Arthur D Little

Independent investigation into the circumstances around multiple stranded trains and passenger self-evacuation to track in the Lewisham and New Cross area in the evening of 2 March 2018

Report for Network Rail South East Route and Southeastern

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Executive Summary

On the evening of Friday, 2 March 2018, nine Southeastern trains carrying several thousand passengers became stranded away from platforms between Lewisham and North Kent East Junction, most for over four hours, with many passengers self-evacuating onto the track. This event began with a single train, 2M48, the late-running 15:56 service from Charing Cross to Dartford, struggling to take power when leaving Lewisham station at 17:35, and developed quickly so that by 18:20 all nine trains were stranded. All nine trains were then stopped until 21:48, with the last not moving again until 22:30, and some not arriving at their final destinations until after midnight.

The incident came at the end of an extremely challenging week for the rail and other transport networks in which severe cold weather conditions, including snowfall over several days, had resulted in extensive service disruption. On the day in question, Southeastern was operating a reduced service on principal routes only since further snowfall was forecast. Over the Friday morning and into the afternoon, Southeastern had already experienced ten trains stranded away from platforms across Kent and the consequent closure of several lines due to icing of the conductor rail, leaving Maidstone, Sittingbourne, Canterbury, Faversham and Ramsgate with no rail service and only a very limited service to the Medway Towns. From mid-afternoon onwards, freezing rain falling in the Lewisham area exacerbated the problem, leading to particularly heavy ice formation on both Platform 4 of Lewisham station and the conductor rail in the area, reportedly up to 10mm thick.

By 16:30 on Friday, 2 March 2018, Southeastern had instructed their stations to stop selling tickets and were actively advising customers not to travel unless absolutely necessary, however they felt a very strong obligation to transport passengers home, having taken them into London in the morning. They were working with Network Rail South East Route to clear the closed lines, and five empty trains, as well as to source replacement bus services. At the same time, they were arranging alternative overnight accommodation, anticipating that they may not be able to get all their passengers home, as well as negotiating the acceptance of train tickets on all bus services across Kent. Elsewhere in London and Kent the wider transport network was experiencing few difficulties as a result of the weather. Docklands Light Railway was operating, albeit with minor delays in the Lewisham area, and the local bus and road networks were operating acceptably, although there were reports of snow and ice on the pavements. London City Airport was closed for parts of the afternoon. However, these modes of transport are less susceptible to the build-up of ice than main line railways electrified using the third rail DC system.

Passengers on the nine stranded trains experienced significant levels of discomfort – initially many were standing due to crowding and then as the incident progressed, lower levels of interior train lighting and loss of heating were experienced. Many passengers understandably complained about the lack of toilet provision – forcing a number of passengers to relieve themselves in their clothes causing loss of dignity. These factors, combined with the proximity of several of the stranded trains to stations and ineffective communication with passengers, led them to self-evacuate to the track. The first self-evacuation occurred from train 2M50 after the first train, train 2M48, had been stationary for 63 minutes, with the front of the train less than 50m from the bottom of the ramp of Platform 4 at Lewisham station, and the station clearly visible. The first few passengers that self-evacuated acted as an encouragement to others to follow.

Although passenger self-evacuation was understandable in the circumstances, self-evacuation of trains is not normally recommended by the rail industry, especially on third rail lines where there is a risk of electrocution from the 750v DC power supply unless suitable mitigation is put in place.

With passengers on the track, Network Rail South East Route rapidly implemented an emergency electrical traction current isolation to protect passengers, but this isolation prevented train movement across a wide area and progressively led to the loss of on-train electrical systems.

The London Ambulance Service reported that they treated four people on-site with minor injuries and that nobody required transport to hospital by ambulance.

Poor communication and the ineffective command and control arrangements implemented contributed to the incident, allowing it to escalate.

An independent investigation was commissioned jointly by Network Rail South East Route and Southeastern to investigate the circumstances surrounding the incident, led by independent consultant Mike Sowden supported by Stephen Watson of Arthur D. Little. This investigation is separate from others being undertaken by the Rail Accident Investigation Branch and the Office of Rail Regulation, and is designed to establish the facts, determine the causes and make recommendations without apportioning blame.

The investigation identified that:

- The rail industry did not do enough to manage the incident in a manner that put the needs of stranded passengers first, ensuring the well-being of passengers, and this led to many passengers experiencing unacceptable conditions
- The Network Rail signalling team in the London Bridge Area Signalling Centre did not recognise the significance of the emerging incident and react quickly enough to prevent escalation
- The rail industry command and control arrangements as implemented were inadequate for the type and scale of the incident encountered
- The communications during the incident, covering many dimensions and parties, were inadequate to support the effective management of the incident
- The existing rail industry procedures relating to management of stranded passengers were not fully followed although they are not developed for an incident of this nature (geographical spread, duration of incident, number of passengers involved and cumulative demand on railway resources).

The investigation team have identified six areas of recommendations for Network Rail South East Route and Southeastern to consider to as far as possible prevent and/or mitigate the consequences of this type of stranded train incident in the future:

- Strengthening the train-service decision making including use of the existing conductor rail weather forecast, pre-service and in-service triggers during periods of known severe weather
- Additional infrastructure and rolling stock measures to help prevent the build-up of ice on the conductor rail
- Additional and reinforced measures to support decision-making and communication with passengers during stranding incidents to prevent passenger self-evacuation
- Strengthening how rail industry staff in control, signalling and driving functions can by their actions prevent potential stranding incidents, and respond rapidly to them to prevent further escalation
- Review and update processes and procedures for managing incidents involving stranded passengers, particularly focusing on passenger welfare, incidents involving multiple trains and ensuring that all procedures are compatible within the Route and with national guidance
- Strengthening command and control arrangements for management of incidents and testing of these arrangements through both table-top and real-life exercises involving stranded passengers/trains.

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1. Introduction

On the evening of Friday, 2 March 2018, nine Southeastern trains containing several thousand passengers became stranded away from platforms between Lewisham and North Kent East Junction after one train became stuck due to icing on the conductor rail. Most of the trains were stranded for over four hours, with many passengers self-evacuating onto the track. The rail industry defines stranded trains as trains that are stationary away from platforms, and there is either no certainty of them resuming their journey within 10 minutes or a reasonable certainty of resuming their journey but only after 30 minutes or more since stopping – and stranded passengers are those on or who have been evacuated from stranded trains.

Because of the safety implications of the self-evacuation, and the severe discomfort and delay experienced by so many passengers, Network Rail South East Route and Southeastern jointly commissioned an independent investigation into the circumstances surrounding the incident. The scope of this investigation was provided on 16 March 2018, setting out broad objectives to determine the sequence of events and their underlying causes, the adequacy of the response to the incident and of arrangements for the safety and welfare of those involved, and to make recommendations without apportioning blame. This investigation is separate from others being undertaken by the Rail Accident Investigation Branch (RAIB) and the Office of Rail and Road (ORR).

The investigation team has reviewed over 30 written reports from Network Rail South East Route and Southeastern staff involved in the incident, supplemented by follow-up discussions and interviews with key staff, and attended the emergency services debrief. The team has also reviewed passenger feedback, web and social media coverage of the incident, CCTV footage, On Train Data Recorder readouts, recorded radio communications and other documentary evidence. This includes a review of relevant rail industry, Network Rail South East Route and Southeastern standards and procedures, to determine whether they were applicable and whether they were followed.

The incident came at the end of an extremely challenging week for the rail and other transport networks as severe cold weather, including snow on several days, had resulted in extensive service disruption. On the day in question conditions were particularly severe and Southeastern had already experienced ten trains stranded away from platforms and the closure of many lines due to icing on the conductor rail. The weather forecast at the start of the week had predicted snowfall on the Monday and passenger train services had been reduced (through a process known as Key Route Strategy/KRS) in order to provide a timetabled service and infrastructure that was more robust in the event of extreme weather. By 16:30 on 2 March, Southeastern were advising passengers not to travel unless going home.

The events considered in this report took place from around 17:30 until around 22:30 on 2 March, involving staff from Network Rail South East Route (the rail infrastructure manager), Southeastern (the passenger train operator), British Transport Police (BTP), London Fire Brigade (LFB), London Ambulance Service (LAS), London Underground Ltd. (LUL) Emergency Response Unit (ERU) and the Metropolitan Police. The event took place across a wide geographical area and evolved rapidly at points throughout the evening, making on-site control from a single location very difficult.

This report considers the unfolding of events in two distinct stages – leading up to and then following the first passenger self-evacuation to track at 18:40. Prior to the first self-evacuation, the rail industry's incident response was focused on getting train 2M48 moving again, as it was struggling to draw power due to thick ice formation on the conductor rail. The other eight trains were queued behind this train. Following the first passenger self-evacuation, the nature of the event changed as the focus shifted to ensuring the safety of the passengers on the track and trains. This necessitated an electrical traction power isolation throughout the area at 18:42, which prevented further train movement until the tracks were clear and the electrical traction power could be restored, which did not occur until 21:36 because of continuing self-evacuation throughout the evening. The last trains were ready to move or moving by 22:30.

2. Background

Lewisham station is located in South East London, postcode SE13, in the London Borough of Lewisham. It is located six miles from Charing Cross station, and four miles from London Bridge station. At the time of the incident, the London Bridge Area Signalling Centre (ASC) signalled Lewisham station and its immediate surroundings. However, several of the signalling panels at London Bridge ASC had been relocated to the new Rail Operating Centre (ROC) at Three Bridges in Sussex. This meant that at the time of the incident, passenger train services from London Bridge through the Lewisham and St Johns area were signalled from two different signalling centres, interfacing with each other through signalling systems and primarily communicating between signallers by telephone.

The week leading up to Friday, 2 March brought extremely cold weather, including snow and ice over much of the UK, from a weather system nicknamed the "Beast from the East". The rail network in Kent functioned during the week, but railway staff spoken to variously described the week as "long" and "challenging". Some railway staff stayed away from home for some or all of the week to support passenger train service delivery.

During the days leading up to the incident, Network Rail South East Route and Southeastern reviewed the weather forecasts regularly in line with their procedures and updated a published "declared condition". On the basis of the forecast for Friday, they declared a condition of "Snow 2 Adverse", with up to 6cm of snow expected drifting up to over 15cm, and appropriately decided to implement Full Key Route Strategy (KRS) with an additional shuttle passenger train service between Ramsgate and Dover stations. This provided a half-hourly service on most routes, but with the Medway Valley line, Bromley North and Sheerness branches, and Canterbury lines closed.

The risk of ice on the conductor rail is exacerbated by the presence of freezing rain, a rare weather phenomenon in which rain falls at temperatures below zero °C and freezes on contact, rapidly forming sheet ice, which was observed across the south of England on 2 March from mid-afternoon onwards and acknowledged by the Met Office. Freezing rain has a severe effect on the third rail railway, which relies on good electrical contact between the train's current collection "shoes" and the top of the rail for traction power, as ice build-up on the third rail effectively creates an insulating layer preventing traction power from being drawn. The specific conditions for freezing rain were the result of the "Beast from the East" weather system and the warmer weather system of "Storm Emma" colliding over southern England. This is distinct from the more usual risk of ice formation from moisture on the conductor rail when it is below zero °C, and is a far greater problem for trains drawing traction current as it lays down thicker layers of ice, more rapidly. The Emergency Weather Action Team (EWAT) considered freezing rain during one of their conference calls on the Friday but the forecast provided at the time did not predict any "east of the Isle of Wight". The conductor rail forecast for Friday correctly predicted a risk of ice formation in Kent, but was not specific to any particular location. Furthermore, retrospective analysis shows that conductor rail forecasts for West Kent predicted ice risk on 60% of the days between the start of 2018 and 3 March, undermining the usefulness of such a forecast as a means of predicting a particularly elevated risk of ice formation. Consequently, it is unlikely that the EWAT could have used the forecast information to anticipate a particular crisis, and make any decision to stop running trains. Furthermore, in professional opinion provided by rail operations specialists the Lewisham area was not a known "problem area" for conductor rail icing.

