programme of testing, London Trams increased the thickness of the film fitted to tram its windows from 100 microns to 175 microns. Work was completed in April 2019. TOL has communicated the outcome of this work to its staff.

48. On 19 December 2019 West Midlands Metro and Transport for West Midlands provided the following joint update:

Please refer to the market sounding report and our previous response. We remain of the opinion that clear industry wide guidance, based upon empirical research should be given on containment requirements if these are to vary from existing international standards before ad-hoc changes are made to individual tram fleets.

49. On 12 December 2019 Blackpool Council provided the following update:

The fleet currently has anti vandal film on the inside of the trams. Considering all the factors, the likelihood of an overturned tram is extremely unlikely and therefore no further containment is deemed practicable/cost-risk benefical. However, if other practicable solutions are identified within the industry then these will be considered.

50. On 16 December 2019 Blackpool Transport provided the following update:

BTS currently has anti vandal film on the inside of all tram saloon glass. We believe that the implementation of recommendations 3 - 5 greatly reduce the chance of overturning and there for the need for greater containment.

BTS will, however, await the findings of other member of UKTram into possible solutions and will consider the practicability of any improvements.

Recommendation 6

51. On 30 December 2019 Edinburgh Trams provided the following update:

ET has reviewed the tram alignment for areas where loss of containment due to derailment or overturning can occur and verified that there no potential points of collision with infrastructure and/or lineside equipment thereby making it less likely to lose containment.

Other measures to facilitate improvements associated with passenger containment provided by tram windows and doors, were proposed by our vehicle maintainer. They have proposed that it would be possible to simulate the integrity of laminated glass by using an anti-vandal film applied on the outside face of the existing toughened glass covering the whole surface of the glass, including the part of the glass that is bonded to the window frame. This would not however prevent the glass from shattering but would hold it in place, removing the risk of pieces of glass flying loose. Additionally we have considered the fact that any such measures introduced to increase tram window and door system integrity to further enhance passenger containment may in turn directly impede and conflict with the potential use of a door or window as a possible point of passenger emergency egress or rescue in the event of an incident.

ET will continue to work with LRSSB in their development of a generic industry guidance/standard document covering escape and rescue requirements in consultation with emergency services.

ET will act accordingly on any pursuant recommendations to:

- *Enhance and further develop our emergency procedures and continue to facilitate both individual vehicle familiarisation and escape and rescue strategy evaluation by the emergency services via regular scenario-based emergency exercises.*
- *Establish enhanced performance requirements associated with window and door system integrity within new and future vehicle design specifications and procurement.*

52. On 20 December 2019 Transport for Greater Manchester and Keolis Amey Metrolink provided the following joint update:

Transport for London have shared the outcome of the testing they have completed on different glazing solutions and their ability to withstand different impact forces.

We are proposing to follow a similar path as Tfl with the application of an additional laminate film to the glazing. This is subject to TfGM/KAM confirming that this is the appropriate solution for our current fleet.

53. On 30 September 2019 Nottingham City Council,
Tramlink Nottingham Limited and Nottingham Trams Limited (as duty holder for the operations of the Nottingham Express Transit (NET) system) provided the following joint update:

Recommendation 6

Both types of NET trams are currently fitted with 3M Ultra SGOO safety films to the inside of.saloon windows and doors. The films are certified to EN12600 2B2 (impact) and EN 45545-2: HL 1, 2, 3 (fire) and GSA TS-01 3B (blast). These mitigate the effects of glazing breakage and provide the same level of containment as per the current industry standard.

NTLs initial risk assessment concludes that the current fitment of 3M Ultra is sufficient to achieve a risk that is ALARP.

Any further modification, such as redesigned window apertures, frames or increasing thickness is not possible without significant redesign of the tram bodyside and structure and has been discounted. This would be prohibitively expensive even if shown to be possible within the current design structure.

Action: No further action required.

54. On 23 December 2019 Stagecoach Supertram provided the following update:

SYSL have recently received an update from LRSSB regarding their industrywide review of recommendations 6 and 8. We welcome the development of industry guidance covering escape and rescue requirements in consultation with emergency services and we will re-evaluate our approach to recommendation 6 based on the guidance developed.

We have also liaised with other Operators and Infrastructure Maintainers on this research topic which has indicated laminated glass is the most effective option for containment. This is already a standard feature for our Citylink trams however the Siemens trams bodywork was not designed to support the weight of laminated glass. The Siemens fleet is currently fitted with a vinyl for the purposes of anti-vandalism which offers some limited properties of holding broken glass together. Taking into consideration the SYPTE plans for fleet renewal or refurbishment (to meet the requirements of recommendation 6) SYSL's preferred approach is to focus resource on implementing recommendations 3,4 and 5 aimed at prevention of an overturn situation.

55. On 20 December 2019 South Yorkshire Passenger Transport Executive provided the following update:

The Citylink fleet already has laminated glass. Regarding the Siemens fleet SYSL has advised that there would be insurmountable issues introducing laminated glass due to the vehicle frame.

As detailed in our response to recommendations 3 and 4 SYPTE are currently in the process of developing an Outline Business Case for renewal of the Supertram system, including replacement of the Siemen's fleet. We would expect this procurement process to specify a vehicle that meets current tram design standards.

Recommendation 6

56. On 8 January 2020 LRSSB provided the following update:

Following review and assessment of the recommendation for the introduction of measures to facilitate improvements associated to passenger containment provided by tram windows and doors. LRSSB in consultation with operators and manufactures have determined that the recommendation is generally feasible, however the range, type and application of additional practical controls will be fleet dependent given window and door systems design characteristics for individual vehicle types.

In arriving at our conclusions the LRSSB has also taken into consideration the fact that any measures introduced to increase tram window and door system integrity to further enhance passenger containment may in turn directly impede and conflict with the potential use of a door or window as a possible point of passenger emergency egress or rescue in the event of an incident. Page 3 of 4

- *Operators should identify and apply enhancements to door and window integrity within scope of their individual vehicle type in consultation with vehicle manufactures and emergency services, ensuring that there is sufficient balance between passenger containment, escape and rescue. Additionally any enhancements should be incorporated into individual operator risk models and assessed to ensure their application will not import any additional risk.*

- *Development of a generic industry guidance/standard document by LRSSB covering escape and rescue requirements in consultation with emergency services. That in turn will allow operators to enhance and further develop emergency procedures in addition to facilitating both individual vehicle familiarisation and escape and rescue strategy evaluation by the emergency services via regular scenario based emergency exercises.*

- *Establish enhanced performance requirements associated to window and door system integrity within new and future vehicle design specifications and procurement.*

Recommendation 7

57. On 3 January 2020 London Trams provided the following update:

We have awarded a contract for the design and provision of emergency lighting to the tram fleet. This system will provide additional lighting units within the tram equipped with autonomous batteries. In the event of the tram's own batteries or lighting circuits becoming unavailable, the new system will provide suitable illumination throughout the tram. TOL supported us in the development of the design and scope of requirements with operational and driver input.

As per our last update to you in March, we had hoped to complete this project by the Summer of this year. However, this has not proven to be possible mainly due to the delay in finalising a compliant design. The design for the new system was ready for installation late this year, however at the moment the contractor was ready to mobilise, the work has started on the fleet to install the PPOS system mentioned earlier. It was not possible for both sets of contractors to work on the tram at the same time, so therefore the decision was taken to prioritise the installation of the PPOS system ahead of the emergency lighting.

We have now committed to have the emergency lighting installed and operational by the end of March 2020.

58. On 9 December 2019 Tram Operations Ltd provided the following update:

During December 2018, LT appointed a supplier to replace the standby emergency lighting in all trams. A completed design was expected by end of April 2019 with installation expected to have been completed by end of June 2019, however a delay occurred.

The procurement process recommenced, and a new lighting supplier was appointed late summer 2019. The new supplier has redesigned the proposed emergency light which is with LT for technical review. When this new design is available TOL will review any operational impact with Trade Unions and drivers.

It is anticipated the emergency lights will be completed during Spring 2020.

59. On 19 December 2019 West Midlands Metro and Transport for West Midlands provided the following joint update:

Please refer to our market sounding report and our previous response.

60. On 24 January 2020 West Midlands Metro provided the following update:

In regard to our discussion on recommendation 7 of the RAIB Sandilands incident report on Tuesday 21st January I have asked our technical department to confirm that emergency lighting power requirements are maintained by OESS battery power in the

Recommendation 7

event that the primary source of power is lost (in this case it would be auxiliary battery power supplies)

My understanding is that if is the case then the OESS system will supply a second back up source of power to the trams emergency lighting circuits and would possibly be an acceptable resolution to recommendation 7 of the report.

61. On 12 December 2019 Blackpool Council provided the following update:

BTS have programmed an upgrade of the emergency lighting in November 2020 when the planned refurbishment takes place.

62. On 16 December 2019 Blackpool Transport provided the following update:

BTS will integrate a modification of the emergency lighting in the current fleet of tram to ensure that the lighting cannot be unintentionally switched off or disconnected. This modification will be carried out with the planned refurbishment of the trams beginning November 2020.

63. On 30 December 2019 Edinburgh Trams provided the following update:

ET will integrate modification of the emergency lighting in the current fleet by means of some additional spotlights to identify the doors as the main emergency exit (British standards GMRT 2130 and GMRT 2100).

This will be implemented under the scope of on-board systems renewal works planned for 2021/22.

64. Transport for Greater Manchester and Keolis Amey Metrolink – **Note: This recommendation was reported as 'Implemented' for both on 5 April 2019.**

65. On 30 September 2019 Nottingham City Council,

Tramlink Nottingham Limited and Nottingham Trams Limited (as duty holder for the operations of the Nottingham Express Transit (NET) system) provided the following joint update:

The current lighting configuration on both Incentro and Citadis trams provides battery operated emergency lighting levels where the main power supply is interrupted, to meet all credible emergency conditions.

