OFFICE OF RAIL REGULATION

# The track obstruction by a road vehicle and subsequent train collisions at Great Heck 28 February 2001

*A report of the* Health *and* Safety Executive *investigation*

HSE

**HSE** BOOKS

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# THE TRACK OBSTRUCTION BY A ROAD VEHICLE AND SUBSEQUENT TRAIN COLLISIONS AT GREAT HECK 28 FEBRUARY 2001

## Contents

## 1. FOREWORD

1.1 This report sets out the findings of the Health and Safety Executive's (HSE) technical investigation into the obstruction of the track by a road vehicle and subsequent train collision at Great Heck on 28 February 2001. Six passengers and four railway staff were killed and a further 82 people suffered serious injuries. HSE expresses its deepest sympathies to the bereaved and to those who were injured.

1.2 HSE published an interim report on the collision on 6 March 2001. A number of major policy issues relating to the collision were the subject of a Health and Safety Commission (HSC) report: 'Obstruction of the railway by road vehicles', published in February 2002. Recommendations from the HSC Report are being taken forward by the Department for Transport and the Highways Agency. Although the direct cause of the incident was established at the time, this report further examines what happened, and the rail specific issues arising the collision.

1.3 The circumstances surrounding the incident are that on the morning of Wednesday 28 February 2001 near Great Heck, 11½ miles north of Doncaster, a road vehicle towing a loaded trailer ran off the M62 motorway just before a bridge carrying the motorway over the East Coast Main railway line (ECML) between Doncaster and York. The vehicle and trailer ran down the motorway embankment and came to rest obstructing the southbound (Up) line. Shortly afterwards, at about 06.13hrs, the vehicle was struck by an Inter City 225 (IC225) passenger train. This was 1F23 the Great North Eastern Railways (GNER) 04.45hrs Newcastle to London Kings Cross service.

1.4 As a consequence of this collision the leading vehicle of the train became derailed. The train ran in this condition for some distance until a trailing turnout from a freight terminal at Plasmor Sidings. This deflected the derailed leading end of the passenger train further towards the Down line and into the path of a north bound freight train. This was 6G34 the Freightliner Heavy Haul 05.00hrs Immingham to Ferrybridge service.

1.5 A collision occurred in which both trains were extensively damaged and derailed. Wreckage was spread over a considerable area blocking both lines and causing considerable damage to the railway infrastructure.

1.6 The emergency services received many calls to attend and managed the incident with a high level of efficiency and effectiveness.

1.7 The severity of the second collision resulted in the deaths of 10 people and a further 82 people being taken to hospital, many with serious injuries.

1.8 The incident occurred during the hours of darkness. The weather at the time was cold with intermittent sleet showers, the temperature being just above freezing.

1.9 HSE's Her Majesty's Railway Inspectorate (HMRI) was informed of the incident at 06.55hr by telephone from Railtrack Zone Control and initiated emergency call out arrangements. HMRI inspectors were on site by 09.24hrs. Details of their ensuing investigations are contained in this report.

1.10 Removal of damaged vehicles commenced on Sunday 4 March and continued until Wednesday 7 March 2001. On Wednesday 7 March the site was handed back to Railtrack by British Transport Police. Following repair to the damaged infrastructure the railway was reopened to traffic on Tuesday 13 March 2001.

## 2. EXECUTIVE SUMMARY

2.1 The initial derailment of 1F23 was as a result of a collision with a Land Rover obstructing the Up line at a location near to where the M62 motorway crosses the East Coast Main Line. The speed of the train at the time of the collision was thought to be at or near the line speed of 125 mph.

2.2 The subsequent collision between the passenger and freight trains arose through a combination of factors including the location of the turnout to Plasmor sidings, deflection of the derailed leading vehicle of the passenger train and the approaching freight train heading north on the Down Line.

2.3 Early in the investigation it became apparent that the incident was related to the initial impact with the road vehicle and unlikely to be associated with any failing in respect of Health and Safety legislation by the railway infrastructure controller (Railtrack) or the train operators (GNER and Freightliner).

2.4 All the railway companies who commissioned technical investigations by consultants agreed to the findings being shared. All the investigative work was subjected to critical review by HSE.