During the Friday morning a number of Southeastern trains became stranded away from platforms due to ice formation on the conductor rail, while others were heavily delayed. This did not lead to any change in the KRS timetable for the afternoon, although by 17:00, as a result of the ice formation on the conductor rail, lines between Swanley and Ramsgate, Swanley and Ashford, Ashford and Ramsgate via Canterbury and Hither Green and Dartford via Sidcup had been closed, leaving Maidstone, Sittingbourne, Canterbury, Faversham and Ramsgate with no rail service and only a very limited service to the Medway Towns. Network Rail South East Route and Southeastern felt that they had a very strong obligation, typical across the rail industry, to transport passengers home, having taken them into London in the morning.

Railway emergency planning considers the need to balance the evening rush period with the service provided during the morning peak, to enable London commuters to return home. However, there was an appreciation that this might not be possible and senior Southeastern staff were also actively working to secure acceptance of rail tickets on alternative transport modes and suitable alternative accommodation in central London in the event that they could not transport passengers home. Additionally, following the stranding incidents of the morning, by 16:30, Southeastern had instructed their stations to stop selling tickets and were actively advising customers not to travel unless absolutely necessary or going home.

Elsewhere in London and Kent, the wider transport network was experiencing few difficulties as a result of the weather. The DLR was operating, albeit with minor delays in the Lewisham area, and the local bus and road networks were operating safely, although there were reports of snow and ice on the pavements. London City Airport was closed for parts of the afternoon. However, these modes of transport are less susceptible to the build-up of ice than main line railways electrified using the third rail DC system.

Shortly prior to the incident, a set of points on the Down North Kent line between St Johns and Lewisham stations failed due to ice build-up, resulting in no Down trains passing through Platform 4 at Lewisham station for over 90 minutes. There were also reports of dangerous icing conditions on the platforms at Lewisham station, leading to a decision for some trains not to stop there.

Third rail electrical traction power systems are known to have problems in severe snow and ice, but frequent train services are often sufficient to keep the conductor rail clear of ice, so the points failure will have exacerbated the ice formation on conductor rail around Lewisham station by allowing ice to build up undisturbed.

These issues should have alerted staff in the London Bridge ASC and the Kent Integrated Control Centre (KICC) that problems were developing in the Lewisham area, a key route to Dartford with the Sidcup line closed as a result of earlier icing problems.

At the same time the staff within KICC were also dealing with late running trains. At 1700 there were 19 trains over 20 minutes late, five over 10 minutes and three over 5 minutes. The Public Performance Measure (PPM) was 57% for the day and 23% for the 1500 to 1700 period (measured against the KRS timetable).

3. The incident

The incident narrative is split into two parts, reflecting the fundamental change in the nature of the incident at 18:40 when the first passenger self-evacuation to track took place. Prior to this, the incident was one of multiple passenger trains stopping and becoming stranded, due to ice on the conductor rail bringing train 2M48 to a stand. After the first evacuations, the incident was primarily characterised by passenger self-evacuations and the associated response of the railway industry and the emergency services.

The four chapters following this one examine several specific aspects of the incident in more depth. Additionally, detailed narratives for each of the nine stranded trains, a full chronological timeline and a diagram illustrating the locations of the stranded trains are provided in Appendix B.

Initial stoppage and stranding of trains

The severe cold weather throughout the day had led to ice formation on the conductor rail in various locations across Kent, causing many trains to have trouble in drawing traction current and ten passenger trains to become stranded during the morning and early-afternoon. From the mid-afternoon onwards, freezing rain falling in the Lewisham area exacerbated the problem, leading to particularly heavy ice formation on Platform 4 of Lewisham station, reportedly up to 10 mm thick. The points failure on the Down North Kent line between St Johns and Lewisham prior to the incident had only made matters worse by enabling the ice to build up further on the conductor rail through Platform 4 without trains disturbing it for over 90 minutes. On the wider Southeastern network, by 17:00 several routes were closed – including all routes to Maidstone, Canterbury, Sittingbourne, Faversham and Ramsgate.

The first train to arrive at Lewisham station Platform 4 after the points had been cleared of ice was the 15:56 service from Charing Cross to Dartford (train 2M48), running over an hour late due to severe weather on its journey into London, reaching Lewisham at 17:25. The driver reported difficulty drawing electrical traction power to the signaller, and began to leave the station at 17:35. The driver continued to report difficulty as the train made very slow progress, and at 17:47 reported the activation of a PassComm handle on board his train whilst still partially in the platform (PassComm – the Passenger Communication system – is a system by which passengers can communicate with the driver in an emergency). At this point it should have been apparent that issues were developing that might lead to line blockages. The professional opinion from signalling and control specialists is that a more proactive response (from the Network Rail South East Route signalling team in London Bridge ASC and the Southeastern Train Service Manager (TSM) in the KICC) could have prevented further train movement and possibly stopped four or five of the other trains from becoming involved in the incident. At 17:54, some of the rear carriages of train 2M48 were still at the platform and a passenger used an emergency egress handle to open the doors, and platform staff observed two passengers leave the train. At 17:55, the signaller notified the KICC of the PassComm and egress activation on train 2M48. The driver, assisted by a Southeastern Driver Manager (DM) travelling on-board as a passenger, reset the egress and the train continued to pull out of the station, eventually stopping at 18:20.

While train 2M48 was struggling to exit the platform, the late-running 16:26 service from Charing Cross to Dartford (train 2M50) was waiting behind it to enter Platform 4, having come to a stand at 17:37 at the signal protecting the platform (signal L445), which would not clear until train 2M48 had cleared the next signal. The front of train 2M50 came to a stand around 10m from the London end of Platform 4 at Lewisham station, with many passengers able to see the platform. Additionally, this train was extremely crowded and was not fitted with toilets. Because of its length, the rear of train 2M50 was standing across Lewisham Junction, blocking the Up and Down North Kent and Down Tanners Hill/Down Lewisham lines. This in turn caused the 17:06 Charing Cross to Orpington service (train 2S54) to come to a stand at 17:40 on the Down Tanners Hill line as it waited to proceed towards Lewisham station. Despite efforts by the driver and signaller to bring this train as close as possible to the signal in front of it, the rear of 2S54 was across the Tanners Hill Junction, which in turn blocked the Up and Down North Kent Fast lines.

With the Up and Down North Kent Fast lines blocked, all trains running on those lines soon came to a stand as well. While some trains were held at platforms, the 17:10 Charing Cross to Ashford International (train 2R46), 17:30 Charing Cross to Tunbridge Wells (train 2H50), 17:36 Charing Cross to Orpington (train 2S56) and 17:40 Charing Cross to Ashford International (train 2R48) services become stranded away from platforms on the Down North Kent Fast line. Meanwhile, the 16:28 Tunbridge Wells to Charing Cross (train 2H00) and 17:10 Tonbridge to Charing Cross (train 2H02) services became similarly stranded on the Up North Kent Fast line. These trains all came to a stand over the period from 17:40 to 18:10.

By 18:10 train 2M48 had made sufficient progress to be clear of the country end of Platform 4, although not sufficiently clear of the next signal, which prevented train 2M50 from being conventionally signalled into Platform 4. Southeastern staff from Lewisham Station Control contacted the London Bridge ASC signaller to inform him that the platform was clear and requested that train 2M50 be signalled into Platform 4 – but was told that under the normal signalling rules the signallers could not bring train 2M50 into the platform until train 2M48 had cleared the signal beyond the platform (signal L447). The signaller could have at this point considered moving train 2M50 into Platform 4 under Emergency Permissive Working (EPW). EPW is a special provision in the signalling rules for signallers to caution trains past red signals at low speed, having established that it is safe to do so. An EPW move requires authorisation by the Signalling Shift Manager (SSM) (the signaller's immediate manager) and, according to the signalling rules, is intended primarily for the purpose of moving stranded trains into nearby platforms to enable safe passenger disembarkation. Moving train 2M50 into Platform 4 at this or any other point prior to the first passenger evacuations to track at 18:40 would have not only enabled its passengers to get off, but would have cleared the Down Tanners Hill/Down Lewisham lines and enabled train 2S54 to proceed into Platform 2 at Lewisham station. With train 2S54 clear of Tanners Hill Junction, this would have cleared the Up and Down Kent Fast lines, enabling the six trains stranded there also to move.

At 18:16 the KICC, by then aware of the extent of the unfolding problem, dispatched the Network Rail South East Route Mobile Operations Manager (MOM) from Lewisham (called the Lewisham MOM hereafter) to assist by de-icing the conductor rail around train 2M48. This was 44 minutes after train 2M48 first reported difficulty drawing power. The KICC had previously deployed him to attend to an incident elsewhere after he had attended to the iced up points at Lewisham earlier. The Southeastern TSM in the KICC who took the call from the signaller at 17:55 about the PassComm and egress activation had not recognised the significance of this information, so there was a delay in passing this information to the Network Rail Route Control Manager (RCM) leading the KICC. However, the dispatch of the Lewisham MOM prior to this indicates that a Network Rail controller knew about train 2M48 by 18:16, which is when the KICC log for the incident starts.

At 18:20 train 2M48 came to a complete stop over an Automatic Warning System (AWS) magnet and was unable to start moving again. The DM on-board began to assist with de-icing the conductor rail. At no point was train 2M48 declared a failed train, as this status is reserved for trains with an on-board fault preventing them from moving. However, the signaller and the driver could have determined between them that, given the extremely slow progress of train 2M48 since 17:35 and the difficulty drawing electrical traction power for a period of eventually over 45 minutes that the train should have been treated in a similar manner to a failed train and assistance with de-icing formally requested sooner. The signaller and the driver had had a number of voice-to-voice communications prior to 18:20, during which the signaller could have more robustly questioned the driver to understand the lack of progress and the severity of the conductor rail icing or the driver could have asked for assistance.

At around the same time, there was a change of signallers on the relevant panel in the London Bridge ASC. The new signaller immediately began making preparations to move train 2R48, at the back of the queue on the Down Kent Fast line, back towards London Bridge, made a general update announcement to all drivers in the area concerning the developing situation, and at 18:25 notified the KICC of the stoppage of train 2M48.

At 18:30, nearly an hour after train 2M48 first reported difficulty, the Lewisham MOM arrived on-site to attend to that train and was appointed Railway Incident Officer (RIO) by the Network Rail RCM in the KICC, while the KICC also mobilised a second MOM to assist him. At 18:34 the RIO formally requested the Electrical Control Room (ECR) to isolate the electrical traction power to the Up and Down North Kent lines to enable de-icing of train 2M48 without risk to railway staff of accidental electrocution (62 minutes after the first report of train 2M48 struggling to draw power).

At 18:39, nearly 30 minutes after Lewisham Station Control had queried the possibility of moving train 2M50, the SSM contacted the KICC to propose use of EPW to bring train 2M50 into Platform 4 at Lewisham station. However, by this stage many passengers on board the stranded trains were finding their conditions intolerable. Crowding was especially severe on-board train 2M50, where the lack of toilets added to passenger discomfort, although on most of the trains the crowding made accessing the toilets difficult where they were available. Finally, many passengers on-board train 2M50 could see the platforms at Lewisham station and were clearly frustrated that they were not being allowed to get to them, and by a general lack of definitive information about when trains might move again. Because of these conditions, and before either an EPW move or the electrical isolation requested by the RIO could take place, at 18:40 passengers on-board train 2M50 activated the egress handles and approximately 30 people self-evacuated onto the track. The driver of train 2M50 immediately put down his short circuit bar between the conductor rail and one of the running rails to discharge the electrical traction current and protect those passengers exiting his train.

Passenger self-evacuation and emergency response

When the first passengers self-evacuated onto the track from train 2M50, the driver was immediately aware of the activation of the egress handles and alerted the signaller, who in turn alerted the ECR, requesting an emergency isolation of the traction current. This isolation was put into effect immediately to protect the passengers, also making train movement throughout the Lewisham, St Johns and New Cross areas (including the proposed EPW movement of train 2M50) impossible. With the traction current now isolated, the stranded trains had to rely on battery power. Train design means that each train immediately began a process of load shedding, which automatically and progressively shuts down electrical systems powered by the on-board train battery, to preserve power for as long as possible for the most critical systems such as lighting and the GSM-R radio system (used to communicate train to signaller and/or control). This meant the loss of toilet facilities, loss of heating and lighting at reduced levels, which added to passenger discomfort and prompting further evacuation. Most of the trains also lost the use of their public address (PA) systems by just after 20:00, preventing the drivers from making announcements to keep their passengers informed.