NTLs initial risk assessment concludes that if overspeed alarms and DVDs are installed across the fleet the risk of battery power disconnect to the emergency lighting is not a credible failure; therefore there is no justification for fitting an uninterruptible power supply to the emergency lighting.

<u>Action:</u> No further action required.

Recommendation 7

66. On 21 February 2020 NTL provided the following update:

The current lighting configuration on both Incentro and Citadis trams provides battery supplied emergency lighting levels when the main (OLE) power supply fails. The emergency mode is designed to meet all credible emergency conditions. However, in light of the RAIB recommendation further investigations have been undertaken with the tram manufacturer to assess the practicality of providing higher security emergency lighting using discrete UPS or battery back-up lighting fixtures in saloon vestibules. This has been subject to further risk assessment. This solution is now being taken forward as an engineering change to the vehicles.

Action: NTL

67. On 23 December 2019 Stagecoach Supertram provided the following update:

For our Siemens trams SYSL have developed a secondary wiring loop to provide emergency lighting above exit doors in the saloon in the event of power disconnection from the battery. The wiring configuration is being developed with the intention to fit to a tram by 31st January 2020. The trial will then run till approximately April 2020 in order to understand the discharge capacity of the battery as well as checking for any wiring faults. Following a successful trial we intend to undertake a campaign to retrofit all Siemens trams in 2020/21.

On Citylink vehicles, the risk of interruption to the emergency lighting is less likely due to the configuration of multiple batteries providing a power supply, and the ability of these batteries to continue to operate whilst laid on their side. As such we do not intend to make any alterations to the current arrangements.

68. On 20 December 2019 South Yorkshire Passenger Transport Executive provided the following update:

For the Siemens fleet SYSL have informed us that that they have developed a secondary wiring loop to provide emergency lighting above the exit doors in the saloon. Further details are provided in SYSL's response.

69. On 8 January 2020 LRSSB provided the following update:

Emergency Lighting

UKTram and LRSSB have advised members to engage with suppliers and vehicle manufactures to implement this recommendation. Options and Best Practice of implementation have been shared within the UKTram Functional Group forums.

Recommendation 8

70. On 3 January 2020 London Trams provided the following update:

UK Tram Subcommittee 1 on behalf of the Industry came to the collective view that installing escape hatches in the floor or roof of any Tramcar would import significant risk. We are awaiting the output of the industry risk model (see recommendation 2) which may inform further enhancements to our evacuation arrangements.

As part of the business as usual safety governance arrangements we will support TOL when they review their emergency procedures, especially following the installation of thicker window film (Recommendation 6) and the new emergency lighting system being installed (Recommendation 7).

71. On 9 December 2019 Tram Operations Ltd provided the following update:

Strengthening of the anti-vandal film on the tram windows was completed in April 2019. Whilst the update to the Emergency lighting in trams is underway, it has been delayed due to procurement issues; these have now been resolved.

A new design has been received by LT from the Supplier. It will be shared with TOL after a technical review. Due to commitments on completion of the other projects resulting from Sandilands, the installation of the new Emergency lighting has been delayed until Spring 2020.

Once the installation of the emergency lights has been completed, TOL will review its evacuation process to take into account any changes that flow from the provision of emergency lighting and the strengthening of the film on the tram glass. In addition, TOL are awaiting the output of the industry risk model before any further review of the evacuation arrangements on Tramlink trams.

72. On 19 December 2019 West Midlands Metro and Transport for West Midlands provided the following joint update:

Please refer to our market sounding response and our previous response. We would emphasise that neither our chosen vehicle supplier nor any of the potential suppliers of vehicles for our third Generation fleet consider they can comply with this recommendation.

73. On 12 December 2019 Blackpool Council provided the following update:

Blackpool Council does not accept this recommendation due the very rare likelihood that one of our trams would overturn. There are no reasonable foreseeable instances where this could occur, even more so if the COMPAS system is integrated. There is no room for a roof hatch and a floor hatch would pose more danger to our patrons being accessible to vandals whilst the tram is in motion.

Recommendation 8

74. On 16 December 2019 Blackpool Transport provided the following update:

BTS does not accept this recommendation. There is no space for a hatch in the roof. A hatch in the floor would be assessable to customers during normal operation and would therefore import additional unacceptable risks.

75. Blackpool Transport provided the following further update dated 21 January 2020:

BTS in conjunction with BBC have reviewed the options available for the rapid evacuation of a tram that is on its side after an accident.

There is no space for a hatch in the roof. A hatch in the floor would be assessable to customers during normal operation and would therefore import additional unacceptable risks.

Making changes to the windscreen making it easier to break or easily removable would import additional risks for the driver if missiles are thrown at the tram. For security purposes the driver's door is secured giving no access to members of the public meaning that easily removable windscreens may not give an easy means of escape.

It is believed with the measures being looked at for recommendation 3 and recommendation 4 will reduce the chance of a tram being laid on its side to a very low level and that the current tram evacuation procedure in place in Blackpool is sufficient.

76. On 30 December 2019 Edinburgh Trams provided the following update:

Following review and assessment of the recommendation for the introduction of measures to facilitate the rapid evacuation of a vehicle, ET in consultation with our vehicle manufacturer have assessed the application of both removable windscreens and emergency escape hatches.

The current fleet has 20 egress routes for evacuation (4 double leaf doors and 2 single leaf door per side; double leaf counts as 2 routes-) provided with Internal Egress Device. Additionally, single doors at both ends cabs are provided with External Egress Device to be operated externally by rescue services (square key). Front windscreen and right-side lateral window in cab are not considered as evacuation routes because they are laminated windows, but the left side lateral window in cab is monolithic and it can be considered as evacuation route, as per point 8.48 of Tramway Principles & Guidance.

The recommendation is considered generally feasible but deemed impractical because the use of removable windscreens and emergency escape hatches as means of rapid egress under certain incident scenarios predominately relates to the

Recommendation 8

overturning of a light rail vehicle. It is considered that due to the very low frequency of this type of incident, in addition to the primary safety control measures already implemented or being implemented by operators in relation to other RAIB recommendations made in their report on the Sandilands incident, significantly reduce and mitigate the probability of future occurrences of this nature to extremely low levels.

Examples of mitigation controls already applied or under implementation:

- *Driver vigilance devices.*
- *Transitional speed signage.*
- *Enhanced fatigue control management systems.*
- *Comprehensive system risk profiling.*
- *Enhanced hazard awareness train ing.*
- *Enhanced driver competency management.*

Additionally we are in discussion with our vehicle suppliers to consider implementation of an automatic tram stopping system as part of future renewals.

The installation of both removable windscreens and or emergency escape hatches would require extensive redesign for both existing and future light rail vehicles at considerable cost, which in turn is indicative of being disproportionate to the risk reduction benefit that they would provide. Such modifications associated to either removable windscreens or escape hatches could also impact on the integral strength of the vehicle bodyshell.

It is considered that the risk-reduction facilitated by the introduction of removable windscreens or escape hatches is marginal given that incorporating either has the potential to increase and import additional risk to drivers, passengers and systems under certain circumstances.

The use of removable windscreens or emergency escape hatches in certain scenarios indicates that it would be safer for passengers to remain contained within the vehicle following an incident in certain circumstances where the rapid evacuation of a vehicle may place them at an increased level of risk.

77. On 20 December 2019 Transport for Greater Manchester and Keolis Amey Metrolink provided the following joint update:

We can now confirm that we will not be progressing this recommendation any further. Our justification is detailed below.

- *In the intent for this recommendation the RAIB did make suggestions about having removable windscreens at the end of trams. As both ends of our trams have a driver's cab modifying the windows will be challenging and complex. Additionally, both cabs have a locked door between them and the passengers,*
  so a removable windscreen may not be accessible if it was needed in an emergency.

Recommendation 8

- *The other option for improved evacuation of a tram on its side is to add an emergency exit point on either the roof or the floor. The space above and below the passenger compartment contains equipment that would be extremely challenging to relocate. Such a solution would also require major modifications to the tram structure and cause issues with supplier warranties. It is unlikely that a modification of this nature could be completed.*

- *Even if such a solution were achievable there are unintended consequences especially with regards to anti-social behaviour.*

- *From the above points our position and based on the Metrolink network it is our view that such an engineering challenge is grossly disproportionate compared with the benefit such a solution would bring.*

The Metrolink Industry Risk Model published in August 2019 did identify a tram overturning as the top hazardous event ranked by controllable collective risk. TfGM and KAM are working together to address the precursors identified that will reduce the likelihood of such an event happening.

Using bow tie analysis terminology, this recommendation is a mitigating control to reduce the severity of the consequence. Our focus is on the prevention controls to avoid the event happening in the first place.

78. On 30 September 2019 Nottingham City Council, Tramlink Nottingham Limited and Nottingham Trams Limited (as duty holder for the operations of the Nottingham Express Transit (NET) system) provided the following joint update:

Providing additional passenger evacuation routes is not possible with the current tram designs andcan only be incorporated, if at all possible, with significant redesign at a cost disproportionate to thereduction in risk. New vehicle design should consider incorporating additional evacuation routes. The LRSSB have also undertaken a review of the practicality of providing additional evacuation routes that supports our conclusion.

We currently work with the emergency services in planning and training for a number of emergency situations. This includes ensuring safety for access to vehicles in the event of an incident (e.g. isolations), the use of emergency features such as door access arrangements, etc., and will include overturning as a scenario to be considered during exercises.

<u>Action:</u> NTL to maintain liaison with emergency services

79. On 23 December 2019 Stagecoach Supertram provided the following update:

Recommendation 8

SYSL have, with support from SYPTE assessed options for enabling rapid evacuation of a tram lying on its side using a Taking Safe Decisions approach. Our assessment of the options found that the benefits to evacuation from fitting escape hatches was outweighed by the risks associated with misuse or unintended use when the tram is upright. Similarly there are perceived risks with making alterations to tram windscreens, taking consideration of historical vandalism incidents where projectiles have been thrown at trams.