2.5 A significant role of HSE became the provision of technical advice and guidance on incident related railway issues to British Transport and North Yorkshire Police.

2.6 The driver of the Land Rover was subsequently convicted of ten charges of causing death by dangerous driving at Leeds Crown court on 13 December 2001 and sentenced to five years imprisonment.

2.7 The railway industry, under the direction of Railway Safety, carried out a formal inquiry into the circumstances of the incident that resulted in a number of recommendations. A summary of the main recommendations is included in an appendix to this report.

2.8 At the request of the Deputy Prime Minister the Health and Safety Commission set up a working group to examine the obstruction of railway lines by road vehicles. The HSC findings have been set out in a report titled *Obstruction of the railway by road vehicles*.

2.9 During the subsequent investigation by HSE and the railway industry no defects were found with the infrastructure, rolling stock or personnel competencies that could have contributed to the outcome of the incident.

2.10 Condition of the road infrastructure complied with standards applicable at the time of the collision. Recommendations within the Railway Safety and HSC reports have initiated actions to review the adequacy of these standards.

2.11 During the course of the incident six passengers and four train crew were fatally injured and a significant number of passenger and train crew received varying degrees of injury.

2.12 The closing speed of the trains involved in this collision was estimated to be in the region of 142 mph. The severity of the collision was outside the parameters of all recognised crashworthiness standards. However, bearing in mind the high closing speed, it is the opinion of the investigators that the rolling stock performed adequately in terms of crashworthiness in that survival space was to a large extent maintained.

2.13 HSE has initiated further research into the effects of collisions with obstructions in relation to different passenger train formations, and the containment of fuel in diesel tanks.

## 3. COURSE OF EVENTS

3.1 The initial event occurred just to the south of a bridge where the M62 Hull to Liverpool and Manchester motorway crosses over the ECML near the village of Great Heck. This bridge has the railway designation EC2/8A and its south face is located at the railway mileage of 167.57 miles from Kings Cross. The secondary collision between the two trains took place to the south of a road bridge with the railway designation EC2/7, carrying Pollington Lane over the ECML. This bridge is at a railway mileage of 167.18 miles from Kings Cross to its south face. The location of the incident site is shown in **Figure 1**.

To the south of the M62 bridge there are parallel and straight sections of the East Coast Main Line, without significant gradients. The maximum permissible line speed is 125 mph (200 km/h). These lines pass beneath a bridge at Green Lane before a trailing turnout connects a freight yard, known as Plasmor Sidings, to the Up line just before the Pollington Lane bridge, close to Great Heck village.

A simplified diagram of the layout of the railway lines, to the south of the M62 bridge in the vicinity of Great Heck, at the time of the collision, is shown in **Figure 2**.

The “Up” direction of travel is towards London. The terms 'right' and 'left' used in vehicle descriptions are those when facing the direction of travel of a train.

The track terminology used is defined in **Figure 3.**

3.2 The sequence of events which led to the collisions on Wednesday the 28 February 2001 have been deduced from site investigation, witness statements, post incident examination and investigation, and the data recorder from the locomotive of the freight train. This process has been aided by the railway industry making their technical reports freely available to the HSE.

The sequence of events that follows for the collision of the IC225 and the freight train attempts to explain the main events. As a consequence of the train speeds, the complex interaction between the impacting moving vehicles, the position and nature of fixed railway structures, and the terrain in the vicinity of the railway, no precise mapping of events is possible.

3.3 The make up of both trains is shown diagrammatically in **Figure 4** and described in detail in section 7.

3.4 The M62 bridge was equipped with safety barriers that were fully compliant with existing standards. They protect motorists from collision with the bridge parapet itself while also acting as a barrier capable of containing light vehicles which leave the carriageway and which might otherwise encroach on the railway below. A Land Rover towing a trailer loaded with a Renault Savanna estate car left the M62 hard shoulder of the westbound carriageway some distance before the barrier. They traversed the steep road embankment and then continued down a railway embankment, with the Land Rover coming to rest fouling the Up mainline on the south side of the bridge. The distance travelled from the motorway to the Up line was over 115 metres. It was considered to have left the motorway when the nearside wheel crossed the kerb defining the edge of the motorway hard shoulder. The jack-knifed trailer became detached and came to rest on the embankment close to the Land Rover, with the displaced estate car resting next to it but clear of the Up line.