The RIO, who had been attending to the de-icing of train 2M48, left before completing this to assist with train 2M50 as soon as he became aware that passengers were self-evacuating from it. At this point, passengers self-evacuated from train 2M48 as well, following him back towards Lewisham station. Within a few minutes, several passengers also self-evacuated from train 2S54 and walked towards St Johns station. Shortly after this, the first British Transport Police (BTP) officer arrived at Lewisham station, having been notified of the developing incident at 18:38 by their Embedded Inspector in the KICC. However, they were initially unaware that the traction current had been isolated as they were unable to make contact with the RIO as no Rendezvous Point (RVP) had been set-up on-site. The KICC dispatched a third MOM to assist (and would dispatch a further three over the course of the evening from across Kent and Sussex), and Land Sheriffs were dispatched at around this time. Throughout the evening, passengers continued to self-evacuate from trains 2M48, 2M50 and 2S54, while the drivers on-board each train attempted to dissuade them from doing so, primarily through regular PA announcements. Several of the drivers found that they were unable to reset their egress handles, either because they could not move through their trains due to crowding or because passengers were activating them almost as soon as they were reset in order to continue to evacuate. Eventually, passengers began to self-evacuate from several of the other trains, with large numbers evacuating from trains 2S56 and 2H50 towards New Cross, or assisted towards Milton Court Road by a Network Rail maintenance team. On the less crowded trains, drivers and conductors were better able to communicate with passengers and persuade them to remain on-board, and in several cases were able to walk up and down their trains to provide assurance about the ongoing situation.

The second MOM arrived at Lewisham at 19:00 to assist the RIO, but the task of managing the situation was impossible for only two MOMs and more support was required. Over the following hour, significant additional resources arrived at Lewisham and elsewhere. The BTP requested assistance from both the London Fire Brigade (LFB) and London Ambulance Service (LAS) while the KICC requested assistance from the London Underground Limited Emergency Response Unit (LUL ERU) and dispatched a Southeastern team consisting of an Operations Manager and two DMs to assist with controlled evacuation of train 2M50. LFB firefighters arrived at Lewisham at 19:37. The Southeastern team arrived at 19:56, but instead of attending train 2M50 as originally instructed they were sent by the RIO to assist with train 2M48, where passengers were continuing to self-evacuate. Additionally, both Network Rail South East Route Permanent Way and Signalling and Telecommunications (S&T) personnel arrived on site to assist with managing evacuations from trains on the Up and Down North Kent Fast lines.

The BTP and other emergency services personnel attempted to conduct a controlled evacuation of train 2M50 just after 20:00, bringing passengers out safely through the driver's door. However, within a few minutes of commencing this, hundreds of passengers began to self-evacuate along the length of the train, and emergency services personnel hurried to bring the evacuation back under control and ensure everyone's safety, bringing ladders to the doors. The BTP requested further assistance from the Metropolitan Police to assist with public order on the platforms and when the LUL ERU arrived at Lewisham station it was sent to assist with the evacuation of train 2M50 rather than to de-ice the conductor rail around train 2M48 as it was originally tasked. Train 2M50 was reported empty at 20:52.

Throughout this stage of the incident, railway staff and emergency services personnel were at times striving towards conflicting goals. The railway staff were attempting to get the lines clear of people so that the traction current could be safely restored, as efforts to de-ice the conductor rail around train 2M48 were ongoing and soon the only thing preventing train movement would be the electrical isolation, which remained necessary while there were people on the tracks. The BTP and LFB, however, were attempting to evacuate the stranded trains closest to Lewisham station, although eventually only train 2M50 was fully evacuated. This resulted in passengers receiving mixed messages and not knowing what they were supposed to do, particularly once the PA systems on the trains failed due to load shedding. While many passengers were eager to leave the trains, many others were reticent due to the icy conditions underfoot and preferred to wait for the trains to move and were frustrated as the continued self-evacuations further delayed any attempt to restore traction current. Only when train 2M50 was empty was the RIO able to return to train 2M48.

Communication between the KICC and the on-site RIO relied on the RIO's mobile phone and at times this became a bottleneck. The RIO received calls from various staff in the KICC as they tried to understand the rapidly evolving incident, and some of these calls could most likely have been avoided with better information sharing within the KICC and the use of a single nominated person within the KICC to maintain dialogue with the RIO and then share this information across KICC. Throughout the evening, the KICC, signallers and ECR were attempting to coordinate with the RIO to establish whether the lines were clear (of all people) and it was therefore safe to restore the electrical traction current.

For long periods when events were escalating on-site, the RIO was unable to maintain effective contact with the KICC and thus the KICC was unaware of the scale of the incident for a long time. As a result, they were not able to fully engage their formal emergency command and control structures with either the site team or the emergency services incident leaders. They also did not apply the Joint Emergency Services Interoperability Principles (JESIP) when attempting to coordinate efforts between the rail industry, the LFB, the BTP and the LAS, which led to further confusion on-site as to who was in overall command and a general lack of shared situational awareness. There were points during the evening when there were many passengers still on the tracks but the KICC and the signallers, unaware of this, were attempting to contact the RIO with a view to establishing whether it was safe to instruct the ECR to restore the traction current.

After train 2M50 was fully evacuated and most of the passengers from 2M48 had also evacuated, the KICC, signallers, ECR and site team began to evolve a better joint understanding and to move closer to being able to restore traction current. Their efforts continued to be interrupted by sporadic reports of further self-evacuations (notably at 21:06 from train 2R46 and 21:16 from train 2S54), but eventually all lines were confirmed clear by on-site staff for long enough to restore the current. This was slightly further delayed by a disagreement between the RIO and the lead LFB officer on whether a drone should be deployed to check that all people were clear of the running lines. The RIO took responsibility so at 21:25 the signallers advised all drivers to prepare to resume train movement with a 5 mph speed restriction as an added precaution in case any passengers, railway staff or emergency services personnel were still on the track. At 21:36, having established that all lines were clear of people, the RIO instructed the ECR to restore the traction current to all lines in the area.

The driver of train 2M48 prepared to move his train at 21:48 with the conductor rail now successfully de-iced over a short length. At 21:51, the KICC gave authorisation to the London Bridge ASC signaller to move train 2M50 under EPW into Platform 4 at Lewisham station, as had originally been the intent of the signallers prior to the first self-evacuations. However, train 2M48 began to move at 21:53 and quickly cleared signal L445, making EPW unnecessary. Trains 2M50 and 2S54 were able to move shortly after this, entering Platforms 4 and 2 respectively at Lewisham station at 21:57. This cleared Tanners Hill Junction and the Up and Down North Kent Fast lines, freeing the other six trains to move. Trains 2H00 and 2H02, stranded on the Up Kent Fast line and train 2R46 on the Down Kent Fast line began to move at around 22:00.

Meanwhile, the batteries on train 2H50 had run completely flat, preventing the train from powering up again so that it continued to trap trains 2S56 and 2R48 behind it. The signallers began to develop a plan to send trains 2S56 and 2R48 back to London Bridge while using a rescue train to evacuate train 2H50. However, at 22:13 a team of Southeastern train maintenance staff successfully restarted train 2H50, and the train was moving a few minutes later, so these plans were no longer necessary. By 22:29, all nine stranded trains were reported to the KICC as either ready to move or moving again. Trains 2M48 and 2M50 continued on their journeys to Dartford, with Southeastern managers present to provide further assistance with de-icing, with train 2M48 arriving at around 23:00.

4. Communication, Command & Control Arrangements

During this incident there were inadequacies in communication, and effective operation of the rail industry command and control arrangements. Earlier recognition of the developing situation at Lewisham by Network Rail South East Route signalling staff could have prevented so many trains from joining the queue and becoming stranded. A quicker decision to implement Emergency Permissive Working for train 2M50 could have avoided passengers self-evacuating from this train and also released the remaining trapped trains. More effective communication, command and control once passengers had self-evacuate may have shortened the duration of the incident.

Network Rail South East Route and Southeastern operate a joint Control called the Kent Integrated Control Centre (KICC), where staff from both organisations fulfil a number of different defined roles. Control manages the route under both normal business-as-usual conditions, and during incidents. It is led 24/7 on a rotating shift basis by the Route Control Manager (RCM) from Network Rail South East Route alongside the Passenger Delivery Experience Manager (PDEM) from Southeastern. The British Transport Police (BTP) have an Embedded Inspector based in the KICC to act as liaison between the rail industry and the Police. Southeastern also have a communication team based within the KICC that monitor and actively use social media, as another communication channel with passengers. A separate meeting room is available adjacent to the KICC that can be used for incident command and management.

Routine and safety-critical voice-to-voice communication between many operational railway staff across the Network Rail controlled infrastructure (including between signallers in signalling centres and drivers on-board trains) uses the Global System for Mobile Communications – Railway (GSM-R) system. Calls made using the GSM-R system are time-stamped and recorded, and these recordings have been used extensively by the investigation team to establish the timeline of events and the detail of the exchanges between key personnel.

The trains involved in the incident all have on-board electrically powered Public Address (PA) systems that allow drivers and conductors to make announcements to passengers within the train. The PA systems have an additional feature that allows staff in KICC or the signalling centre to make in-train announcements using the GSM-R system. Train drivers use the GSM-R system to speak to the signaller as their primary point of contact, and always in the case of emergency calls.

Drivers of the trains with stranded passengers on-board reported difficulties in getting useful information to pass on to their passengers and neither Network Rail South East Route nor Southeastern passed messages at the frequency recommended by their own policies. This was through a combination of difficulties in getting through to the right people in KICC, and the various TSMs in the KICC not having information, or shared situational awareness, to be able to support the drivers. This meant many of the messages to passengers on the stranded trains were misleading. In the post-incident interviews with Southeastern's TSMs who were working during the incident, none knew that the incident involved nine separate trains containing stranded passengers. This demonstrates the failure of the KICC to collectively understand the extent of the incident and to provide staff working within the KICC with information to allow them to pass this on to the drivers of the affected trains. Eventually the on-train PA systems stopped working due to load shedding, and the GSM-R system would have failed due to train battery depletion, after which it was left to personnel on-site to convey messages.

Many Southeastern and Network Rail South East Route staff subsequently interviewed talked about the messages on-site being confused as well, with nobody clearly taking the lead, and that communication both with London Bridge ASC and with the KICC was very patchy and at times non-existent. However, a few passenger reports were complimentary of the communication given, saying it provided good feedback and updates on the resolution of the incident. As best as it can be established, these reports came chiefly from passengers on trains that did not experience self-evacuation and where it was possible for the on-train rail industry staff to make direct contact and provide assurance to passengers.

Social media was used by both Southeastern and Network Rail South East Route although there seems to have been little co-ordination between them. Even this does not appear to have kept passengers informed to their satisfaction. Many passenger reports indicate a lack of awareness, or a sense of being repeatedly told "soon". Passengers messaged to the effect that they felt that they were being threatened by the rail industry through its social media messaging. In particular, passengers who had self-evacuated were being described as "trespassers", which was badly received. Warnings to stay on trains and of the dangers of self-evacuating may have been effective if the messaging had been definitive about the plans alongside visible evidence of the plans being put into action. In fact, because those communicating for Southeastern and Network Rail South East Route were relying on feedback from KICC, who were lagging the activity on-site, messaging could not be up-to-date. Social media messaging between passengers on the various trains (which painted a very bleak picture, reporting instances of self-evacuation) seemed to add considerably to passengers' propensity to self-evacuate to the track and then walk to the nearest station themselves.

Network Rail has a National Emergency Plan that defines the overall command and control arrangements for managing incidents and emergencies. It deliberately uses the same command structure as that used by the UK emergency services with Gold (strategic), Silver (tactical) and Bronze (operational) Commanders to facilitate working with the emergency services during incidents. The Emergency Plan also includes the Joint Emergency Services Interoperability Principles (JESIP), which were established to help the emergency services carry out their individual roles efficiently and professionally, and to ensure that the multi-agency response to incidents is organised, structured and practiced. They are included in more detail in Appendix C.