As such, SYSL have taken a risk-based decision that we intend to make no further alterations to trams to support rapid evacuation from a tram on its side, largely due to the associated risks with unintended or misuse of any alterations made to the fleet. We also agree with the LRSSB assessment that removable windscreens and/or escape hatches could import additional risk to passengers and systems under certain circumstances. Instead SYSL intend to focus efforts on implementing the recommendations aimed at prevention of a tram overturn.

80. On 20 December 2019 South Yorkshire Passenger Transport Executive provided the following update:

SYSL has developed a taking safe decisions review of this recommendation and has determined that the introduction of safety hatches would import more risk. Further details are included in SYSL's response.

81. On 8 January 2020 LRSSB provided the following update:

Following review and assessment of the recommendation for the introduction of measures to facilitate the rapid evacuation of a vehicle, LRSSB in consultation with operators and manufactures have assessed the application of both removable windscreens and emergency escape hatches.

The recommendation is considered generally feasible but deemed impractical with issues and variables that would differ considerably from the varied individual vehicle design types.

In order to substantiate this conclusion LRSSB has drawn on existing studies, discussions with manufacturers and international best practice.

Evaluation of recommendation 8 has identified the following:

- *The use of removable windscreens and emergency escape hatches as means of rapid egress under certain incident scenarios predominately relates to the overturning of a light rail vehicle. It is considered that due to the very low frequency of this type of incident, in addition to the primary safety control measures already implemented or being implemented by operators in relation to other RAIB recommendations made in their report on the Sandilands incident, significantly reduce and mitigate the probability of future occurrences of this nature to extremely low levels.*

Examples of mitigation controls already applied or under implementation:

- *Driver vigilance devices.*
- *Transitional speed signage.*
- *Enhanced fatigue control management systems.*
- *Automated vehicle speed controls.*
- *Comprehensive system risk profiling.*
- *Enhanced hazard awareness training.*
- *Enhanced driver competency management.*

- *The installation of both removable windscreens and or emergency escape hatches would require extensive redesign for both existing and future light rail vehicles at considerable cost, which in turn is indicative of being disproportionate to the risk reduction benefit that they would provide. Such modifications associated to either removable windscreens or escape hatches could also impact on the integral strength of the vehicle bodyshell.*

- *It is considered that the risk-reduction facilitated by the introduction of removable windscreens or escape hatches is marginal given that incorporating either has the potential to actually increase and import additional risk to passengers and systems under certain circumstances.*

- *The implementation of additional primary safety system risk reduction measures will prove more affective in eliminating hazards and reducing risk. (E.g. automated speed control in areas of derailment risk).*

- *The use of removable windscreens or emergency escape hatches in certain scenarios indicates that it would be safer for passengers to remain contained within the vehicle following an incident in certain circumstances where the rapid evacuation of a vehicle may place them at an increased level of risk.*

Previously reported to RAIB

Recommendation 2

The intent of the recommendation is to better understand all safety risk associated with tramway operation and then provide updated guidance for the design and operation of tramways (this could be achieved by issuing an updated version of the 'Guidance on tramways' with expanded coverage of operational matters). Particular attention will be required to recognise risks from low frequency / high consequence events which may not be apparent from precursor incidents on existing UK tramways. Identifying such events is likely to require input from specialists outside the UK tram community, including specialists with knowledge of main line rail and bus environments. Consideration of main line rail and bus issues is intended to inform evaluation of tramway risks; it does not imply that all heavy rail and bus requirements should be applied to tramways.

UK tram operators, owners and infrastructure managers should jointly conduct a systematic review of operational risks and control measures associated with the design, maintenance and operation of tramways. The review should include:

i. examination of the differing risk profiles of on-street, segregated and off-street running;
ii. safety issues associated with driving at relatively high speeds in accordance with the line-of-sight principle in segregated and off-street areas, particularly during darkness and when visibility is poor;
iii. current practice world-wide and the potential of recent technological advances to help manage residual risk;
iv. safety learning from bus and train sectors that may be applicable to the design and operation of tramways;
v. consideration of the factors that affect driver attention and alertness across all tram driving scenarios in comparison to driving buses and trains; and
vi. guidance on timescales for implementing new control measures (eg whether retrospective or only for new equipment).

Using the output of this review UK tram operators, owners and infrastructure managers should then, in consultation with ORR, publish updated guidance on ways of mitigating the risk associated with design, maintenance and operation of UK tramways.

ORR decision

1. In parallel to the establishment of the LRSSB, UK Tram has been leading the industry work to develop and scope a risk analysis model for the tram industry.

2. Atkins Rail have been appointed to develop the model. UKTram selected the model after a review of a number of existing systems, deciding the quantitative risk model used by West Midland Metro fully met the requirements of the RAIB recommendation. The model used by West Midlands Metro was initially developed by Atkins, being a subset of a model used by RSSB for mainline railways. The model

has been verified over a period of 12 months and been used for the risk analysis of the West Midland Metro extension to Birmingham New Street.

3. The sector has also agreed on the arrangements to gather the required incident and accident data that the model will use to calculate and track the risk profile. These arrangements are in use by one operator, and roll out preparations are commencing in the remaining six operations.

4. Having identified the most suitable model to assist the industry in understanding its risk profile (phase 1), phase 2 of the project involves developing, testing and monitoring the model on one system and then rolling out to other systems nationally. Manchester will pilot the model and will include interface with the tram incident reporting database (TAIR). The pilot will begin in March 2019 and if successful, will be implemented across all systems by autumn 2019.

5. The ORR and sector view is that the successful development of an industry risk model is a key enabler for tram owners and operators to make properly informed risk based decisions on how recommendations 3 to 8 should best be discharged. The completion of the risk model will be one of the first tasks of the LRSSB.

6. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, UK tram owners, operators and infrastructure managers have:

- taken the recommendation into consideration; and
- has a plan in place to run a pilot, with full industry adoption expected by Autumn 2019

Status: Implementation on-going. **ORR will advise RAIB when further information is available regarding actions being taken to address this recommendation.**

Recommendation 3

The intent of this recommendation is to prevent serious accidents due to excessive speed at higher risk locations on tramways. These locations are likely to include all locations where a substantial speed reduction is required for trams approaching at relatively high speed. Implementation of this recommendation may be assisted by work in this area already underway by Croydon tramway organisations.

UK tram operators, owners and infrastructure managers should work together to review, develop, and provide a programme for installing suitable measures to automatically reduce tram speeds if they approach higher risk locations at speeds which could result in derailment or overturning

Previously reported to RAIB

End implementer	Summary of response	Status
Transport for West Midlands	TfWM is working with their existing vehicle supplier (CAF) and other UK operators of the tram type to explore the development of a system to automatically limit /reduce the speed of trams at high risk locations using Balogh tags and a PLC interfacing with the trams Traction Control Unit, HMI, Speedometer and event recorder.	TfWM are considering options to address this recommendation, based on their own research and the output from the UKTram research when completed. **Status: Progressing.**
West Midlands Metro	NX Metro (who operated the West Midlands Metro until 24 June 2018) introduced step down signage and removed any decrease in speed greater than 30 Kph (see rec 5). A decision on what action to take in response to this recommendation will be informed by the outcome of the industry risk model work (rec 2).	WMM are considering options to address this recommendation, based on their own research and the output from the UKTram research when completed. **Status: Progressing.**
Blackpool Borough Council	Blackpool Transport Services, together with Blackpool Borough Council's tram promoter is conducting a trial of a Bombardier system which will initially be used for obstacle detection on moving trams, and may in future be able to be used for controlling tram overspeeding	Blackpool Borough Council are considering options to address this recommendation, based on their own research and the output from the UKTram research when completed. **Status: Progressing.**
Blackpool Transport Services	Blackpool Transport Services is participating in a trial of a Bombardier system which will initially be used for obstacle detection on moving trams, and may in future be able to be used for controlling tram overspeeding.	BTS are considering options to address this recommendation, based on their own research and the output from the

		UKTram research when completed. **Status: Progressing.**
City of Edinburgh Council	City of Edinburgh Council and Edinburgh Trams are supporting the UKTram research and are awaiting the publication of the report in November 2018. Edinburgh Trams are also discussing possible solutions with their vehicle supplier.	City of Edinburgh Council are supporting Edinburgh Trams work to consider options to address this recommendation, based on their own research and the output from the UKTram research, when completed. **Status: Progressing.**
Edinburgh Tram	City of Edinburgh Council and Edinburgh Trams are supporting the UKTram research and are awaiting the publication of the report in December 2018. Edinburgh Trams are also discussing possible solutions with their vehicle supplier.	Edinburgh Tram are considering options to address this recommendation, based on their own research and the output from the UKTram research, when completed. **Status: Progressing.**
Transport for Greater Manchester	A decision on what action to take in response to this recommendation will be informed by the outcome of the industry risk model work (rec 2). TfGM has discussed with a supplier potentially fitting a speed warning or advisory system, which could potentially be linked to the tram braking systems. TfGM are in the process of procuring a new fleet of trams and are discussing with suppliers a system that would augment	TfGM are considering options to address this recommendation, based on their own research and the output from the UKTram research, when completed. **Status: Progressing.**

	video obstacle detection, which is currently being trialled in Europe.	
Manchester Metrolink	A decision on what action to take in response to this recommendation will be informed by the outcome of the industry risk model work (rec 2) and the TfGM research into a technical solution that could automatically apply the brakes on a tram.	KAM will consider options to address this recommendation informed by the output from the UKTram research when completed. **Status: Progressing.**
Nottingham Council/ Tramlink Nottingham Ltd	A decision on what action to take in response to this recommendation will be based on the outcome of the UK Tram research into systems that can automatically reduce the speed of a tram and the outcome of the industry risk model work (rec 2).	Nottingham Council/TNL will consider options to address this recommendation informed by the output from the UKTram research when completed. **Status: Progressing.**
Nottingham Trams	A decision on what action to take in response to this recommendation will be based on the outcome of the UK Tram research into systems that can automatically reduce the speed of a tram and the outcome of the industry risk model work (rec 2).	NTL will consider options to address this recommendation informed by the output from the UKTram research when completed. **Status: Progressing.**
South Yorkshire PTE	SYPTE is supporting SYSL work in approaching potential suppliers that may form part of a response to recommendations 3 and 4. SYPTE are awaiting the outcome of the work associated with recommendation 2 before taking a decision on further control measures associated with recommendations 3, 4, 6, 7 and 8.	SYPTE/SYSL are considering options to address this recommendation, based on their own research and the output from the UKTram research when completed. **Status: Progressing.**