3.5 The uninjured driver attempted to reverse the vehicle from the track, but was unable to do so. The driver then left the vehicle and used a mobile telephone to call the emergency services. During this conversation, at about 06.13hrs, the south bound 04.45hrs Newcastle to London Kings Cross IC225 struck the Land Rover. The IC225 had a driving van trailer (the DVT) leading nine Mark 4 coaches, and a Class 91 locomotive (the Class 91) propelling in the rear. It is considered that there was probably sufficient 'sighting distance' of the Land Rover obstructing the line for the IC225 driver to have made an emergency brake application just prior to hitting the Land Rover, but this cannot be verified.

3.6 The Land Rover was about 11 metres south of the M62 bridge. At impact the IC225 is considered to have been travelling at between 120 and 125 mph. The impact caused the leading bogie on the DVT to derail at a distance of 48 metres beyond the impact point. The remains of the Land Rover following the impact, and the adjacent motorway embankment down which it travelled are shown in the photograph in **Figure 5**.

3.7 After derailment the two wheelsets of the leading DVT bogie settled into running parallel with the rails, with the left-hand wheels running between the rails and near to the track centre line. The right-hand wheels ran on the ballast between the tracks just clear of the Up line sleeper ends. The impact with the Land Rover was on the DVT left hand side, causing minor damage to the bottom edge of the buffer and obstacle deflector. A jumper socket and part of the DVT fibreglass skirt in front of the obstacle deflector were torn off.

3.8 The IC225 continued south, staying substantially in line and upright, with the brakes fully applied and the DVT leading bogie derailed, passing beneath the Green Lane bridge, until reaching the trailing turnout at Plasmor Sidings, 515 metres from the point of impact.

3.9 The 05.00hrs Immingham to Ferrybridge freight train (6G34), hauled by a Class 66 locomotive (number 66521), was made up of 16 fully laden bogie wagons carrying an estimated 1758 tonnes of coal. The freight train was running within permitted speeds and slightly early on what had been an uneventful journey. It was braking for a speed restriction associated with embankment stabilisation works to the north as it approached the subsequent point of impact.

3.10 At Plasmor Sidings the turnout closure rail, crossing from left to right between the rails of the Up line, was contacted by the derailed left-hand wheels of the leading DVT bogie. The closure rail is shown in **Figure 6**. As these wheels were running close to the centre line of the track, they were deflected to the right, such that the leading bogie was pushed over into the space between the lines (the six-foot). The wheels of the trailing bogie also became derailed at this time, moved towards the right, stabilised, and then ran parallel to the rails in a manner similar to the leading bogie earlier. The wheels of the leading bogie of the DVT became airborne, after striking the turnout closure rail, for a distance of approximately 23 metres. They landed on the foot of the Down line six-foot rail, having contacted a redundant turnout switchset (also shown in **Figure 6**) located between the Up and Down lines. All the wheels of the leading bogie of the DVT were then running in the six-foot as it approached the bridge at Pollington Lane, such that the leading end of the DVT was fouling the Down line. The displaced leading end of the DVT impacted the freight train at a point estimated within 29 metres of the southern face of Pollington Lane bridge and about 642 metres from the impact with the Land Rover. The estimated position of impact is derived from the best technical evidence and is at variance with the recollections of an instructor/driver on the Class 66 locomotive. Immediately prior to the impact of the two trains, the speed of the IC225 has been estimated as 88 mph, and that of the freight train as 54 mph.

3.11 As a result of the second impact the IC225 train was completely derailed. The DVT and leading eight coaches descended the Up line cess embankment into an adjacent field to the south of the Pollington Lane road bridge. The trailing coach and Class 91 locomotive remained upright astride the Up running rails. The Class 66 freight locomotive was also completely derailed along with eight of the sixteen wagons. The locomotive and two wagons came to rest in a garden adjacent to the Down line on the north side of Pollington Lane road bridge. The aerial photograph at **Figure 7** shows where the trains eventually came to rest, and the coach and wagon identification numbers used subsequently in this report. Distances are referenced to the south face of Pollington Lane bridge, 613 metres from the initial impact with the Land Rover. The location of passenger vehicles is illustrated in greater detail in **Figure 8.**

## 4. <u>THE INVESTIGATION BY HSE</u>

4.1 The overall aim of the investigation by HSE was to:

- record as accurately as possible the sequence of events and in particular those related to the derailment;
- identify any underlying causes and compliance with Health and Safety legislation;
- ensure a thorough and definitive technical examination of the site and rolling stock in order to identify any improvements to railway safety and the crashworthiness of rolling stock.