The investigation team has considered the "shared situational awareness" JESIP principle when it was looking at the effectiveness of communication during this incident and the command and control arrangements established.

Network Rail South East Route decided for the week leading up to Friday 2 March to change the usual Gold Command arrangements, recognising the likely difficulties to be caused by the severe weather and designed to give the Gold Commander position elevated importance. The normal Incident Officer, who would become the Gold Commander if required, was "stood-down" and replaced by Route senior managers operating on a rota. During the incident, the Gold Commander was initially not located in the KICC, but instead in the Cottons Centre near London Bridge station, which is the Network Rail South East Route Headquarters. He decided to move to the KICC, arriving at 19:50, to be able to better interact with both the Control staff and senior managers from Southeastern fulfilling their equivalent Gold role.

The BTP learned of the incident at 18:38 through their Embedded Inspector in the KICC. However, the fact that the Inspector is outside the BTP operational command structure was not well understood by staff in the KICC. Staff there believed that informing the Embedded Inspector was "notifying" the BTP. It is important to note that it was the BTP, and not anyone in the rail industry command structure, who called for additional resources from the LFB and LAS.

Throughout the incident, Network Rail South East Route and Southeastern personnel based in the KICC were frequently unaware of the conditions on-site as the incident developed, instead lagging behind the staff on-site in their understanding and trying to catch up. Furthermore, because KICC was unaware that additional emergency services personnel were being called to site by BTP and LFB they did not effectively involve these organisations into the Gold command cell.

Furthermore, the rail industry guidance recommends appointment of both a Stranded Passenger Champion in the Gold cell and Train Operator Liaison Officer (TOLO) in the Silver cell. The Stranded Passenger Champion is to "*ensure that the emerging needs of stranded passengers are responded to and that they are a key input to the decision making process"* and the TOLO is *"to ensure that conditions on board the train are regularly monitored and reported back to the RIO"*. Neither of these roles were formally identified during this incident, and if appointed they could have brought additional insights into passenger welfare to support incident management and encouraged the achievement of better shared situational awareness.

Few, if any, 'timeouts' were convened in the KICC during the incident to take stock of the current position. This prevented the KICC from being able to provide effective strategic incident support to site. Furthermore, the typical rail industry practice of assigning staff (both within the KICC and with the on-site RIO) to act as note-takers, call handlers and scribes was not followed, which meant there were few contemporaneous records available to support effective investigation.

Because of the ineffective communication between the incident site and KICC, neither knew precisely what the other was doing or what their respective plans were in real time. Therefore, depending upon the source of the messaging, be it from on-site staff or from within KICC, a different message was given which led to the confusion that the on-site staff, emergency services personnel and passengers all referred to during the investigation.

On-site there were tensions between the Network Rail South East Route RIO and the LFB senior officer as to who should be in charge on-site and responsible for developing the tactical plans. Furthermore, no clear RVP was set up at Lewisham and therefore in several cases it was reported that as additional resources were arriving, they were unable to efficiently get a brief on the safety arrangements put in place throughout the site and the plan being worked to.

This inconsistency and ineffectiveness in communication meant that the command structure both in the Gold command cell in KICC and on-site was not as effective as required. Additionally, the number of calls made and received by the RIO throughout the incident prevented him from undertaking other on-site command activities.

It is important however, to recognise that while the efforts of the emergency services were not fully aligned with the objectives of the rail industry during the incident, they made a positive contribution to the management of the incident on-site, they provided invaluable facilities and helped keep passengers that had evacuated from trains safe as they walked to stations and subsequently left the railway.

5. Passenger welfare

Throughout the incident, many passengers experienced conditions that were a source of extreme physical discomfort. In particular, this was due to the crowding on many of the stranded trains and lack of functioning toilet facilities on-board a few of them for the duration of the incident.

There is general rail industry belief that the best approach for managing stranded passengers, from a passenger welfare perspective, is to keep passengers on trains and get the trains moving because experience shows that controlled evacuation can be hazardous, time consuming and requires significant resources. This was certainly true for the staff within the KICC and London Bridge ASC, because they lacked the situational awareness that an effective command structure would have provided to enable a specific strategy for dealing with this complex incident to have been developed. This view persisted even once they knew that passengers had begun to self-evacuate, with Network Rail South East Route and Southeastern staff more focused on trying to clear the tracks, re-energise the traction current and move trains forward, than on the welfare of passengers.

Both Network Rail South East Route and Southeastern's stranded train policies as well as the existing rail industry guidelines emphasise the importance of passenger reassurance through frequent contact and updates.

Throughout the incident, there is evidence of train drivers and KICC staff making use of the GSM-R and PA systems to speak to passengers on-board the trains. However, because of the lack of shared situational awareness between the KICC, signallers and on-site staff, messages to passengers were often misleading or provided insufficient information about how long the delay was likely to last and what the rail industry was doing about it. This left many passengers frustrated and lacking confidence that the rail industry was responding adequately to their situation. Many passenger reports indicate a lack of awareness or confidence, with similar criticisms directed at Network Rail South East Route and Southeastern's communications to the public via social media. To make matters worse, electrical load shedding on the trains meant the PA and GSM-R systems would have eventually failed around 90 minutes after the traction current isolation.

By contrast, where uniformed rail industry staff or BTP officers were able to speak directly to passengers and maintain a presence in the carriages, passengers were far less likely to self-evacuate. Maintaining this presence was impossible on the most crowded trains, such as train 2M50, as the drivers could not move through the train, but on trains where a driver and/or conductor were able to walk up and down the train to reassure passengers face-to-face passengers were more responsive to messages not to leave the train. It is believed that there were no self-evacuations at all from trains 2H00 and 2H02, which being services into London were far less crowded. Additionally, passengers were less likely to self-evacuate from trains where the driver had additional support in maintaining a face-to-face presence, where either conductors or off-duty staff travelling as passengers were present on the train and assisted.

The policies and guidelines also address the need for the command structure and responders to consider as a priority the physical needs of stranded passengers. From the social media feeds and subsequent correspondence to Southeastern, several key factors impacted on the passengers' physical comfort and wellbeing during the incident:

- Crowding on the trains, leading to many passengers standing in awkward positions for long periods and in some cases, prior to the loss of heating on the trains and doors being forced open, uncomfortably warm surroundings
- Lack of blankets for passengers left in freezing conditions for a prolonged period
- Lack of available toilet facilities on-board the trains, either because toilets were not provided by design, were out of service, were inaccessible due to the crowds or became unavailable due to load shedding
- Reduced light levels following loss of traction current due to load shedding
- Hunger and thirst, once the incident had been going on for several hours.

The lack of toilet facilities is, however, one of the major issues highlighted in the passenger feedback and social media commentary. Train 2M50, being designed for short suburban journeys, was not fitted with toilets. However, on other trains with toilets provided, once the traction current had been lost all toilet facilities ceased to be available as this system shuts down quickly under load shedding. As a result, many passengers reported being forced to relieve themselves where they stood, suffering severe embarrassment and loss of dignity and causing several of the carriages it was reported by several passengers and responders to smell as the incident progressed.

To their credit, some train crews did make toilets on their trains at least accessible with appropriate warnings of the restrictions of doors not locking and the toilets being unable to flush. Additionally, some train crews distributed emergency blankets, food and water where these were available.

More broadly it appears that, the following factors contributed to individual decision making to self-evacuate:

- Individual comfort including whether standing or seated, discomfort caused by the need to use the toilet, the overall level of crowding, warmth and overall train interior lighting.
- Trust in the messages being given by the rail industry (both through PA announcements and face-to-face communication) including the reason for the delay, the likely time for resumption of the journey and how unattractive (dangerous) walking trackside was.
- Trust in Twitter messages from rail industry organisations, which were frequently incorrect, contradictory and/or confusing.
- The end destination of the journey and whether leaving the train was thought to shorten the likely journey time.
- The proximity and visibility of station platforms (given the presence of snow on the ground and the ambient level of light).
- The absence of uniformed staff (whether rail industry or BTP).
- The information being received from smart phones including Twitter trending and direct phone calls.
- Whether anybody had also self-evacuated from nearby within the same train leaving doors open.
- Whether other passengers could be seen walking along the trackside.

Although passenger self-evacuation was understandable in the circumstances, self-evacuation of trains is not normally recommended by the rail industry, especially on third rail lines where there is a risk of electrocution from the 750v DC power supply unless suitable mitigation is put in place. The rail industry guidance states that *"self-evacuation, which – if it occurs when a train is not in a platform – creates a risk to their [passengers'] own and other people's safety and will make the situation more difficult to manage and likely to take longer to resolve"*, and this proved to be the case, with the traction power supply being turned off over a large area to remove the risk of electrocution.

Once passengers had started to self-evacuate onto the track the principal welfare concerns for passengers became ensuring their safety walking on the ballast in icy conditions and making their way up to the platforms, as well as ensuring their welfare when they reached the stations and providing support for onward travel.

It was very difficult for rail industry staff and emergency services personnel to ensure the welfare of passengers on the track once uncontrolled evacuations were underway. Where small numbers of passengers self-evacuated, rail industry staff did in some cases follow them until they were in a safe environment, or persuade them to get back onto the trains, but once uncontrolled evacuation was taking place this became impossible. According to reports from LAS, four passengers were treated for minor injuries sustained during evacuation but none required transferring to hospital. This reflects well on the efforts of the rail industry and emergency services teams working on-site in a very difficult environment.

Reports from the LFB suggest that there were not sufficient Southeastern staff present at Lewisham station to ensure passengers' safety once on the icy and snow-covered platforms and to assist them with onward travel arrangements, as well as to ensure their welfare after they had reached this station (e.g. by provision of water, blankets or hot drinks). However, many passenger reports indicate that there were some staff present, mainly providing advice and leaflets on how to make compensation claims and reminding passengers to "tap out" if they were using Oyster cards to avoid extra charges. It is therefore likely that Southeastern did not have enough staff available at Lewisham to cover all possible exit points throughout the entire duration of the incident.

It should also be recognised that prior to the incident, senior Southeastern staff in the KICC were preparing contingency plans with the Kent County Council, Kent Resilience Forum and various London Councils. This included arranging alternative accommodation for passengers in case they were unable to get them home and negotiating the acceptance of train tickets on all bus services across Kent as a further means of assuring passenger welfare.

6. Winter preparedness

All the Southeastern trains involved had been through the winter preparation process, and there is no evidence that the condition of the trains contributed to the incident, apart from the availability of on-board toilets.

Network Rail South East Route applies an anti-ice product to the conductor rail in the Lewisham area on a number of planned nightly circuits from a fleet of Multi-Purpose Vehicles (MPV) once every 24 hours during winter conditions. The circuit involving Lewisham (through Lewisham Junction, Lewisham station Platforms 3 and 4 and between Lewisham and Blackheath stations) had been completed overnight (1 to 2 March) ahead of the incident. However, rail operations specialists consulted were unable to confirm how long the anti-ice product remained effective meaning that by 17:00 on 2 March the anti-ice product may not have been fulfilling its purpose of preventing ice from sticking to the conductor rail as effectively as it could have been.

The conductor rail in and around the Lewisham station area is not provided with conductor rail heating despite its strategic importance to operations across Kent. However in the professional opinion provided by rail operations specialists this location was not a known "problem area" for conductor rail icing.

Several other sections across the South East Route do have conductor rail heating installed, which is designed to prevent ice formation on the conductor rail during the winter. The Investigation Team were advised that this was not installed on a route-wide risk basis or with the detail of the KRS policies in mind although several rail operations specialists consulted by the Investigation Team perceive the conductor rail heating not to be particularly effective. There is also widespread doubt as to whether conductor rail heating would have had much effect on the 'freezing rain' encountered at the beginning of this incident, other than to possibly break the strong bond between the thick ice and the conductor rail making it easier to shift with the passage of trains. There is debate as to whether conductor rail heating should be installed at this location and whether it could have been effective – this therefore must be an area for further investigation

During the period leading up to and throughout the incident, most point work at rail junctions in the immediate vicinity of Lewisham worked well with the sole exception of L844 points at Lewisham Junction, which were the points over which train 2M50 was eventually stranded. Earlier in the afternoon of 2 March, these points experienced ice build-up and the Lewisham MOM had successfully de-iced them demonstrating that the response arrangements to reported switch icing were effective and that general infrastructure preparedness for routes identified in the KRS was adequate in this area.