South Yorkshire Supertram Ltd	TPWS is fitted to new tram-train vehicles that will operate on the mainline. However this technology will not be active on existing tramway infrastructure. SYSL have held initial discussion regarding the practicalities of installing TPWS with Thales.	SYPTE/SYSL are considering options to address this recommendation, based on their own research and the output from the UKTram research when completed. **Status: Progressing.**

7. **Previously reported to RAIB on 5 April 2019**

Recommendation 3

The intent of this recommendation is to prevent serious accidents due to excessive speed at higher risk locations on tramways. These locations are likely to include all locations where a substantial speed reduction is required for trams approaching at relatively high speed. Implementation of this recommendation may be assisted by work in this area already underway by Croydon tramway organisations.

UK tram operators, owners and infrastructure managers should work together to review, develop, and provide a programme for installing suitable measures to automatically reduce tram speeds if they approach higher risk locations at speeds which could result in derailment or overturning

ORR decision

London Trams/Tram Operation Ltd

1. Since our initial response to the Sandilands report, London Trams have provided more detail about the programme to install a physical prevention of over-speeding system (PPOS).

2. LT and TOL identified a suitable system to support this recommendation and LT has awarded a contract to implement PPOS by the end of 2019, initially at high risk locations on the Croydon network. The system is designed to automatically apply the brakes and bring a tram to a stop should a clear over speed violation occur. TOL and LT are in the process of identifying and agreeing the high-risk locations where the system should be installed.

3. LT/TOL have stated they will review the output from the Ian Rowe Associates Ltd (IRAL) research for UKTram into overspeed detection and driver vigilance devises to determine if any further measures should be taken.

4. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, London Trams and Tram Operations Ltd have:

- taken the recommendation into consideration; and
- has taken action to implement it.

Status: Implemented.

Previously reported to RAIB

5. On 4 December 2018 ORR reported the following:

End implementer	Summary of response	Status
Tram Operations Ltd	TOL supported LT's work to introduce step-down speeds on the approach to the areas of the tramway where there is a need to reduce the speed by greater than 30kpmh between the higher and lower speed limits. TOL also supported LT's work to increase the visibility of speed signs, add chevron signs at sharp curves and install digital signage at high risk locations to inform drivers if they are speeding. TOL has played an active role supporting the LT research into an automatic speed reduction system.	TOL are supporting the LT project to fit the Croydon tram fleet with a system that can automatically reduce tram speeds. The project is planning to be completed by December 2019. **Status: Implementation on-going**
London Trams	LT is in the process of researching and procuring an automatic speed reduction system. The outcome of the research has been shared with other tram owners and operators and UK Tram. LT are planning to have selected a system by December 2018, with full fleet roll out and implementation planned by December 2019. TOL has been working closely with LT on this initiative. LT are also supporting UK Tram research into automatic braking systems.	LT have started a project to fit the Croydon tram fleet with a system that can automatically reduce tram speeds. The project is planning to be completed by December 2019. **Status: Implementation on-going**

Update

6. On 7 March 2019 Transport for London provided the following update:

In order to determine a suitable automated braking system for retrospective fitment to the London tram fleet, we engaged a specialised consultancy and conducted a global search into appropriate proven technologies. After extensive research into applicable systems the invitation to tender was issued on 31 July 2018 for a physical prevention of over-speeding system (PPOS). TOL were an active stakeholder in this

and have supported us in this research. The outcome of the research was shared with other tram owners and operators and UK Tram.

Engineering Support Group (ESG), (a subsidiary of Deutche Baun, working with Sella have been selected to design and deploy a variant of their Sella's Tracklink 3 product to meet this need. The contract was awarded on 14 December 2018. This system will be set to activate at a safe margin above the posted speed limits at high risk locations. On activation the PPOS will brake a tram to a stop on the basis that a clear over speed violation has occurred. London's tram network will be the first in the UK to have an automatic braking system.

The system will be installed and in operation by the end of 2019, including a period of training and familiarisation with tram drivers ahead of it becoming fully operational.

The new system will initially be configured to priority locations as suggested by the RAIB but will have the flexibility to be introduced elsewhere on the tram network.

In addition, UK Tram have appointed Ian Rowe Associates Ltd (IRAL) to research, identify, and evaluate systems capable of automatically reducing the speed of a tram at high risk locations. IRAL are also carrying out research on behalf of UKTram into driver vigilance devices (recommendation 4). This work analyses the potential impacts, benefits, drawbacks and human factor considerations for each system. The work also considers the practicality, capability and readiness of the various identified solutions. The result of this research is awaited. Together with TOL we will review and evaluate the outcome of this research to determine if any further measures should be taken.

7. On 8 March 2019 Tram Operations Ltd provided the following update

TOL and LT identified two projects to support this recommendation:

- Signage and Speed Reduction – (closed)
- Physical Prevention of over-speeding (PPOS)

The enhanced visibility of signage and speed reduction signs project was completed and closed in Autumn 2017. It also supported RAIB recommendation 5.

Physical Prevention of over-speeding (PPOS)

This is a project currently being led and managed by LT to provide a Physical Prevention of Over-speed System (PPOS). This device is anticipated to be installed over a 14-month period on the infrastructure (track and tram).

During December 2018, LT awarded the contract to implement PPOS to Engineering Support Group (ESG).

TOL and LT are identifying and agreeing the high-risk locations for potential speeding. Recently a review of the visual cues in Croydon Town Centre was carried out and some proposed changes were identified. These changes are being evaluated by LT.

A timeline is being prepared by LT for completion by December 2019. Once the proposed full specification and operational impact is confirmed, TOL will consult with the Trade Union Safety Representatives.

Recommendation 4

The intent of this recommendation is to reduce the likelihood of serious accidents due to tram drivers becoming inattentive because of fatigue or other effects. Existing tram systems relying on drivers applying forces to driving controls (driver safety devices) do not necessarily detect an inattentive driver. Implementation of this recommendation may be assisted by work in this area already underway by Croydon tramway organisations.

UK tram operators, owners and infrastructure managers should work together to research and evaluate systems capable of reliably detecting driver attention state and initiating appropriate automatic responses if a low level of alertness is identified. Such responses might include an alarm to alert the tram driver and/or the application of the tram brakes. The research and evaluation should include considering use of in-cab CCTV to facilitate the investigation of incidents.

If found to be effective, a time-bound plan should be developed for such devices to be introduced onto UK tramway.

Previously reported to RAIB

End Implementer	Summary of response	Status
Tram Operations Ltd	LT/TOL have installed the Guardian system on the Croydon tram fleet. The system monitors eye and face movements to detect the onset of fatigue or distraction and then alerts the driver, either with a vibration motor or an alarm. Alarm events are relayed to TOL's control centre. The work was completed in October 2017. LT/TOL have demonstrated the system and shared their experience a number of tram owners and operators and also supported the UK Tram research.	ORR recognises the safety benefits of the Guardian system in the context of this recommendation. ORR notes that Guardian is a system designed to detect driver inattentiveness and provide an alert, but does not apply the brakes, as suggested as an option in the recommendation. ORR also notes that research work being undertaken on behalf of UK Tram is exploring what an appropriate

		automatic response is if a low level of driver attentiveness is detected, such as application of vehicle brakes. ORR will await the outcome of the industry's research work that is coming to a conclusion before considering if the Guardian system fully implements recommendation 4. **Status: Implementation on-going.**
London Trams	LT/TOL installed the Guardian system on the Croydon tram fleet, which was completed in October 2017. The system monitors eye and face movements to detect the onset of fatigue or distraction and then alerts the driver, either with a vibration motor or an alarm. Alarm events are relayed to TOL's control centre, via the Guardian Safeguard centre. LT/TOL have demonstrated the system and shared their experience with the tram industry and fed into the UK Tram research.	ORR recognises the safety benefits of the Guardian system, but is awaiting the outcome of industry research before deciding if the London Trams have implemented the recommendation. **Status: Implementation on-going.**
Transport for West Midlands	WML commissioned further human factors analysis to optimise the settings on the driver vigilance device.(DVD). MML are undertaking staff consultation on the proposed changes; the tram manufacturer is engineering the changes that will be fitted to all WMM trams. We have asked West Midlands Metro to provide us with the consultants' report that supports the proposed reduction in the	**Status: Implementation on-going.**

	threshold of the Driver Vigilance Device (DVD) intervention from 30 to 15 seconds. Once the changes to the tram fleet have been made and staff consultation completed we will be consider the recommendation to be implemented for TfWM/WMM.	
West Midlands Metro	WML commissioned further human factors analysis to optimise the settings on the driver vigilance device.(DVD). MML are undertaking staff consultation on the proposed changes; the tram manufacturer is engineering the changes that will be fitted to all WMM trams. We have asked West Midlands Metro to provide us with the consultants' report that supports the proposed reduction in the threshold of the Driver Vigilance Device (DVD) intervention from 30 to 15 seconds. Once the changes to the tram fleet have been made and staff consultation completed we will be consider the recommendation to be implemented for TfWM/WMM.	**Status: Implementation on-going.**
Blackpool Borough Council	Blackpool Borough Council will appraise the outcome of the UK Tram research before making a decision whether to replace or supplement their current vigilance system	Blackpool Borough Council/BTS are awaiting the outcome of the UKTram research before taking action to address the recommendation. **Status: Progressing.**
Blackpool Transport Services	BTS will appraise the outcome of the UK Tram research before making a decision whether to replace or supplement their current vigilance system	Blackpool Borough Council/BTS are awaiting the outcome of the UKTram research before taking action to