4.2 Following telephone contact between HSE's HM Railway Inspectorate and Railtrack London North Eastern Zone Control (York) at 06.55hrs emergency call-out arrangements were initiated. HM Railway Inspectors were on site by 09.24hrs.

4.3 Immediate site liaison was established with the emergency services and key railway industry representatives, who were still fully involved in the rescue phase of the operation. Early discussions were held with North Yorkshire Police and British Transport Police (BTP) to implement the work-related deaths protocol that HSE has with police forces and the Crown Prosecution Service (CPS). This protocol acknowledges that in the case of work-related death on the railway HSE and BTP both have different, but related, roles and responsibilities. North Yorkshire Police and BTP have responsibility to investigate the possibility of negligence, manslaughter (due to individual or corporate failures) in connection with any deaths, and also have a role in assisting the coroner. HSE is responsible for enforcement of relevant health and safety legislation. In accordance with the protocol, the Great Heck incident became a joint investigation, with HSE managing the technical issues, while North Yorkshire Police and BTP explored potential manslaughter issues.[1] Throughout the investigation there was excellent co-operation and liaison between all teams.

4.4 HSE maintained a team at Great Heck for eight days following the incident. In addition to railway inspectors, HSE called on the services of photographic and mechanical engineering experts from its Health and Safety Laboratory (HSL). Evidence recovery and management was carried out under HSE/BTP supervision, which allowed controlled access to nominated parties drawn from the organisations listed in 4.5 below.

4.5 Access was granted to staff from Great North Eastern Railway Ltd and their consultants Interfleet Technology Ltd, HSBC Rail (UK) Ltd and their consultants WS Atkins Rail Ltd, and Railtrack PLC and their consultants AEA Technology Rail. AEA Technology Rail concentrated on the initial impact with the Land Rover and subsequent derailment, while Interfleet Technology Ltd addressed traction and rolling stock issues and WS Atkins Rail Ltd rail vehicle crashworthiness.

4.6 It became apparent early in the investigation that the cause of the incident was related to the initial impact with the Land Rover and it was unlikely that there had been any failing by the railway infrastructure controller or train operators in respect of health and safety legislation. It was agreed at this stage that the findings of any technical investigations carried out by the consultants identified in 4.5, including those carried out off-site, would be made freely available to all parties. A schedule of reports and other information is detailed in **Appendix 1.** This working relationship proved to be successful.

4.7 The main role of HSE became the provision of technical advice and guidance on incident related railway issues to the British Transport Police and

[1] The workplace death protocol accepts that when the police/CPS decide that a charge of manslaughter or any other serious offence cannot be justified, HSE will continue with its own investigation in relation to breaches of health and safety legislation.

North Yorkshire Police. At a later date the investigative work undertaken by the railway company consultants was subjected to critical review by the HSL.

4.8 The technical investigation led to the production of detailed technical reports by the railway company consultants. Railway Safety carried out the industry formal inquiry into the incident, and the recommendations of the inquiry are summarised in **Appendix 2**. The detailed technical reports by the rail industry consultants are summarised in the relevant chapters of this report.

4.9 Because of the considerable public concern about the collisions HSE made the facts of the collision known as quickly as possible. An interim report was published on the 6 March 2001, seven days after the incident, summarising the findings from the first six days of investigation.

4.10 After the site investigation further investigations by North Yorkshire Police and BTP into possible manslaughter implications of the collision continued with the HSE providing technical support. The driver of the Land Rover was subsequently convicted at Leeds Crown Court on 13 December 2001 of ten charges of causing death by dangerous driving, and sentenced to five years imprisonment.

4.11 At the request of the Deputy Prime Minister the Health and Safety Commission convened a working group to examine the obstruction of railway lines by road vehicles. The group's work has been taken forward alongside that of a group established by the Highways Agency to consider the provision of nearside safety fences on major roads. The HSC findings have been set out in their report *Obstruction of the railway by road vehicles* which was published in February 2002. The main recommendations of this report are contained in **Appendix 3**.