The various rail industry staff who attended the incident carried suitable de-icing sprays and equipment, albeit different across the various organisations involved, and they used these sprays and equipment to remove sufficient ice from the conductor rail around train 2M48. When the electrical traction power was restored at 21:36 train 2M48 was able to move off at 21:48 without significant issues.

Finally, Network Rail South East Route no longer supplements front-line teams during periods of potential severe weather disruption that could enhance the response capability. This is due to the practicability of knowing where to locate the additional staff. Despite this during the incident both Network Rail South East Route and Southeastern were able to deploy additional staff from other locations assisted by teams from LUL's ERU, Network Rail's maintenance teams and its security contractors to assist passengers and de-ice the conductor rail around train 2M48. Additional LFB firefighters were brought in to clear Lewisham platforms deemed to be dangerous because of ice and snow.

7. Procedures

Decisions around operation of the train service on 2 March were made in accordance with industry procedures for weather forecasting. During this incident procedures for dealing with stranded passengers and trains and for command and control of major incidents were not fully implemented and this probably extended the time taken to resolve the incident.

A process exists within Network Rail South East Route and Southeastern to review the weather forecast at Emergency Weather Action Team (EWAT) conference calls, and to define and publish a "declared condition" (for example Snow 1, 2 or 3) [as per Autumn Operational Delivery, Southeastern, April 2017, Version 1 SE/OP/16]. This determines which KRS should be used (Full, Partial or Lite) as per Network Rail's Additional Winter Preparations: Appendix E document. The "declared condition" for Friday, 2 March was "Snow 2 Adverse" with up to 6cm of snow expected drifting to over 15cm so full KRS was selected. Given the available information to both organisations, the investigation team believe that this decision was reasonable.

Both Network Rail South East Route and Southeastern have specific standards/procedures relating to stranded passenger incidents. These are based on the industry guidance ATOC/Network Rail Guidance Note – Meeting the Needs of Passengers when Trains are Stranded, ATOC NR/GN SP01.

Network Rail's procedure *National operating procedures: Managing stranded trains and train evacuation, Procedure: 4.15, Issue1, Network Rail, September 2017* is based on Issue 3 of the ATOC/Network Rail Guidance Note (June 2014) and is supported by the South East Route specific *Memorandum: Management of Stranded Trains*, published in January 2017.

Southeastern's standard *Managing the Needs of Passengers when Trains are Stranded - Incident Command, Control and Communication, SE/WI/OPS/035, Issue 1, Southeastern, June 2013* is based on Issue 2 of the ATOC/Network Rail Guidance Note (February, 2012) of the ATOC/Network Rail Guidance Note and is supported by a briefing document from February 2018 "Briefing: Stranded Passengers".

Issues 2 and 3 of the ATOC/Network Rail Guidance Note are broadly similar, but Issue 3 includes an additional appendix (Appendix D – Guidance for Railway Undertaking staff on actions to take in respect of passengers stranded on trains) that was not in existence when the current version of the Southeastern standard was written, although it is known that an updated version has been drafted in December 2017.

The ATOC/Network Rail Guidance Note (and the derived Network Rail South East Route and Southeastern documents) has been written to cover incidents involving both single and multiple trains. Stranding incidents involving multiple trains are not fundamentally different from those involving a single train but are inherently more complex to manage. An example from this incident is signaller-driver communication, where one signaller had to communicate with the drivers of nine separate trains. The Guidance Note does not specifically cover how to manage the increased complexity due to the involvement of multiple trains – a weakness that transfers into both Network Rail South East Route and Southeastern's documents.

Section 5 of the Guidance Note summarises the key principles that should guide the industry response to any incident involving stranded passengers:

- *Preventing the situation becoming worse – this includes taking immediate action to prevent or limit an increase in the extent of the problem, e.g. by holding other trains back at stations outside the affected area rather than allowing them to approach or diverting them to an alternative route.*
- *How best to meet the needs and expectations of the passengers on board – broadly the choice here is likely to be between i) holding passengers on the train until the situation has been resolved (i.e. the train is able to continue its journey or has been assisted) or ii) evacuating the passengers (either directly to a station platform or rescue train or via a track access point). Passenger related considerations (including the effects on passengers on other trains which may be affected) should always take precedence over railway operational factors.*
- *How to gain/maintain control of the situation – by demonstrating care, empathy, competence and confidence.*

- *Avoiding relying exclusively on a single plan.*
- *Discipline of decision making – there is often a temptation to defer key decisions in the hope that the situation will improve or that new information will become available. In practice, it is better to initiate an early full activation of the response plan and subsequently stand down resources than it is to ramp up the response as a degraded situation evolves into a crisis. In essence the principle should be to plan for the worst while hoping for the best.*

It also identifies the "two biggest challenges" to be the lack of information available to those taking decisions and the need to shift mind-set "away from railway operating considerations to meeting the needs of stranded passengers". Both of the challenges and to a greater or lesser extent the key principles are relevant to this incident.

Throughout this incident Network Rail South East Route and Southeastern, did not actively follow their procedures for managing incidents involving stranded passengers. This was not a conscious decision by the teams from either organisation, but unfortunately the result of the lack of situational awareness within the KICC, caused by a lack of effective communication through the command structure. The Gold command cell was unable to build these challenges into the strategic intent of the incident management plan. Without the guidance of the strategic command cell, the on-site incident management team comprising both rail industry staff and emergency services personnel managed to their own priorities. Subsequently most of the on-site team acknowledged that they had little awareness of their own companies' procedures or those of the other organisations involved during the incident. The on-site incident management team applied pragmatism, their training, skills, experience and knowledge to take decisions based on information available to them at the time.

Furthermore, the LFB always considered this to be a 'rescue incident' giving priority to getting passengers off the stranded trains, whereas rail industry staff intuitively want to keep stranded passengers on trains unless a controlled evacuation to track becomes absolutely necessary. This is because a controlled evacuation of so many passengers, especially across so many trains, would itself take several hours and require extensive additional manpower to conduct safely, and would still leave thousands of passengers in need of alternative onward transport or accommodation. This on-site incident management conflict of direction, without any input from the Gold command cell, probably hindered the timely resolution of the incident.

8. Conclusions

On the evening of Friday, 2 March 2018, nine Southeastern trains carrying thousands of passengers became stranded away from platforms between Lewisham and North Kent East Junction, most for over four hours, with many passengers self-evacuating onto the track. The incident occurred at end of a difficult week for the rail and other transport networks in which severe cold weather conditions, including snowfall over several days, had resulted in extensive service disruption. The incident started as Network Rail South East Route and Southeastern had just finished resolving several stranded passenger train incidents from the morning and this later event was a fast moving, dynamic incident.

The investigation identified that:

- The rail industry did not do enough to manage the incident in a manner that put the needs of stranded passengers first, ensuring the well-being of passengers, and this led to many passengers experiencing unacceptable conditions.
- The Network Rail South East Route signalling team within London Bridge ASC did not recognise the significance of the emerging incident and react quickly enough to prevent escalation.
- The rail industry command and control arrangements as implemented were inadequate for the type and scale of the incident encountered.
- The communications during the incident, covering many dimensions and parties, were inadequate to support the effective management of the incident.
- The existing rail industry procedures relating to management of stranded passengers were not fully followed, although they are not developed for an incident of this nature (geographical spread, duration of incident, number of passengers involved and cumulative demand on railway resources) .

9. Recommendations

The Investigation Team have identified six areas of recommendations for Network Rail South East Route and Southeastern to consider to as far as possible prevent and/or mitigate the consequences of similar incidents in the future.

Train-service decision making

- Review the existing conductor rail weather forecast (in particular focussed on the likely presence of ice on the conductor rail) to make it more useful to railway staff as part of the decision process for what train services to operate.
- Identify both pre-service and in-service triggers (such as reports of arcing/difficulty drawing traction power due to ice formation on the conductor rail) during periods of known severe weather conditions that can assist railway staff as part of the decision process for reducing and/or stopping services.

Prevention of ice build-up on the conductor rail

- Consider implementation of additional/more effective conductor rail heating on a structured and risk-based basis (potentially linked to the Key Route Strategy) across the route.
- Consider how the existing passenger train service rolling stock can help keep the conductor rail free of ice including such initiatives as scrapers and heated "shoes".
- Understand how long railway anti-ice products remain effective during severe weather conditions so that the railway can potentially implement a more effective preventative regime.

Prevention of passenger self-evacuation

- Improve how railway staff communicate with passengers (particularly face-to-face) during stranding incidents to advise them of the likely delay, the actions being taken by the rail industry and the need to remain on the train.
- Develop a decision-making tool to assist prioritising the response to all stranded trains that includes attributes such as the passenger needs, on-board train environment and the physical location of the train relative to stations.
- Provide a prominent visual display (for example a stopwatch style timer) in Control of the time that each train has been stranded to support effective decision-making.

Prevention and management of stranding incidents

- Consider how railway staff in Control and Signalling functions can use existing control/signalling systems and work with train drivers to quickly identify trains that are moving unusually slowly and/or have stopped and are stranded.
- Consider how the early use of Emergency Permissive Working and the practice of holding passenger trains in station platforms are used, both during periods of severe disruption to minimise the potential for stranding and to prevent additional trains becoming stranded during stranding incidents.
- Consider how train drivers during stranding incidents can work with railway staff in Control and Signalling functions to get sufficient suitable additional resources (such as Driver Managers and Mobile Operations Managers) mobilised rapidly to the incident location, both to assist passengers and to provide general situational awareness to the command structure.
- Consider how existing Network Rail South East Route and Southeastern resources can be more effectively used during periods of known severe weather conditions, to help prevent and respond to incidents.

- Consider how to make both the GSM-R radio and Public Address systems usable for longer time periods on trains following loss of electrical traction current, and review how best to manage on-train battery capacity beyond the existing load shedding, to minimise potential for train batteries to completely deplete during extended stranding incidents involving loss of traction current.

Processes and Procedures for Stranded Passengers

- Review the respective stranded passenger/train policies against industry guidance, and to confirm their applicability, practicality and compatibility with each other during both single and multi-train incidents.
  - Include a requirement to appoint an on-site Train Operator Liaison Officer for all stranded passenger incidents to assist the RIO.
  - Include a requirement to estimate the time required for onward travel of passengers based on the specific plan developed for that incident, and what additional supplies and equipment (including for example toilets, drinking water and blankets) should be brought to the train after a defined time-period to assist passenger welfare.
  - For a multi-train stranding incident, identify sufficient railway staff both in Control and with each train involved to ensure the needs of all passengers are considered and committed.
  - Include a requirement to consider both passenger welfare and onward travel for evacuated passengers (whether during controlled or uncontrolled evacuations).

Command and control arrangements

- Implement the JESIP principles (particularly Shared Situational Awareness and Joint Understanding of Risk) to strengthen the Command and Control arrangements for rail incident management.
- Review the implementation of the Network Rail National Emergency Plan on the South East Route including:
  - The appointment of Gold strategic commanders, Silver tactical commanders and Bronze operational commanders, and how these map to existing positions, together with suitable support from all affected and involved organisations.
  - The facilities provided to the Gold cell
  - Whether senior managers should take on key command roles rather than providing support
  - How Southeastern's arrangements (as described in its own Emergency Plan) support the Route Plan.
  - How to manage multiple calls from Control to the on-site Railway Incident Officer
  - The provision of note takers and/or additional support and technology to key positions
  - The training provided to both organisations in setting up and running incident command and control arrangements.
- Consider the organisation of exercises based on stranding incidents (both table-top and real-life) with railway front-line staff, and where necessary the emergency services. Specifically organise a table-top exercise to re-run the Lewisham incident focussing on the Gold and Silver command levels and a real-life passenger train evacuation exercise.