		address the recommendation. **Status: Progressing.**
City of Edinburgh Council	City of Edinburgh Council are supporting the Edinburgh Trams position on recommendation 4.	City of Edinburgh Council support the Edinburgh Tram position. **Status: Progressing.**
Edinburgh Tram	Since our initial response Edinburgh Trams (ET) have advised us that they have enhanced the settings of the Driver Vigilance and Driver Safety Device to mitigate the risks from driver inattention to the extent that every 400 metres the driver must take a positive action to reset the hardware or an automatically controlled braking of the vehicle will occur. They advised us that additionally they carry out sample reviews of the vehicle data recorder to ensure drivers are driving to the correct speed limit and appropriate use of traction demand and braking is being followed. ORR is seeking more risk based evidence of how the timings of the DVD fitted to the Edinburgh trams have been optimized. This inspection/assurance work will take place during the first half of 2019/20 with a view to potentially moving the status of the recommendation to “implemented”.	**Status: Implementation on-going.**
Transport for Greater Manchester	TfGM intend to work with KAM to consider the options for a driver vigilance device once the UKTram research is complete. TfGM and KAM attended a workshop with TfL to review devices for detecting inattention. TfGM is exploring options to improve the existing “deadman” system by moving to a vigilance based system, similar to heavy rail rolling stock.	TfGM/KAM are awaiting the outcome of the UKTram research before taking action to address the recommendation. **Status: Progressing.**

Manchester Metrolink	KAM are awaiting the completion of the UKTram research into speed control and vigilance devices, as well as the development of the industry risk model (rec 2).	TfGM/KAM are awaiting the outcome of the UKTram research before taking action to address the recommendation. **Status: Progressing.**
Nottingham Council/ Tramlink Nottingham Ltd	Nottingham Council/TNL/NTL will make a decision whether to continue with the existing driver safety device or replace it, based on the output from the UKTram research and the industry-wide risk model (rec 2).	Nottingham Council/TNL/NTL are awaiting the outcome of the UKTram research before taking action to address the recommendation. **Status: Progressing.**
Nottingham Trams	Nottingham Council/TNL/NTL will make a decision whether to continue with the existing driver safety device or replace it, based on the output from the UKTram research and the industry-wide risk model (rec 2).	Nottingham Council/TNL/NTL are awaiting the outcome of the UKTram research before taking action to address the recommendation. **Status: Progressing.**
South Yorkshire PTE	SYPTE are awaiting the outcome of the UKTram research and will make a decision on fitment of driver vigilance device in collaboration with SYSL.	SYPTE are awaiting the outcome of the UKTram research before taking action to address the recommendation. **Status: Progressing.**
South Yorkshire Supertram Ltd	Of the two tram fleets operated by SYSL, the Citylink (including tram train) fleet has a vigilance device fitted, which is designed to apply service brakes in the event of driver inattentiveness.	SYSL are awaiting the outcome of the UKTram research before considering if action needs to be

		taken to address the recommendation. For the Citylink fleet the recommendation has been implemented. **Status: Progressing.**

8. **Previously reported to RAIB on 5 April 2019**

Recommendation 4

The intent of this recommendation is to reduce the likelihood of serious accidents due to tram drivers becoming inattentive because of fatigue or other effects. Existing tram systems relying on drivers applying forces to driving controls (driver safety devices) do not necessarily detect an inattentive driver. Implementation of this recommendation may be assisted by work in this area already underway by Croydon tramway organisations.

UK tram operators, owners and infrastructure managers should work together to research and evaluate systems capable of reliably detecting driver attention state and initiating appropriate automatic responses if a low level of alertness is identified. Such responses might include an alarm to alert the tram driver and/or the application of the tram brakes. The research and evaluation should include considering use of in-cab CCTV to facilitate the investigation of incidents.
If found to be effective, a time-bound plan should be developed for such devices to be introduced onto UK tramway.

ORR decision

Edinburgh Trams

1. Since our initial response Edinburgh Trams (ET) have advised us that they have enhanced the settings of the Driver Vigilance and Driver Safety Device to mitigate the risks from driver inattention to the extent that every 400 metres the driver must take a positive action to reset the hardware or an automatically controlled braking of the vehicle will occur. They advised us that additionally they carry out sample reviews of the vehicle data recorder to ensure drivers are driving to the correct speed limit and appropriate use of traction demand and braking is being followed.

2. ORR is seeking more risk based evidence of how the timings of the DVD fitted to the Edinburgh trams have been optimized. This inspection/assurance work will take place during the first half of 2019/20 with a view to potentially moving the status of the recommendation to “implemented”.

3. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, Edinburgh Tram has:

- taken the recommendation into consideration; and
- is taking action to implement it.

Status: Implementation ongoing. **ORR will advise RAIB when actions to address this recommendation have been completed.**

Transport for West Midlands/West Midlands Metro

4. WML commissioned further human factors analysis to optimise the settings on the driver vigilance device.(DVD). MML are undertaking staff consultation on the proposed changes; the tram manufacturer is engineering the changes that will be fitted to all WMM trams.

5. We have asked West Midlands Metro to provide us with the consultants' report that supports the proposed reduction in the threshold of the Driver Vigilance Device (DVD) intervention from 30 to 15 seconds. Once the changes to the tram fleet have been made and staff consultation completed we will be consider the recommendation to be implemented for TfWM/WMM.

6. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, TfWM/WMM:

- have taken the recommendation into consideration; and
- are taking action to implement it

Status: Implementation ongoing. **ORR will advise RAIB when actions to address this recommendation have been completed.**
Previously reported to RAIB

7. On 4 December 2018 ORR reported the following:

End Implementer	Summary of response	Status
Edinburgh Trams	City of Edinburgh Council and Edinburgh Trams are supporting the UKTram research and are awaiting the publication of the report in December 2018. Edinburgh Trams are also discussing possible solutions with their vehicle supplier.	Edinburgh Tram are considering options to address this recommendation, based on their own research and the output from the UKTram research, when completed. **Status: Progressing**

Transport for West Midlands	The trams used on the West Midlands network have a Driver Vigilance Device (DVD) which will automatically apply the tram brakes if a driver fails to respond to a warning within a set time period. The system is set to fail safe by applying the emergency brakes in the event of a DVD system failure. Currently the DVD is set to test for driver attention every 30s, with brakes being applied if the driver fails to respond by movement of the thumb on the Traction Brake Controller (TBC) within 4s of the alert. ORR has asked West Midlands Metro to consider reducing the alert interval to 15s and this request is under consideration noting that human factors impacts of a higher frequency of alert. TfWM are monitoring the work being done by UK Tram to review Driver Vigilance Devices and how this may impact on their own work.	TfWM/WMM are reviewing the operation of their existing DVD system and awaiting the outcome of the UKTram research. **Status: Progressing.**
West Midlands Metro	WMM are working with TfWM to consider whether to reduce the frequency of the DVD fitted to their tram fleet from 30s to 15s. An assessment has been completed which included driver behaviour and workload monitoring and a report is currently awaited.	TfWM/WMM are reviewing the operation of their existing DVD system and awaiting the outcome of the UKTram research. **Status: Progressing.**

Update

8. On 8 March 2019 Transport for West Midlands provided the following update:

MML commissioned Ian Rowe Associates to undertake a human factors analysis of the proposal to reduce the frequency of the Driver Vigilance Device ("DVD") fitted by CAF to the Urbos 3 tram fleet from 30s to 15s. An assessment has been completed which included driver behaviour and workload monitoring and a report has been received. The report supports the proposed reduction in DVD interventions therefore we are in the process of undertaking staff consultation will take place and subject to a satisfactory outcome the change will be implemented. The proposed technical change is currently being manufactured by CAF and will be fitted to all WMM trams.

9. On 19 March 2019 Edinburgh Trams provided the following update:

Edinburgh Trams has reviewed potential solutions provided by the vehicle supplier/maintainer and will consider these further as part of a renewals programme or for new vehicle introduction.

We continues to support the work currently being undertaken by UKTram Subcommittee 1 and we are progressing with our innovation challenge relating to pro-actively monitor and recognise the drivers level of attentiveness.

The D.I.S.C. project is expected to produce a solution within 18 months.

Recommendation 5

The recommendation is intended to provide tram drivers operating on line-of-sight with signage giving visual information cues comparable to those for bus drivers. This recommendation builds on the RAIB's Urgent Safety Advice issued in November 2016 and recognises that driving a tram on line-of-sight has considerable similarities with driving a bus on a public road.

UK tram operators, owners and infrastructure managers, in consultation with the DfT, should work together to review signage, lighting and other visual information cues available on segregated and off-track areas based on an understanding of the information required by drivers on the approach to high risk locations such as tight curves. Comparison should be made with the cues provided to road vehicle drivers on highways that are designed in accordance with current UK highway standards. Prior to the installation of suitable measures to automatically reduce tram speeds at higher risk locations (Recommendation 3) consideration should also be given to providing in-cab warnings to tram drivers on the approach to high risk locations.

The findings of this review should then be used by UK tram operators and tramway owners to improve the information and/or warnings provided to drivers at high risk locations in segregated and off-track areas

Previously reported to RAIB

End implementer	**Summary of response**	**Status**
Transport for West Midlands	TfWM and NX Metro had installed step down speed restriction at all locations with a speed reduction of 30km/h or greater. TfWM will consider the output from the UKTram subcommittee 1 and the results of active signage trials before making any further changes.	TfWM/WMM have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before making further changes.