## 5. DETAIL OF DERAILMENT OF THE TRAINS INVOLVED

### The track obstruction by the Land Rover and subsequent IC225 collision

5.1 The Land Rover involved in the initial collision was a Defender 110 CSW 2.5 Tdi with a kerb weight of 1.91 tonne. The trailer carrying the Renault car detached as the Land Rover came to rest obstructing the track, and was approximately 45 degrees to it. The car had part slipped from the trailer and lay alongside the Land Rover such that the driver's door could not be opened.

5.2 At the place where the Land Rover obstructed the track the ballasted area falls away by some 0.2 metres over a distance of 2 metres to a concrete cable trough. The ground was level over a further metre before the start of a grass covered embankment, which had a typical slope of 22 degrees. The space alongside the line is known as the 'cess'.

5.3 The left front wheel of the Land Rover was between the rails of the Up line, such that it was slewed at approximately 45 degrees to it, and facing north, towards the IC225. The front wheel was 11.5 metres from the south face of the M62 bridge. The nearside Land Rover tyre was deflated, the consequence of tyre penetration by a broken wooden fence post.

5.4 Impact with the Land Rover caused the leading wheelset of the leading DVT bogie to derail at 21.5 metres from the impact point, followed shortly afterwards by the second wheelset of the same bogie at a distance of 48.2 metres.

5.5 The trailer and car it was carrying took little part in the collision with the train, and their position was little changed by the Land Rover/IC225 impact.

5.6 The main body of the Land Rover came to rest pointing south, parallel to the Up line, in the cess. The impact spun the Land Rover through an estimated 495 degrees (nearly 1½ rotations) in an anti-clockwise direction before it came to rest 18 metres south of the impact point. Blue paint marks on the roof suggest that during this rotation a glancing contact was made with the side of the DVT or subsequent coaches.

5.7 Much of the Land Rover equipment and superstructure were detached as far back as the rear of the driver's door. The engine unit remained intact and came to rest in the rear of the Land Rover at the side of the Up line, 11 metres from the impact point. Debris from the Land Rover was scattered alongside the Up line as far as the Green Lane bridge, 150 metres from the impact point.

5.8 It is likely that the first contact was between the offside (driver's side) wing of the Land Rover and the left side buffer of the DVT. Progressive collapse of the wing followed by shattering of the radiator and pulley system brought the buffer into contact with the substantial mass of the engine. Until this time it is unlikely that the Land Rover moved significantly from its initial position.

5.9 In an attempt to explain how the Land Rover brought about the derailment of the IC225 substantial computer modelling was undertaken by AEA Technology Rail. This established that the passing of an object of greater than 10 millimetres diameter under the right-hand leading DVT wheel, together with the impulse imposed on the DVT body by the Land Rover, was the likely cause of the derailment.

**The effect of Plasmor Sidings turnout on the derailed IC225**

5.10 After hitting the Plasmor Sidings closure rail the leading end of the DVT was redirected towards the Down line. As noted earlier (in 3.10), a redundant switchset was lying out of use in the six-foot south of the Plasmor Sidings turnout. The underside of the obstacle deflector in front of the leading DVT bogie and the right-hand leading wheel made contact with these. There was no evidence that they influenced the movement of the IC225 train and its subsequent collision with the freight train.

5.11 With the six-foot rail of the Down line initially guiding the leading end the DVT took up a slewed position, at an angle of about 9 degrees to the Up line. As the IC225 approached impact with the freight train the slew angle reduced to about 6 degrees.

5.12 When the two trains met, the near centre of the DVT front and the right-hand edge below the Class 66 cab, would have been the first point of contact, at headstock height. Just before impact the front right side of the DVT would have filled the view from the right cab window of the Class 66, a consequence of the estimated 0.9 metre overlap.