Appendix A: Glossary

ASC	Area Signalling Centre
ATOC	Association of Train Operating Companies
AWS	Automatic Warning System
BTP	British Transport Police
DM	Driver Manager
ECR	Electrical Control Room
Egress	Passenger emergency external door release equipment
ERCO	Electrical Control Room Operator
EPW	Emergency Permissive Working
ERU	Emergency Response Unit
EWAT	Emergency Weather Action Team
GSM-R	Global System for Mobile Communications – Railway
JESIP	Joint Emergency Services Interoperability Principles
KICC	Kent Integrated Control Centre
KRS	Key Route Strategy
LAS	London Ambulance Service
LFB	London Fire Brigade
LUL	London Underground Limited
MDC	Metro Duty Controller
MOM	Mobile Operations Manager
MPV	Multi-Purpose Vehicle
OCM	Operational Communication Manager
OTDR	On Train Data Recorders
PassComm	Passenger Communication equipment (Emergency Alarm)
PEDM	Passenger Experience Delivery Manager
PPM	Public Performance Measure
ROC	Rail Operating Centre
RIO	Railway Incident Officer
RCM	Route Control Manager
RVP	Rendezvous Point
S&T	Signalling and Telecom
SSM	Signalling Shift Manager
TOLO	Train Operator Liaison Officer
TSM	Train Service Manager

Appendix B: Detailed description of events and timeline

Information about the trains that had stranded passengers on-board is shown Table 1 (below) including:

- The train head codes (which is how trains are identified in signalling systems and by rail industry staff).
- Details of the planned journey, departure time and the time the train actually departed on Friday 2 March.
- The unit numbers making up each train.
- Details on the presence and operational state of toilets at the start of the journey.
- Passenger capacity of each train (both in terms of total seats and nominal capacity used by the Department for Transport that includes standard class seats and, where permissible, an allowance for standing passengers).

Table 1: Train status at the start of the incident

Head code	Train details	Actual time left origin	Unit numbers	Toilets	Seats per train	DfT capacity per train
2M48	15:56 Charing Cross - Dartford (via Bexleyheath)	17:03	466024, 465164, 465003	Operational in all three units.	864	1153
2M50	16:26 Charing Cross - Dartford (via Bexleyheath)	17:13	376002, 376035	No toilet fitted.	448	1280
2S54	17:06 Charing Cross - Orpington	17:23	465008, 465175, 465181	Operational in all three units.	1044	1392
2S56	17:36 Charing Cross - Orpington	17:37	465027, 465017	Operational in both units.	696	928
2H50	17:30 Charing Cross – Tunbridge Wells	17:29	466014, 465901, 465915	Out of service in all three units.	820	1037
2H00	1628 Tunbridge Wells - Charing Cross	16:56	465906, 465005, 466004	Operational in all three units.	842	1095
2H02	1710 Tonbridge - Charing Cross	17:24	466019, 465914, 465928	Out of service in the first and third units – operational in the middle unit. However, no passenger connections between units.	820	1037
2R46	1710 Charing Cross – Ashford International	17:24	377521, 377511, 377514	Operational in all three units.	723	1098
2R48	1740 Charing Cross - Ashford International	17:40	375703, 375913, 375808	Four (out of six) toilets operational across three units.	758	1095

Source: Information from Southeastern

During this incident there were several other trains (including train 2V07 at St Johns station and train 2K43 at Ladywell station) which were held at platforms and thus heavily delayed by the incident, but were never stranded in the true sense of the definition. These have been omitted here for simplicity as they were never involved in the self-evacuation incident, but the investigation team recognise that passengers on those trains experienced heavy delays as well.

Description of events on each train

What follows is a narrative description of the events that took place on and around each of the nine stranded trains involved in the incident, based on the staff and passenger reports, recorded calls, event logs and other information available to the investigation team and should be read in conjunction with the diagram in this appendix. Following these narratives, an overall timeline is provided to present all events in chronological order (Table 2), followed by a diagram illustrating the track layout and the positions of the stranded trains (Figure 1). The information available for each train has varied depending on what was related in the reports or discussed in the calls, and therefore not all the same details are available for each train.

15:56 Charing Cross to Dartford (2M48)

This service departed Charing Cross at 17:03, 67 minutes late, owing to severe weather during its journey into London, and arrived at Lewisham station Platform 4 at 17:25, 72 minutes late. At 17:35, the train began to leave Lewisham station, experiencing difficulty drawing electrical traction current due to ice on the conductor rail, moving slowly and haltingly away from the platform. While the rear of the train was still in the platform, a manual emergency door release (egress handle) was activated, which had to be reset, and two passengers exited to the platform. At 18:20, the train came to a complete standstill with its rear approximately 100m from the platform. This was still within the overlap of the platform signal (L447), stopping the signal in the rear (L445) clearing to allow the following train (2M50) into the platform (the overlap is a safety margin ahead of a signal which must be clear before the signal in rear can be cleared to allow another train to pass it). A Southeastern Driver Manager (DM) who happened to be travelling off-duty as a passenger on the train assisted the driver.

Upon instruction from the KICC to go to the site of the struggling train, the Lewisham Mobile Operations Manager (MOM) arrived on site at 18:30 and began making arrangements for an electrical isolation to enable the conductor rail around train 2M48 to be safely de-iced, protecting staff from accidental electrocution. However, before de-icing could commence, passengers began self-evacuating from train 2M50, necessitating an emergency electrical isolation of all lines through Lewisham station. The MOM left to attend to train 2M50, and passengers began to self-evacuate from train 2M48 as well. Over the following two hours, passengers continued to leave the train and walk back to Lewisham station while the driver, with the assistance of a DM, a Driver Instructor and a Trainee Driver on board the train, reset the egress handles and alarms and attempted to persuade passengers to remain on-board. The DM (on board) and a Southeastern team sent to assist the train (who arrived at around 20:00) de-iced the conductor rail, while BTP in attendance began evacuating passengers from the rear four carriages. The driver attempted to provide announcements to the passengers still on board but the PA system stopped working due to loss of battery power after some 90 minutes from the time that the traction current was isolated at 18:42. At around 20:20, some passengers disembarked and walked towards Blackheath station, followed by the DM who verified their safe arrival.

Passengers who remained on the train were subject to cramped conditions and were unable to use the toilets due to load electrical system shedding following traction current isolation.

The electrical traction current was eventually restored at 21:36 and, after some delay building up air pressure in the train braking system, the driver was able to move out of the signal overlap at 21:53, eventually reaching Dartford station shortly after 23:00.

16:26 Charing Cross to Dartford (2M50)

This service left Charing Cross at 17:13, 47 minutes late, and made its way without incident to Lewisham. Being composed of class 376 rolling stock, the train was not fitted with toilets, and was extremely crowded.

At 17:37, the train came to a halt at signal L445 on the approach to platform 4 at Lewisham station, where train 2M48 was struggling to draw traction power and proceeding very slowly out of the station. Train 2M50 was standing across Lewisham Junction, blocking both the Up and Down North Kent and Down Tanners Hill/Down Lewisham lines. The front of train 2M50 was approximately 10m from the London end of the Lewisham station platform ramp and many passengers could see or were aware of their proximity to the station. The driver made regular announcements to the passengers but was unable to provide an indication of how long it would take the train ahead to move.

At 18:10, Southeastern staff from Lewisham Station Control contacted the signaller for Panel 5 of London Bridge ASC (responsible for signalling trains throughout the Lewisham area) to advise that train 2M48 was clear of the platform, and asked whether train 2M50 could now be brought into Platform 4. They had not realised that this was not possible under normal signalling rules until train 2M48 cleared signal L447. The signaller reminded them of this, which they acknowledged. Neither party mentioned Emergency Permissive Working (EPW) during this exchange.

At 18:39, the Shift Signaller Manager at London Bridge ASC sought clearance from the Kent Integrated Control Centre (KICC) to move train 2M50 under caution into Lewisham station Platform 4 using EPW (in line with the earlier request from Lewisham Station Control, although that request had not specifically mentioned EPW). However, at 18:41 several passengers exited the train to the track by activating the emergency egress handles within the train and jumping down onto the snow-covered ground. The driver made an emergency call to the signaller at London Bridge ASC and then placed a short circuit bar on the track to discharge the electric traction current from the conductor rail system. The driver was unable to hear the signaller when making the emergency call, but the signaller heard him and promptly called for an emergency electrical traction current isolation on all lines through Lewisham station (preventing any Emergency Permissive move being undertaken). The short circuit bar ensured that the current remained isolated at the train's location in the event that the traction current was restored whilst passengers were still on the track. At 18.54, the driver requested permission to evacuate the front five carriages of his train through the cab, but this was deferred by the signaller pending the availability of sufficient personnel to safely conduct an evacuation. The Lewisham MOM (now the Railway Incident Officer/RIO) arrived from train 2M48 to assist train 2M50.

By 19:45, many egress handles had been activated but the train remained too packed for the driver to move through the train to reset them. Some passengers became increasingly aggressive, prompting the driver and the MOM to attempt to initiate a controlled evacuation through the front cab at 20:01. At this point, passengers forced open doors all along the train and began self-evacuating in large numbers to the track, although the BTP and London Fire Brigade (LFB) personnel present managed to bring the evacuation back under control. However, by 20:52, the train was empty and the driver had reset the egress handles, while the MOM departed to assist train 2M48 again.

Following restoration of the traction current at 21:36, the train took some time to build up air pressure in the train braking system. At 21:51, the KICC gave authorisation to undertake EPW to bring train 2M50 into the station, but by the time the train 2M50 was ready to move, train 2M48 had cleared the signal ahead allowing signal L445 to clear normally and train 2M50 to be signalled into Platform 4. Train 2M50 entered Platform 4 at Lewisham station, empty, at 21:57, and was routed via Bexleyheath to Dartford with a Southeastern DM accompanying the driver, encountering several locations of severe conductor rail icing which the driver and DM were able to deal with.

17:06 Charing Cross to Orpington (2S54)

This service left Charing Cross at 17:23, 17 minutes late, and ran towards Lewisham station via the Down Kent Fast and Down Tanners Hill lines, where it was held at signal L243 at 17:40. This was because the train ahead (train 2M50) was being held in a position across Lewisham Junction whereby the rear was in the overlap of signal L253, the signal ahead of signal L243. This resulted in signal L243 not being able to be cleared and the rear of train 2S54 standing in the overlap of Tanners Hill Junction. This meant that it was not possible to operate trains on the Up and Down Kent Fast lines between North Kent East Junction and Parks Bridge

Junction, blocking six further services away from stations. At the signaller's direction, the driver of train 2S54 attempted to creep right up to the signal but was unable to clear the junction behind.

The driver made regular announcements to the passengers but was unable to provide an indication of how long it would take the train ahead to move. At around 18:45, the driver received a general emergency call advising of passengers self-evacuating from train 2M50 ahead, followed by a loss of electrical traction current as it was now isolated. Shortly following this, several passengers activated an egress handle in one of the carriages, exited the train to the track and walked towards St Johns station. A Trainee Driver present on board assisted in resetting the egress handle. Door interlocking was lost again later in the evening, suggesting another possible egress, although the driver did not see anyone exiting the train. A further egress handle was pulled at around 21:16, which was reset by one of the MOMs assisting the stranded trains.

After the electrical traction current was restored and the train powered up, the signaller cleared train 2S54 into Platform 2 at Lewisham station at 21:57, over four hours late.

17:10 Charing Cross to Ashford International (2R46)

This service left Charing Cross at 17:24, 14 minutes late, and ran towards Lewisham before becoming trapped at 17:40 at signal L233 on the Down Kent Fast line by train 2S54 standing at signal L243 (on the London side of the Lewisham Vale Junction). The driver observed loss of traction current when other trains began to self-evacuate. Eventually, the driver removed the key from his cab to completely switch off the train electrical systems and preserve some train battery power to prevent difficulty powering up when the electrical traction current was eventually restored. At 21:06, passenger egresses from train 2R46 were reported to the KICC.

The electrical traction current was restored at 21:36. At 21:59 the train was reported to be still building up air pressure in the train braking system, but it moved shortly afterwards.