		Status: Implementation on-going.
West Midlands Metro	WMM reviewed existing signage provision following publication of the report. A further review of signage is underway and any further recommended changes will be considered in light of this and the results of the active signage trails.	TfWM/WMM have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed. **Status: Implementation on-going.**
Blackpool Borough Council	In response to the USA, one sign was moved. Having reviewed all speed limits, signs and high risk areas BCC/BTS concluded that no additional signage was required. Consultation with DfT was not considered necessary as signs on the Blackpool network comply with the applicable guidelines in TSRGD issued by Oft as well as RSP2 /(TGN3) and the ORR Technical Guidance 4. However, changes to signage may be made in future if necessary.	Blackpool Borough Council/BTS have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed. **Status: Implementation on-going.**
Blackpool Transport Services	In addition to the collaboration with Blackpool Borough Council, BTS are monitoring the London Tram's trial of Illuminated warning signs.	Blackpool Borough Council/BTS have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any

		further changes are needed. **Status: Implementation on-going.**
City of Edinburgh Council	City of Edinburgh Council are supporting the Edinburgh Trams position on recommendation 5.	Edinburgh Tram have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed. **Status: Implementation on-going.**
Edinburgh Trams	Edinburgh Trams has reviewed the signage and visual cues at three locations where trams brake from 70kph to less than 30kph. Revised signage was installed at one of the locations. Edinburgh Trams are introducing the SmartDrive system. The system uses route modelling analysis to identify optimum movement sequences - such as where the driver should coast and brake, or be travelling at an optimum speed - that is passed on to driver teams through bespoke training. Edinburgh Trams support the work currently being undertaken by Subcommittee 1 and will act on any recommendations accordingly. Edinburgh Trams are considering appropriate locations for chevrons but do not consider that active speed signs are required.	Edinburgh Tram have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed. ORR consider the SmartDrive system to be for energy efficiency and passenger comfort rather than to provide a safety warning. **Status: Implementation on-going.**

Transport for Greater Manchester	TfGM supported the KAM review (see below or move) of speed limits and signage and the actions taken as a result. In-cab warnings are being considered as part of discussions with a supplier which will also be relevant to addressing recommendation 3.	TfGM/KAM have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed. **Status: Implementation on-going.**
Manchester Metrolink	KAM identified four locations to install drop-down speed signage. KAM has also introduced a new role of Driver Analyst, to audit driving behaviours, including the identification of any over speeding events with trends monitored through the monthly franchise report, provided to both the KAM and TfGM Senior Management Teams.	TfGM/KAM have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed. **Status: Implementation on-going.**
Nottingham Council/ Tramlink Nottingham Ltd	On the Nottingham network NET, drop down speed markers have been installed at three locations. Further to this, NTL also undertake random speed checks, using radar guns, and review on-vehicle speed monitoring reports to assess signed speed compliance by drivers.	Nottingham Council/TNL/NTL have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed.

		Status: Implementation on-going.
Nottingham Trams	On the Nottingham network NET, drop down speed markers have been installed at three locations. NTL also undertake random speed checks using radar guns, downloads from OTMR and analysis of driving behaviours, with priority given to over speeding events.	Nottingham Council/TNL/NTL have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed. **Status: Implementation on-going.**
South Yorkshire PTE	SYPTE have supported the SYSL work installing new signage at locations identified in their review.	SYSL/SYPTE have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any further changes are needed. **Status: Implementation on-going.**
South Yorkshire Supertram Ltd	SYSL made no changes to speed limits on curves following their review, but the position of a speed reduction sign was moved. A Route Risk Assessment identified further opportunities to reposition speed limit signs to allow more reaction time prior to higher risk locations such as curves, pedestrian crossings and tramstops. A curve that would benefit from the placement of	SYSL/SYPTE have made changes to signage provision in response to the USA and are awaiting the outcome of the UKTram research and active signage trials before considering if any

	chevrons visible on approach has also been identified. The review also identified some new risk areas where driver's line of sight has been affected by third parties (for example neighbouring fencing reducing sight lines at a road crossing), the risk assessment is being updated and the information will be fed through to drivers through training (including refresher) and assessment.	further changes are needed. **Status: Implementation on-going.**

9. **Previously reported to RAIB on 5 April 2019**

Recommendation 5

The recommendation is intended to provide tram drivers operating on line-of-sight with signage giving visual information cues comparable to those for bus drivers. This recommendation builds on the RAIB's Urgent Safety Advice issued in November 2016 and recognises that driving a tram on line-of-sight has considerable similarities with driving a bus on a public road.

UK tram operators, owners and infrastructure managers, in consultation with the DfT, should work together to review signage, lighting and other visual information cues available on segregated and off-track areas based on an understanding of the information required by drivers on the approach to high risk locations such as tight curves. Comparison should be made with the cues provided to road vehicle drivers on highways that are designed in accordance with current UK highway standards. Prior to the installation of suitable measures to automatically reduce tram speeds at higher risk locations (Recommendation 3) consideration should also be given to providing in-cab warnings to tram drivers on the approach to high risk locations. The findings of this review should then be used by UK tram operators and tramway owners to improve the information and/or warnings provided to drivers at high risk locations in segregated and off-track areas.

ORR decision

London Trams/Tram Operation Ltd

1. LT/TOL provided a further update on action taken to improve the visual clues provided to tram drivers operating on line of sight principles. This work has included enhancing the visibility of speed signage; additional clues when moving from one speed zone to another, and increased driver assistance in Sandilands Tunnel.

2. We are of the opinion that the initiatives undertaken by LT/TOL have implemented this recommendation. We note that whilst LT have not yet taken account of the output of the UKTram research nor provided evidence of consultation with DfT, significant action has been carried out to review signage provision,

enhance it, and provide other visual clues where necessary including adopting best practice solutions from highway.

3. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, LT/TOL have:

- taken the recommendation into consideration; and
- taken action to implement it

Status: Implemented.

Previously reported to RAIB

4. On 4 December 2018 ORR reported the following:

End implementer	Summary of response	Status
Tram Operations Ltd	TfL are implementing the iTram system to provide in-cab over speed alerts. Following a successful pilot study TfL have started fitment of the system across the Croydon fleet to be completed by December 2019.	London Trams/TOL have identified an in-cab system to alert the driver to over speeding and have a time-bound plan for fleet fitment by December 2019. **Status: Implementation on-going.**
London Trams	Following Sandilands, LT installed additional step down speed signage in place in all locations where speeds reduced by 30kph. Maximum speed on the network was reduced from 80kph to 70kph. Where speed signs are located immediately in advance of locations such as tram stops or a marked curve, the sign has been enhanced with the addition of a high visibility outer boarder as an additional cue to drivers of an approaching hazard. Chevrons have been added at sharp curves and installed digital signage at high risk locations to inform drivers if they are speeding. LT/TOL have carried out a route hazard analysis which concluded that the additional speed signage and visual cuing is sufficient. Following the Sandilands incident, additional temporary lighting was installed	London Trams/TOL have identified an in-cab system for alert the driver to over speeding and have a time-bound plan for fleet fitment by December 2019. **Status: Implementation on-going.**

	on the approach to the Sandilands tunnel, while TfL road tunnel lighting experts develop a permanent solution. Work is expected to be complete on the improved tunnel lighting in early 2019. London Trams/TOL are working together to install the iTram system by December 2019	

Update

5. On 7 March 2019 Transport for London provided the following update:

As noted in our previous update, together with TOL we reviewed the tunnel lighting levels following feedback from staff and installed additional temporary lighting on the approach to the Sandilands tunnel. This was in addition to providing enhanced visual cues for drivers as reported in our last update. Working with our highway experts within TfL a specification for enhanced tunnel lighting has been developed, adopting best tunnel lighting practice from highways. The new lighting solution will provide comprehensive lighting both within the Sandilands tunnel and also to the tunnel approach at Sandilands Junction. Adoption of latest technologies will link the tunnel lighting to exterior ambient light conditions and will minimise retinal impact to the drivers' vision on tunnel ingress and egress, allowing them to retain the highest levels of visual acuity throughout the tunnel.

An invitation to tender has been released to industry with a return date of end of March 2019. Bidders are incentivised to complete the works by October 2019.

The adoption of highways type road studs ("cats eyes") as a sleeper mounted orientation aid within the Sandilands tunnel is currently being trialled in the Therapia Lane Depot. Subject to acceptance of suitability and reflectivity, the studs will be deployed on the tunnel Up road only to provide differentiation between directions of travel. The studs will also be configured to provide visual orientation between the individual tunnel sections. A network operational trial will commence in March 2019, with overall deployment planned for the same month.

6. On 8 March 2019 Tram Operations Ltd provided the following update:

TOL believe there are three activities that support this RAIB recommendation. All were or are being project managed by LT with TOL providing operational input.

- *Enhanced visibility of speed control signs (closed)*
- *Update signage and other visual cues (signage closed)*
- *Review of tunnel lighting*

The enhanced visibility of speed control signs and signage project was completed and closed in Autumn 2017. This project also supports RAIB recommendation 3.

Update other visual cues – such as directional (orientation) assistance and moving between different speed zones.

During 2018, following further assessment, LT and TOL confirmed a requirement for additional visual cues on the network and jointly agreed that directional 'cats eyes' in Sandilands tunnel would be implemented.

LT set up a project to implement the 'cats eyes'; and TOL has provided operational input. LT and TOL have jointly agreed to install. The intention is to install a combination of different colours of 'cats eyes, e.g. amber and white in the three tunnel section at Sandilands tunnel.

The cats eyes were tested in the sidings at the Therapia Lane depot for 2 weeks at the end of January 2019. The test results will be reviewed, and the outcome used to shape installation moving forward. It is anticipated these will be installed during the spring of 2019.