**The collision between the IC225 and the freight train**

5.13 The collision mechanism is thought to have involved the Class 66 overriding the DVT underframe, a consequence of the DVT floor structure being considerably lower in the derailed condition than that of the Class 66. The DVT cab was severed from the main body shell during the impact, with consequential damage to the right-hand side of the Class 66 cab. The DVT cab was thrown clear, coming to rest further along the Up line, 145 metres south from Pollington Lane bridge. The Class 66 continued to override causing massive damage to the leading end of the DVT. The obstacle deflector and the leading end bolster (the underfloor structure to which the leading bogie was attached) came to rest on the Up line embankment some 55 metres and 70 metres south of the bridge respectively. During this time the DVT leading bogie impacted with the leading Class 66 bogie. A large part of the Class 66 bogie became detached and penetrated the front side of the leading Coach M, coming to rest in the interior, having caused severe damage to the leading right-hand side. The leading Class 66 bogie was then pushed back into the fuel tank causing it to rupture and spray fuel oil onto the leading IC225 coaches. The impact pushed the leading end of the Class 66 locomotive to its left (west). The DVT was also forced to its left (east) resulting in breaking of the Up line rails. The leading Wagon N17 was pushed under the rear of the Class 66 locomotive, and the wagons in the leading section of the formation began to override each other and derail. Some of the wagons became laterally misaligned.

5.14 As the DVT slowed, the force from the following vehicles of the train caused the leading end of the following Coach M to override the DVT, resulting in breaking of the coupling between the two and the shearing away of the rear of the DVT body. As the front of the DVT was trapped beneath the Class 66, it was forced to rotate clockwise, taking the leading end of Coach M with it. The first overhead electrification stanchion, south of the Pollington Lane bridge, was uprooted by the impact with the side of the displaced Coach M. The leading end of Coach H, was also forced upwards such that the leading part of the roof contacted the southern underside of Pollington Lane bridge. The impact shock wave travelled down the train causing the coaches to collide end to end. At about this time the coupling between Coach H and G parted. The trailing end of Coach G and leading end of Coach F were forced upwards, such that the coupling between the two broke. The trailing end of Coach G also hit the northern underside of the Pollington Lane bridge resulting in flattening of the front half of the roof and the ripping away of the remainder. Bridge contact with the roof of Coach F also resulted in it being flattened and part torn away at the leading end.

5.15 After release by the Class 66, the DVT with Coach M traversed the embankment, and as the coupling was still intact, Coach H followed. It is likely that Coach M started to roll towards its left side. Although derailed Coach G continued along the Up line and collided with the trailing end of Coach H. This pushed Coach H further down the embankment and caused the leading end of Coach G to slew clockwise such that it contacted with Wagon N2. As Coach G slowed it was impacted by Coach F. This forced the trailing end of Coach G onto the embankment, and also trapped the front of Coach F between Coach G and the freight train. The leading left side of Coach G demolished the second overhead electrification stanchion south of the bridge. The right side of Coach F scraped the sides of the Class 66 and Wagon N17.

5.16 On reaching level ground at the base of the embankment, Coach H dug into the soft turf, with the consequence that the coupling between Coaches M and H parted in tension. Coach H then came to rest in an upright position 80 metres from the bridge, at an angle of about 45 degrees to the embankment.

5.17 Coach G was slowed further when it impacted with the leading end of Wagon N3. This action guided the front of Coach F into the leading end of Wagon N2. Severe damage to coaches and wagons resulted, so much so that the body shell of Coach G started to buckle. A large vertical indent was also formed towards the trailing end of Coach F, as can be seen in **Figure 12**, from floor to near roof level, probably caused by one or more trapped detached coach bogies. Coach F was rotated about its leading end by about 130 degrees so that it faced the road bridge, but the coupling to Coach E remained intact. The trailing end of Coach F and the leading end of Coach E rose high into the air, both vehicles becoming inverted as they were pushed along. The high forces caused further buckling of the body shell of Coach F, in the area previously weakened by the floor penetration. The leading end of Coach D was forced down the embankment by the manoeuvres of Coach E, which caused the coupling to part between the two.

5.18 The trailing end of Coach F landed upside down and slid to the leading end of Coach G, thereby squashing the leading half of the Coach G body shell. Coach G came to rest on the embankment at an angle of about 20 degrees to the lines, as shown in **Figure 13**, and with the leading end on the Up line. Coach E came to rest on its roof, parallel to the lines. The trailing end of Coach H penetrated the trailing end of Coach E, as shown in **Figure 11**. Having been dragged partially onto its side by Coach E, Coach F came to rest on the embankment, at an angle of about 45 degrees to the lines. The leading end of Coach F was just resting on the leading end of Coach G and Wagon N10, such that it bridged the Up line.