17:30 Charing Cross to Tunbridge Wells (2H50)

This service left Charing Cross on time. At 17:45, the train became trapped at signal TL2055 on the Down Kent Fast line adjacent to New Cross station behind train 2R46. When the electrical traction current in the area was isolated, the train went to half lighting and the heating switched off throughout the train. Following this, an egress handle was activated and at least one passenger exited to the track, who the driver observed climb up to the nearest platform of New Cross station. PassComm alarms were also activated allowing passengers to speak directly to the driver. The driver managed to open one of the locked toilets to enable people to use it without flushing (which would not have worked due to the loss of electrical power). Network Rail and British Transport Police (BTP) personnel attended the train and assisted in resetting PassComm buttons throughout the train.

At 19:52, more passengers self-evacuated, having become aware of passengers from the trains stopped ahead and behind doing the same thing. Further self-evacuations occurred at 20:51 and 21:03. Eventually, the batteries on train 2H50 ran completely flat, so that the train had difficulty powering back up when electrical traction current was restored at 21:36. Southeastern Fleet Technical staff were called to trip the electrical systems on the train and enable the compressors to restart, and arrived on site at around 22:00. The KICC began developing a plan to evacuate train 2H50 via a rescue train in the event that the train maintenance staff were unsuccessful, but this was not necessary as the train had finished "pumping up" by 22:13 and was moving by 22:15. The train proceeded slowly through Grove Park with further arcing before being able to travel above 10 mph, and reached Tonbridge station at 23:07, nearly five hours late.

17:36 Charing Cross to Orpington (2S56)

This service left Charing Cross only one minute late, becoming trapped behind train 2H50 at signal TL2051 on the Down Kent Fast line at 17:52. At around 18:15, an emergency PassComm alarm was activated because of a passenger having a fit. The driver put out an announcement requesting assistance and the passenger was subsequently assisted by a doctor and two first aiders travelling as passengers in the same coach, without requiring further attention. Many passengers were complaining that the PA announcements were not audible, that the toilets were locked, and that the train was crowded.

At 19:07, after the electrical traction current had been isolated when passengers self-evacuated from train 2M50, the driver noted an egress handle activation but was unable to see whether and where passengers had alighted on the track. The driver placed a short circuit bar on the track and reset the egress handle, after being informed by other passengers that two passengers had already exited the train.

Later in the evening, three Network Rail staff from its maintenance team attended to assist the train as many more passengers had begun exiting the train, activating egress handles faster than the driver could reset them. Passengers were evacuated via a lineside gate onto Milton Court Road.

When electrical traction current was restored at 21:36, train 2H50 had difficulty building up air pressure in the train braking system due to the drained train batteries. At around 22:00, the signaller proposed to send train 2S56 back to London Bridge, but Southeastern Fleet Technical staff who had been dispatched to train 2H50 were able to get it on the move, with all trains including train 2S56 moving or ready to move by 22:29.

17:40 Charing Cross to Ashford International (2R48)

This service left Charing Cross on time, and at 17:50 became trapped at signal TL2049 on the Down Kent Fast Line, behind train 2S56 at the back of the queue of stranded trains. At 18:21 following the change of signaller covering Panel 5 in London Bridge ASC, the signaller advised the driver to change driving ends (switching the direction of forward train travel) with a view to move the train back into London Bridge station. However the passenger self-evacuation from train 2M50 occurred before this could happen, resulting in the emergency electrical traction current isolation over a wide area, after which the train could not move. Following the loss of electrical traction current, the train lost heating and went to half lighting, and lost the use of its two working toilets very rapidly. The PA system was also lost, following which the driver and conductor walked through the train to update passengers at regular intervals.

Around 90 minutes into the incident, approximately 12 passengers self-evacuated from the train and walked up the tracks towards London Bridge station. The driver and a trainee driver, also present, disembarked the train and persuaded the passengers to re-enter the train via the rear cab.

After the traction current was restored at 21:36, the driver received an instruction at 22:08 to make a wrong direction movement back to London Bridge station because of train 2H50 ahead having difficulty pumping up its braking system, but this was eventually cancelled when at 22:13 train 2H50 was ready to move. Train 2R48 reached Ashford International station at around 00:15.

16:28 Tunbridge Wells to Charing Cross (2H00)

This service left Tunbridge Wells station at 16:56, 28 minutes late. A previous conductor had noted that the toilets on board were out-of-service. The train became trapped at 17:45 at signal L236 on the Up Kent Fast line by train 2S54 standing in the overlap of Tanners Hill Junction, visible to the left of the train. The conductor walked through the middle four-car set to keep passengers informed and dissuade those considering self-evacuating from the train from doing so, while the driver made regular announcements. Because of the configuration of the train, the driver was unable to walk the entire length of the train without exiting to the track, and so was reliant on the conductor to maintain a physical presence in the middle four-car set and the rear two-car set. The conductor was also unable to access the rear two-car set without exiting to the track. The driver was able to open up at least one of the toilets for passenger use, although without the ability to flush it because of electrical load shedding to save battery power.

When the electrical traction current was isolated, the driver and conductor informed the passengers of what had happened ahead, while passengers exiting train 2S54 were visible from train 2H00. The conductor exited the train to bring a solitary passenger from the rear two-car set into the middle four-car set. A South Western Railways' driver on-board also offered to assist the driver of 2H00, and helped with the distribution of emergency blankets to passengers in the front four-car set while the conductor stayed with the passengers in the middle four-car set. Later a Network Rail South East Route MOM arrived and made announcements to the passengers to remain on board, shortly before the train lost battery power completely. The train resumed its journey at 21:58 and reached Charing Cross station at around 22:20, nearly five hours late. It is believed that no passengers exited this train during the incident, and the rail industry staff on this train were praised for their effective communication with passengers.

17:10 Tonbridge to Charing Cross (2H02)

This service departed Tonbridge station at 17:24, 14 minutes late, and became trapped behind train 2H00 at signal L244 on the Up Kent Fast line. The toilets in the first and third units of the train were out-of-service, with no passenger connections to the second unit where the toilets were working prior to loss of the electrical traction current. After loss of traction current, the train eventually lost battery power completely and the driver had to contact the signaller to ascertain whether the traction current had been restored, as he was unable to detect it. After the electrical traction current was restored the train resumed its journey at 22:02. It is believed that no passengers exited this train during the incident.

Overall chronological timeline of key events

Table 2 (below) is an outline of the sequence of events throughout the evening from the points failure prior to the initial arrival of train 2M48 at Lewisham to the point at which all nine stranded trains were moving again. This is a summary of the detailed investigation analysis undertaken by train, interviews with key personnel, control/signalling/ECR logs and including all the recorded communications and downloads from the trains involved. This timeline should be read in conjunction with the diagram of the track layout and stranded train locations included at the end of this appendix (Figure 1).

Table 2: Timeline of key events

16:31	L844 points fail due to ice, preventing trains from running through Lewisham station on the Down North Kent line from St Johns station. The last train to pass through Platform 4 was at 15:54 and the last train to pass through Platform 2 was at 16:11.
16:57	The Lewisham MOM attends and de-ices L844 points, enabling trains to enter the station from St Johns again. By the time the next train arrives at Platform 4, there have been no trains through that Platform for 91 minutes.
17:25	The 15:56 service from Charing Cross to Dartford (2M48) arrives 72 minutes late at Platform 4 at Lewisham station on the Down North Kent line (having departed Charing Cross 67 minutes late).
17:32	2M48 reports difficulty drawing electrical traction power due to ice formation on the conductor rail, predominantly because of freezing rain.
17:35	2M48 leaves Lewisham station (81 minutes late), moving slowly due to difficulty drawing power.
17:37	The 16:26 service from Charing Cross to Dartford (2M50), having departed Charing Cross 47 minutes late, is held at signal L445 on the Down North Kent/Down Tanners Hill line, due to train 2M48 ahead, locking both the Up and Down North Kent and Down Tanners Hill/Down Lewisham lines, causing its rear to stand in the overlap of signal L253.
17:40	The 17:06 service from Charing Cross to Orpington (2S54), having departed Charing Cross 17 minutes late, is held at signal L243 on the Down Tanners Hill line due to train 2M50 ahead, with its rear standing in the overlap of Tanners Hill Junction. This blocks the Up Kent Fast and Down Kent Fast lines despite attempts to creep forward; the 17:10 service from Charing Cross to Ashford International (2R46), having departed Charing Cross 14 minutes late, is trapped at signal L233 on the Down Kent Fast line by train 2S54.
17:45	The 16:28 service from Tunbridge Wells to Charing Cross (2H00), having departed Tunbridge Wells 28 minutes late, is trapped at signal L236 on the Up Kent Fast line by train 2S54. The 17:30 service from Charing Cross to Tunbridge Wells (2H50), having departed Charing Cross on time, is trapped at signal TL2055 on the Down Kent Fast line by train 2R46.

17:46	Southeastern TSM contacts London Bridge ASC SSM to discuss movement of 5V01 to Slade Green and makes reference to conductor rail icing problems at Lewisham.
17:47	Driver of 2M48 reports activation of emergency PassComm handle – this is the first PassComm associated with this incident, 22 minutes after the train arrived at Platform 4.
17:50	The 17:40 service from Charing Cross to Ashford International (2R48), having departed Charing Cross on-time, is held at signal TL2049 on the Down Kent Fast line by the 17:36 service from Charing Cross to Orpington (2S56), which had departed Charing Cross 1 minute late and is still moving forward at this point.
17:52	Train 2S56 is trapped by train 2H50 at signal TL2051 on the Down Kent Fast line, trapping train 2R48 behind it which is already stationary.
17:54	Activation of egress handle on 2M48 while the rear of the train still at platform, 29 minutes after the train arrived at Platform 4. Platform staff observe two passengers exiting to Lewisham station platform from the rear carriage – this is the first egress activation associated with this incident.
17:55	London Bridge ASC signallers notify one of the Southeastern TSMs in the KICC of egress activation on train 2M48.
18:10	The 17:10 service from Tonbridge to Charing Cross (2H02), having departed Tonbridge 14 minutes late, is trapped by train 2H00 at signal L244 on the Up Kent Fast line. Lewisham Station Control contacts the signaller at Panel 5 London Bridge ASC to advise that train 2M48 is clear of the platform and raises the question of whether train 2M50 can now be brought into the platform (both parties acknowledge that this is not permitted as train 2M48 has not cleared signal L447, and EPW is not mentioned as a possibility).
18:16	The Lewisham MOM is dispatched by the Network Rail Incident Controller in KICC to assist train 2M48 with de-icing equipment, 50 minutes after the train arrived at Platform 4.
18:19	2M48 clears the end of platform 4 at Lewisham station but is still within the overlap of the platform starter signal (L447), stopping the signal in rear (L445) from clearing to allow 2M50 into Lewisham station.
18:20	2M48 comes to a standstill over the Automatic Warning System (AWS) magnet, with its rear approximately 100m from the platform and still within the overlap of signal L447. There is a change of signallers on Panel 5 in the London Bridge ASC.
18:21	London Bridge ASC signaller prepares for train 2R48 to move back towards London Bridge.
18:25	London Bridge ASC signallers notify the Network Rail Incident Controller in the KICC concerning stoppage of 2M48.
18:30	The Lewisham MOM arrives to assist with de-icing the conductor rail ahead of 2M48. He is appointed as Railway Incident Officer (RIO) by the Network Rail Route Control Manager (RCM) in the KICC and KICC mobilises a second MOM to assist the RIO (Lewisham MOM).
18:31	A passenger is reported as having a fit on board train 2S56 but is assisted by a doctor and two first aiders travelling on the train as passengers.
18:32	The signallers decide to implement Emergency Permissive Working (EPW) to bring train 2M50 into Platform 4 at Lewisham station in order to clear Lewisham Junction and enable trains behind to move, 55 minutes after the train came to a stand.
18:34	The RIO makes a request to the Electrical Control Room (ECR) for isolation of Up North Kent and Down North Kent lines to facilitate de-icing of conductor rail ahead of 2M48, 62 minutes after the first report of 2M48 struggling due to ice on the conductor rail.
18:38	The BTP are informed of the incident via the Embedded Inspector in the KICC.
18:39	The Signalling Shift Manager (SSM) at London Bridge ASC proposes to the Network Rail Incident Controller in the KICC to use EPW on train 2M50.
18:40	Passengers on 2M50 activate egress handles and over 30 passengers exit the train to the track.
18:41	The driver on 2M50 notifies the signaller of the egresses (although he is unable to hear the signaller reply) who in turn notifies the ECR; the RIO leaves train 2M48 to assist train 2M50, and passengers egress from 2M48 and follow him; passengers continue to exit both trains throughout the evening as staff on board are unable to reset the egress handles and close the doors as fast as they are opened.
18:42	Extensive emergency electrical traction current isolation (covering the Courthill Loops, North Kent East Junction, Blackheath Junction, Nunhead Junction, Tanners Hill and School Junction, and the areas in between) taken due to passengers on the track. This prevents any possibility of moving train 2M50 under EPW or sending train 2R48 back to London Bridge, and causes all trains in the area to go to half lighting, lose heating, lose toilet facilities and eventually lose their PA systems.