An updated briefing document will be prepared and discussed with staff and Unions prior to installation.

Review of tunnel lighting

During 2018, LT and TOL carried out a review of the lighting in the Sandilands tunnel. Whilst this was not part of the original Sandilands findings, TOL and LT took a decision to review tunnel lighting levels, following feedback about safety concerns from staff, and implemented a temporary solution.

Having identified the issue a temporary solution was installed, and LT are leading on the project for a permanent solution with a target installation date of end of 2019.

iTram (a business as usual joint project between LT and TOL)

LT are leading another project called iTram. Dry installation is complete on 13 trams to date. Technical issues related to remote downloading of information and integration with Vecom systems have delayed full integration of iTram into the vehicles.

Initially iTram will alert the driver via in cab alarms with speed management warnings only. It will otherwise be passive to the driver.

TOL is preparing a briefing for Unions and drivers.

Recommendation 6

The intent of this recommendation is to reduce the likelihood of people being seriously injured or killed by being ejected through tram doors and windows (i.e. to provide better containment). Although it is not expected that ejection can always be prevented in case of overturning, the improvement of containment will deliver improved safety in a range of different scenarios such as collision with road vehicles. Any improvement to containment is dependent on the ability of passengers to easily open doors in an emergency. It is expected that implementation will build on similar research already undertaken by RSSB in respect of railway carriage windows.

UK tram operators and owners should, in consultation with appropriate tram manufacturers and other European tramways, review existing research and, if necessary, undertake further research to identify means of improving the passenger containment provided by tram windows and doors. The findings should then be used to:

i. provide a time-bound plan to modify doors and windows on existing trams when practical to do so (e.g. during planned refurbishment);

ii. promote changes to the specifications and standards governing the doors and windows of new trams; and

iii. inform the Department for Transport of the findings to allow implementation of the safety advice at paragraph 492.

Previously reported to RAIB

End implementer	**Summary of response**	**Status**
Transport for London	TfL are assessing a number of glazing options which they plan to complete by October 2018. When a preferred option has been identified, the findings will be shared with UK Tram and a programme developed for fleet fitment. The evaluation includes assessing of any impact on passenger emergency egress. The outcome of the evaluation will be shared with UKTram to inform their work under RAIB Recommendation 8.	TfL are carrying out research into possible glazing options for the Croydon tram fleet **Status: Progressing.**
Tram Operations Ltd	TOL are awaiting the outcome of the TfL research and a decision on whether any changes will be made to the glazing in the Croydon tram fleet.	TOL are supporting the TfL research and a decision on whether any changes will be made to the

		glazing in the Croydon tram fleet. **Status: Progressing.**
Transport for West Midlands	TfWM are awaiting the publication of industry guidance and standards on glazing/containment (informed by the TfL research) before committing to any changes. The manufacture of trams used on the West Midlands network thinks it may be possible to equip the fleet with laminated glass and is also exploring the possibility of fitting an external film to existing windows.	TfWM/WMM are awaiting the outcome of the TfL research and industry risk assessment before making any changes to glazing in their trams **Status: Progressing.**
West Midlands Metro	WMM are awaiting the outcome of industry risk assessment and research before considering any changes to existing fleets or new ones.	TfWM/WMM are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**
Blackpool Borough Council	Blackpool Borough Council is awaiting the outcome of TfL research into tramcar glazing before considering any changes to the glazing on their tram fleet.	Blackpool Borough Council/BTS are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**
Blackpool Transport Services	BTS is awaiting the outcome of TfL research into tramcar glazing and how it feeds into UKTram subcommittee 1.	Blackpool Borough Council/BTS are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**

City of Edinburgh Council	City of Edinburgh Council are supporting the Edinburgh Trams position on recommendation 6.	City of Edinburgh Council/Edinburgh Tram are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**
Edinburgh Tram	Edinburgh Trams are awaiting the outcome of the TfL research before taking action to address this recommendation. ET have held discussions with their vehicle supplier/maintainer which will be considered in conjunction with the outputs of the UKTram Subcommittee work.	City of Edinburgh Council/Edinburgh Tram are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**
Transport for Greater Manchester	TfGM are awaiting the outcome of the TfL research before taking action to address this recommendation. TfGM have held discussions with their vehicle supplier which will be considered in conjunction with the outputs of the UKTram Subcommittee work.	TfGM/KAM are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**
Manchester Metrolink	KAM will review the outputs of the research into glazing by TFL and Subcommittee 1, and consider that it would be difficult to retrospectively replace glazed panels on the existing fleet. KAM will support TfGM procurement of new trams for the Metrolink system and will review the output of the TFL led glazing tests and assess, at the design stage, the impact of a revised standard for glazing.	TfGM/KAM are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**
Nottingham Council/ Tramlink	Nottingham Council are awaiting the outcome of the TfL research before taking action to address this recommendation.	Nottingham Council/TNL/NTL are awaiting the outcome of the TfL research before making any

Nottingham Ltd		changes to glazing in their trams **Status: Progressing.**
Nottingham Trams	NTL are awaiting the outcome of the TfL research before taking action to address this recommendation. NTL note it may be difficult to retrospectively replace glazed panels on the existing fleet and may more easily be addressed through the design of new tram fleets by the manufacturers.	Nottingham Council/TNL/NTL are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**
South Yorkshire PTE	SYPTE are awaiting the outcome of the TfL research before taking action to address this recommendation	SYPTE/SYSL are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**
South Yorkshire Supertram Ltd	The Citylink (including tram-train) fleet is fully compliant with mainline rail standards for doors and windows in regards to containment. The older Siemens fleet is compliant with Highway standards and any changes to the glazing may not be reasonably practicable. The asset owner SYPTE will be able to specify a suitable window and door standard (as has been done with Citylink) in the new fleet specification, which is likely to be issued within the next five years.	SYPTE/SYSL are awaiting the outcome of the TfL research before making any changes to glazing in their trams **Status: Progressing.**

Recommendation 7

The intent of this recommendation is to provide emergency lighting which will operate without connection to remote power supplies such as the tram's main batteries and the overhead electrical supply. Implementation may involve tram operators seeking input from appropriate tram manufacturers.

UK tram operators and owners should install (or modify existing) emergency lighting so that the lighting cannot be unintentionally switched off or disconnected during an emergency

Previously reported to RAIB

End Implementer	Summary of response	Status
Tram Operations Ltd	LT/TOL have made arrangements for the fitment of a new emergency lighting system to the Croydon tram fleet, to be completed by June 2019. The system will be able to provide emergency lighting using its own power, independent of the trams batteries or power supply.	**Status: Implementation on-going.**
London Trams	LT/TOL have made arrangements for the fitment of a new emergency lighting system to the Croydon tram fleet, to be completed by June 2019. The system will be able to provide emergency lighting using its own power, independent of the trams batteries or power supply.	**Status: Implementation on-going.**
Transport for West Midlands	The manufacture of trams used on the West Midlands network have confirmed that it would be possible to implement a system of emergency lighting which is independent of the main battery on the tram. TfWM are awaiting the development of the industry risk model (rec 2) before going further. Any changes will inform the specification for additional vehicles for Midland Metro in 2021.	TfWM/WMM are awaiting the output of the industry risk model before making any changes to the emergency lighting on their tram fleet **Status: Progressing.**
West Midlands Metro	WMM are awaiting the outcome of industry risk assessment before considering any changes to existing fleets or new ones.	TfWM/WMM are awaiting the output of the industry risk model before making any changes to the emergency lighting on their tram fleet

		Status: Progressing.
Blackpool Borough Council	Blackpool Borough Council are supporting the BTS consideration of the recommendation.	Blackpool Borough Council/BTS are awaiting the output of the industry risk model before making any changes to the emergency lighting on their tram fleet **Status: Progressing.**
Blackpool Transport Services	BTS, after completion of Recommendation 2 will review its current emergency lighting with a view to make any modifications in the overhaul of the tram in year 2019/20.	Blackpool Borough Council/BTS are awaiting the output of the industry risk model before making any changes to the emergency lighting on their tram fleet **Status: Progressing.**
City of Edinburgh Council	City of Edinburgh Council are supporting the Edinburgh Trams position on recommendation 7.	City of Edinburgh Council/Edinburgh Trams are awaiting the output of the industry risk model before making any changes to the emergency lighting on their tram fleet **Status: Progressing.**
Edinburgh Tram	ET are awaiting the outcome of UKTram Subcommittee 1 before taking action to address this recommendation. ET have held discussions with their vehicle supplier/maintainer which will be considered in conjunction with the outputs of the UKTram Subcommittee work.	City of Edinburgh Council/Edinburgh Trams are awaiting the output of the industry risk model before making any changes to the emergency lighting on their tram fleet

		Status: Progressing.
Nottingham Council/ Tramlink Nottingham Ltd	NCC/TNL, have been advised to review the current emergency lighting systems in place on their tram-fleets and to modify them to make them more robust if required.	NCC/TNL/NTL have not provided evidence that there emergency lighting will not be switched off or disconnected in the event of an emergency NCC/TNL are awaiting the operators review of the current lighting systems in place on the tram fleet **Status: Progressing**
Nottingham Trams	Both the Incentro and Citadis tram fleets used by NTL have emergency lights that will run with a full set of batteries for a minimum of 45 minutes. While the tram manufacturers will be contacted to confirm the specification that would be required to implement this recommendation, NTL consider that the change would only be accommodated on new tram fleets.	NCC/TNL/NTL have not provided evidence that there emergency lighting will not be switched off or disconnected in the event of an emergency NCC/TNL are awaiting the operators review of the current lighting systems in place on the tram fleet **Status: Progressing**
South Yorkshire PTE	SYPTE are supporting the SYSL position on recommendation 7 (see below).	SYPTE/SYSL are discussing options with their vehicle supplier regarding changes to the emergency lighting on their tram fleet

		Status: Progressing.
South Yorkshire Supertram Ltd	Citylink tram manufacturer Stadler have highlighted design differences (between Croydon Tram 2551 and Citylink) that suggest that the emergency push button location and integration into the vehicle offers greater protection (from unintended depression) in the event of an overturning vehicle. The Citylink emergency push button is located within a steel box under a flap, rather than being located under the bogie skirt. At the time of writing, Stadler are also investigating the possibility of the emergency lighting being disabled because of damage to any other equipment or cabling on the roof. For Siemens vehicles the battery manufacturer is no longer in business and as such, Supertram will likely be reliant on the findings of other Tram owners and operators if a viable solution is found. It is again likely that the position could be for SYPTE to specify emergency lighting requirements that satisfy this recommendation in the new fleet specification.	SYPTE/SYSL are discussing options with their vehicle supplier regarding changes to the emergency lighting on their tram fleet **Status: Progressing.**

10. **Previously reported to RAIB on 5 April 2019**

Recommendation 7

The intent of this recommendation is to provide emergency lighting which will operate without connection to remote power supplies such as the tram's main batteries and the overhead electrical supply. Implementation may involve tram operators seeking input from appropriate tram manufacturers.