18:44	A third MOM is mobilised by the KICC to assist at Lewisham station.
18:45	Several passengers on 2S54 activate egress handles and exit train to track, walking towards St Johns station.
18:47	Land Sheriffs are called to attend to assist evacuating passengers, expected to arrive in ~45 minutes.
18:52	BTP personnel arrive at Lewisham station.
18:54	The driver of train 2M50 places a short circuit bar to ensure local isolation of electrical power and requests permission to evacuate the front five carriages of the train, but this is deferred pending the availability of sufficient emergency services personnel to facilitate a controlled and safe evacuation.
18:56	BTP are unable to establish whether the traction current has been isolated as they have not yet made contact with the RIO. They advise BTP control of intent to go trackside with live traction current (current is actually off at this point).
18:55	The line at St Johns station is confirmed clear of passengers as those exiting from train 2S54 have reached the platform.
19:07	Two passengers activate egress handle on train 2S56 and exit the train, walking towards New Cross station, the driver places a short circuit bar on the track to ensure local isolation of electrical power is maintained – later in the evening many more passengers activate egress handles and exit the train, and are assisted by Network Rail staff towards Milton Court Road via a lineside gate. BTP personnel arrive at Blackheath station.
19:11	BTP request assistance from the London Ambulance Service (LAS) in response to reports of passengers taken ill on board stranded trains.
19:14	BTP request London Fire Brigade (LFB) attendance for "lighting and additional resources". Hither Green P-way team en-route to Lewisham.
19:15	An egress handle is activated on train 2H50 and passengers exit the train to the track.
19:20	Approximately twelve passengers on train 2R48 activate an egress handle and exit the train to the track to walk back towards London Bridge, the driver and an accompanying trainee disembark and eventually persuade the passengers to re-enter the train via the rear cab.
19:24	There is a change of signallers on Panel 5 in the London Bridge ASC controlling the Lewisham area.
19:32	Hither Green P-way team arrive at Lewisham.
19:37	LFB personnel arrive on site at Lewisham station.
19:40	A DM travelling off-duty on train 2M48 as a passenger goes to assist with the de-icing of the conductor rail ahead of the train (he had intended to assist with this earlier before the egresses occurred).
19:42	The lead RCM in the KICC requests support from the London Underground Limited (LUL) Emergency Response Unit (ERU).
19:48	The LUL ERU is formally tasked by LUL Control to de-ice the conductor rail at Lewisham.
19:50	Network Rail South East Route Gold Strategic Commander arrives in KICC, transferring from the Cottons Centre.
19:51	The LUL ERU departs Stratford.
19:54	The LUL ERU response is upgraded to a "blue lights" response.
19:52	Further egresses are reported from train 2H50.
19:56	A Southeastern Operations Manager and two DMs arrive on site having been dispatched by the Southeastern Gold Command in the KICC to assist the evacuation of train 2M50, but upon arrival the RIO recommends they assist train 2M48 instead where there is more need of additional help.
19:59	Staff on train 2M48 confirm that the line country-side of Lewisham station is clear of people.
20:00	Network Rail South East Route Permanent Way and Signalling and Telecommunications (S&T) personnel arrive on site and are sent by the RIO to assist with de-icing and containing egresses from trains 2M50 and 2M48.
20:01	Attempted controlled evacuation of train 2M50 through the front cab with assistance from BTP and other emergency services.
20:06	Uncontrolled evacuation of train 2M50 commences as passengers open all doors and several hundred passengers exit the train towards the platform at Lewisham station, emergency services personnel act to bring evacuation back under control by bringing additional ladders to the other doors.
20:09	BTP request attendance of London Metropolitan Police to assist with public order on the platform, as some passengers are reported as becoming aggressive and there are insufficient BTP personnel to escort passengers from the train and remain on the platform.

20:16	BTP request police air cover but the helicopter requested is unable to fly due to the weather.
20:18	The LUL ERU arrive on site near train 2M50 and make contact with the RIO who directs them to assist with evacuation of passengers from train 2M50.
20:20	Several more passengers egress from train 2M48 and walk towards Blackheath. The DM travelling on the train follows them to ensure their safety.
20:31	Metropolitan Police arrive at Lewisham station to assist with public order.
20:33	An egress handle is activated on train 2S54 although it is unclear if any passengers exited the train.
20:34	LFB contacted Kent Fire & Rescue to ask for their drone. Subsequently not deployed since RIO took responsibility for getting all passengers, emergency service personnel and railway staff clear of tracks prior to re-energisation.
20:51	Further egresses are reported from train 2H50.
20:52	Train 2M50 is now empty and the line around it is confirmed clear of passengers; the RIO returns to assist train 2M48.
20:53	BTP note the attendance of LAS personnel to a casualty on the tracks.
21:03	Further egresses are reported from train 2H50.
21:06	Egresses are reported from train 2R46 while the KICC and ECR are liaising over the potential for recharging the electrical traction current (the egresses delay the recharge further).
21:16	Further egresses are reported from train 2S54.
21:25	The RIO calls for the signallers to advise all drivers of a 5 mph speed restriction as a precaution so as to minimise risk to any persons still on the track who may have been missed when determining whether the tracks are clear.
21:36	Having established all lines are clear of passengers, emergency services personnel, and railway staff, the electrical traction power is restored to all lines.
21:48	Train 2M48 prepares to move forward by first rolling back ~10 feet in order to take power.
21:51	KICC informs the signallers of authorisation to bring train 2M50 into Lewisham station under EPW in order to clear Lewisham Vale Junction. This is deferred as the train is still powering up and train 2M48 ahead is rolling back.
21:53	Train 2M48 moves away towards Blackheath, clearing the overlap of signal L447 and enabling train 2M50 to be brought into the station without using EPW.
21:57	Train 2M50 arrives empty at platform 4 of Lewisham station, clearing the Lewisham Junction, while train 2S54 arrives at platform 2 clearing Tanners Hill Junction.
21:58	Train 2H00 begins to move.
21:59	Train 2R46 is still powering up. Train 2H50 is having difficulty building up air pressure in the train's braking system due to completely flat batteries. Southeastern technical staff arrive on site having been dispatched earlier by the Southeastern Metro Duty Controller (MDC) to restart the train's electrical systems; the signallers develop a plan to send trains 2R48 and 2S56, currently trapped by train 2H50, back to London Bridge while evacuating train 2H50 via a rescue train.
22:01	The LUL ERU is redeployed to New Cross to assist with the stranded trains in that area.
22:02	Train 2H02 begins to move.
22:13	Train 2H50 is successfully restarted and now powering up. Plans to evacuate train 2H50 and send trains 2S56 and 2R48 back to London Bridge are cancelled.
22:16	Train 2H50 begins to move, freeing trains 2S56 and 2R48.
22:27	Train 2M48 is ready to continue its journey from Blackheath, having had additional de-icing equipment brought to the train by the police following further difficulties drawing power en-route to and at Blackheath. Southeastern DMs accompany the drivers on trains 2M48 and 2M50 for the remainder of their respective journeys (re-routed via Bexleyheath, which was judged the least likely route to cause further problems drawing power due to ice formation on the conductor rail).
22:29	All trains reported to the KICC as ready to move or moving, including trains 2R46, 2S56 and 2R48.
22:37	The LUL ERU is redeployed back to Lewisham but is stood down not long after arrival as the incident is over.

Diagram of track layout and stranded train locations

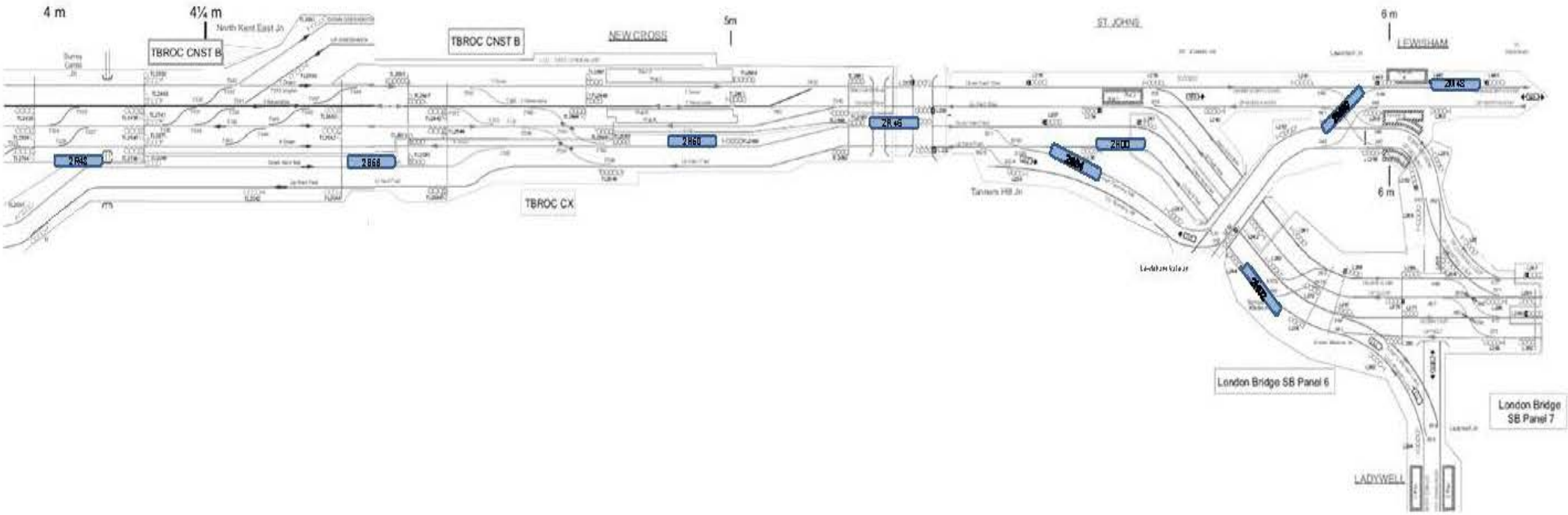

Figure 1: Map of track layout and stranded train locations

Appendix C: JESIP Background and Principles

The findings from a number of reviews of major national emergencies and disasters made clear that the emergency services carry out their individual roles efficiently and professionally. However, there were some common themes relating to joint working where improvement was needed. The Joint Emergency Services Interoperability Principles (JESIP) guidance was established to address these issues:

- Challenges with initial command, control and coordination activities on arrival at scene (sometimes called the "Golden Hour").
- A requirement for common joint operational and command procedures.
- Role of others, especially specialist resources and the reasons for their deployment, not well understood between services.
- Challenges in the identification of those in charge at the scene leading to delays in planning response activity.
- Misunderstandings when sharing incident information and differing risk thresholds not understood.

JESIP is designed to ensure that the initial multi-agency response to all incidents is more organised, structured and practiced.

The Investigation Team has used the JESIP principles (see Figure 2) throughout the investigation as a model for effective inter-agency working and command structure. In particular, the "shared situational awareness" principle was one that the Investigation Team returned to throughout the investigation because for this incident there was very little, and this was an important contributor to the incident response.

Source: JESIP website

Figure 2: JESIP principles