UK tram operators and owners should install (or modify existing) emergency lighting so that the lighting cannot be unintentionally switched off or disconnected during an emergency.

ORR decision

London Trams/Tram Operation Ltd

1. LT/TOL have made arrangements for the fitment of a new emergency lighting system to the Croydon tram fleet, to be completed by June 2019. The system will be

able to provide emergency lighting using its own power, independent of the trams batteries or power supply.

2. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, LT/TOL has:

- taken the recommendation into consideration; and
- is taking action to implement it by June 2019.

Status: Implementation ongoing. **ORR will advise RAIB when actions to address this recommendation have been completed.**

Transport for Greater Manchester/Manchester Metrolink Ltd

3. TfGM/MML have included emergency lights which will operate independently of the tram power supply in the specification for the new Metrolink tram fleet. The emergency lighting on the existing fleet will last for approximately 45 minutes with a set of full batteries.

4. After reviewing the information provided ORR has concluded that, in accordance with the Railways (Accident Investigation and Reporting) Regulations 2005, TfGM/MML has:

- taken the recommendation into consideration; and
- taken action to implement it.

Status: Implemented.

Previously reported to RAIB

5. On 4 December 2018 ORR reported the following:

End Implementer	Summary of response	Status
Tram Operations Ltd	LT are leading a project to investigate options to replace the emergency lighting in the existing tram fleet, with operational and driver input from TOL as required. LT and TOL have developed a scope of requirements and an invitation to tender has been issued.	TOL/LT have a developed a programme for upgrading the emergency lighting on the Croydon fleet, but have not yet finalised a time-bound plan for completion of the work **Status: Progressing.**
London Trams	LT and TOL have developed a scope of requirements for retrofitting emergency lighting and an invitation to tender has been issued. The system will be fully autonomous, and will operate	TOL/LT have a developed a programme for upgrading the emergency lighting

	independently of the trams battery system in the event of an emergency. Finding s will be shared with industry through UKTram subcommittee 1.	on the Croydon fleet, but have not yet finalised a time-bound plan for completion of the work **Status: Progressing.**
Transport for Greater Manchester	TfGM is exploring possibilities to modify the emergency on board lighting with the tram suppliers.	TfGM/KAM are awaiting the output of the industry risk model before making any changes to the emergency lighting on their tram fleet **Status: Progressing.**
Manchester Metrolink	The emergency lighting on the existing KAM fleet will remain lit, with a full set of batteries for approximately 45 minutes. KAM will review the recommendation with their vehicle supplier, to determine if any modifications can be made to make them more robust.	TfGM/KAM are awaiting the output of the industry risk model before making any changes to the emergency lighting on their tram fleet **Status: Progressing.**

Update

6. On 7 March 2019 Transport for London provided the following update:

We have awarded a contract for the design and provision of emergency lighting to the tram fleet. This system will provide additional lighting units within the tram equipped with autonomous batteries. In the event of the tram's own batteries or lighting circuits becoming unavailable, the new system will provide suitable illumination throughout the tram. TOL supported us in the development of the design and scope of requirements with operational and driver input.
Design of the new system is underway, with fleet roll out planned between March and June 2019.

7. On 8 March 2019 Tram Operations Ltd provided the following update:

During December 2018, LT appointed Orion Rail to replace the standby emergency lighting in all trams.

A completed design is expected by end of April 2019 with installation expected to be completed by end of June 2019.

When the final design is available TOL will review any operational impact with Trade Unions and drivers. TOL will also be involved to help minimise impact on customers

and operations of the service, when LT implement the chosen emergency lighting solution in the trams.

8. On 8 March 2019 Transport for Greater Manchester (TfGM) and Keolis Amey Metrolink (KAM) provided the following joint update:

A review of on-board emergency lighting has been carried out, in the design of the new trams for Metrolink, which has resulted in the inclusion of LED lights, with an independent power source on some of the lighting units recommended. This solution will continue to be developed during the design reviews and procurement activities. We are therefore satisfied that the new trams will come with a solution that meets the intent of this recommendation and will look to develop a case to retrofit the existing fleet with the same LED lighting solution.

The emergency lighting on the existing fleet will last for approximately 45 minutes with a set of full batteries.

Recommendation 8

The intent of this recommendation is to minimise the risk of people being trapped in an overturned tram where side windows and doors are either facing the ground or facing the sky. Solutions could include the use of removable windscreens at the ends of trams. Implementation may involve tram operators seeking input from appropriate tram manufacturers.

UK tram operators and owners should review options for enabling the rapid evacuation of a tram which is lying on its side after an accident. If the review identifies practical measures which would provide significant benefit to trapped passengers, UK tram operators and owners should:

i. implement these measures on existing trams if practical to do so in the short term; or

ii. provide a time-bound plan to implement these measures on existing trams when practical to do so (e.g. during planned refurbishment).

Such measures should then be promoted for inclusion in the specifications and standards governing the new builds of trams.

Previously reported to RAIB

End Implementer	Summary of response	Status
Tram Operations Ltd	When a possible solution is identified by UKTram, TOL will review its evacuation process to ensure staff are up-to-date for evacuation of an overturned tram.	London Trams/TOL are awaiting the output of the industry risk model before reviewing

		the evacuation arrangements on their trams **Status: Progressing.**
London Trams	UKTram Subcommittee 1 on behalf of the Industry came to the collective view that installing escape hatches in the floor or roof of any Tramcar would import significant risk.	London Trams/TOL are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**
Transport for West Midlands	TfWM will await the completion of the industry risk model and how this may impact on tram standards before taking any further action. Currently not considered to be reasonably practicable to fit escape hatches in the floor or ceiling of current fleet, nor fitting removable glass to the cab.	TfWM/WMM are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**
West Midlands Metro	WMM are awaiting the outcome of industry risk assessment before considering any changes to existing fleets or new ones.	TfWM/WMM are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**
Blackpool Borough Council	Blackpool Borough Council/BTS consider the risk of a tram overturning on the Blackpool system to be sufficiently low as to not warrant changes to vehicles to improve evacuation. No further action being taken.	On publication of tram safety risk model, ORR will discuss a risk based approach to consideration of emergency

		evacuation to ensure Blackpool trams are in line with the rest of the sector. **Status: Progressing**
Blackpool Transport Services	Blackpool Borough Council/BTS consider the risk of a tram overturning on the Blackpool system to be sufficiently low as to not warrant changes to vehicles to improve evacuation. No further action being taken.	On publication of tram safety risk model, ORR will discuss a risk based approach to consideration of emergency evacuation to ensure Blackpool trams are in line with the rest of the sector. **Status: Progressing**
City of Edinburgh Council	City of Edinburgh Council are supporting the Edinburgh Trams position on recommendation 8.	City of Edinburgh Council/Edinburgh Trams are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**
Edinburgh Tram	Edinburgh Trams are awaiting the output from UKTram Subcommittee 1 before taking action in respect of this recommendation. In the meantime, ET are reviewing a potential solution which involves amending a side window in order to assist evacuation.	City of Edinburgh Council/Edinburgh Trams are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams

		Status: Progressing.
Transport for Greater Manchester	TfGM consider it unlikely they will implement this recommendation as a readily accessible safety egress system that would not also be vulnerable to misuse cannot be fitted to their trams.	TfGM/KAM are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**
Manchester Metrolink	KAM will assess and implement changes to standards as appropriate.	TfGM/KAM are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**
Nottingham Council/ Tramlink Nottingham Ltd	The shadow LRSSB will identify what is appropriate as an industry standard with regard to options for enabling the rapid evacuation of a tram which is lying on its side following an accident. Any suggested changes to tram construction standards will be assessed and implemented as appropriate.	Nottingham Council/TNL/NTL are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**
Nottingham Trams	The LRSSB will identify what is appropriate as an industry standard with regard to this recommendation. Any changes to tram construction standards will be assessed and implemented as appropriate. Enforcement of any recommended change will rely on the regulatory framework of the LRTSB.	Nottingham Council/TNL/NTL are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams

		Status: Progressing.
South Yorkshire PTE	SYPTE are awaiting the output from UKTram Subcommittee 1 before taking action in respect of this recommendation.	SYPTE/SYSL are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**
South Yorkshire Supertram Ltd	SYSL has concluded that incorporation of escape hatches into existing vehicle designs is highly unlikely due to the inability to maintain structural integrity and ensure a safe exit route from the vehicle, considering the potential for live electricity and available space. For Citylink (including tram-train) vehicles the windscreen design was refused acceptance by RSSB due to its lack of antispalling properties that could result in injury/blindness to the driver. However the current windscreens are compliant and have anti-spall properties	SYPTE/SYSL are awaiting the output of the industry risk model before reviewing the evacuation arrangements on their trams **Status: Progressing.**