5.19 Meanwhile, the heavily damaged DVT came to rest, facing away from the embankment, some 105 metres from the bridge, as shown in **Figure 9**. Coach M, on its left side, bounced onto and over the DVT and rotated further, such that the roof at the leading end contacted the ground. Still twisting, while the roof at the leading end slid along the ground, the coach body rotated through a further 180 degrees such that it came to land in an upright position, 130 metres from the bridge. Coach M had, therefore, described a complete 360 degree anti-clockwise roll before coming to rest, as shown in **Figure 10**, with the large fragment of Class 66 bogie still within the body shell.

5.20 As the Class 66 locomotive travelled under the Pollington Lane bridge the leading end, being raised by debris trapped beneath the Class 66, brought its roof into contact with the bridge underside, and remained so while passing under the full width (south to north) of the bridge. After emerging north of the bridge the trailing end of the Class 66 contacted the trailing end of Coach B. The following Wagons, N17, N2, N3, and N4, impacted sides of Coaches D, C, B and A and the leading end of the Class 91 IC225 locomotive. The Class 66 toppled onto its left side and started to slew off the Down line into a domestic garden. The soft soil of the garden seen in **Figure 15** slowed the Class 66 very quickly to a standstill. The following wagon, N17, also fell onto its side and jack-knifed, such that its top came to rest along the roof of the Class 66. Wagons N2 and N3 also toppled onto their left sides at the side of the Down line. Wagons N4 and N5 followed the path taken by the Class 66 and proceeding wagons. The Class 66 came to rest some 55 metres north of the bridge.

5.21 Coach D traversed the embankment and stopped 60 metres south of the bridge with a detached bogie, shown in **Figure 14**, embedded in its leading end. This bogie was probably that which caused the floor penetration of Coach F. Coaches C and B were dragged down the face of the embankment and stopped 40 metres and 15 metres south of the bridge. Coach A came to a standstill beneath the Pollington Lane road bridge on the line of the track with the Class 91 locomotive behind just to the north of the bridge, also correctly aligned on the track-bed.

## 6. <u>INFRASTRUCTURE ISSUES</u>

### Track

6.1 The permanent way through the site of the incident is straight from a location to the South of Templehurst Junction to Balne, a distance of some four miles. The track in the area consists of 113A lb/yd continuously welded flat bottom rail laid on F19 concrete sleepers. Both lines are similar with the exception of track fastening. The Up lines utilising SHC fastenings, while the Down line has Pandrol fastenings. Track and ballast in the area was last renewed in the mid 1990s.

6.2 The trailing turnout to Plasmor Sidings consists of a CV 9¼ turnout. Both left and right-hand switchsets had been renewed in October 2000 as a result of defects associated with gauge corner cracking.

6.3 In the course of the investigation both the track and maintenance records related to the track on either side of the crash site were examined. Balfour Beatty Rail Maintenance Ltd had responsibility for the track maintenance. The maintenance requirements are laid down in Railway Group Standards and Railtrack Company Standards. In summary these involve a hierarchy of visual inspection of the track, together with regular mechanised inspection using a track recording coach. The last inspection by the track recording coach on 9 and 10 February 2001 found no defects requiring attention.

6.4 Inspection for rail cracks, carried out every six months, had shown a problem with the turnout to Plasmor Sidings on 2 August 2000. As a result the turnout switchsets were replaced on 1 November 2000. The scrap switchsets were left on the formation, one in the cess and the other in the six-foot between the tracks, awaiting programmed removal on 10 March 2001.

6.5 As a result of embankment damage due to flooding the previous autumn speed restrictions had been in place on both the Down and Up lines at a location 1.5 miles to the north of the crash site. The speed restriction on the Up line was removed on the 26 February 2001, while that on the Down line remained in force. The problems with flooding had been reported in the media, and were, therefore, public knowledge.

6.6 On the 28 February a number of trains had passed over the route without incident. Freight train, 6T33, passed on the Up line just prior to the incident. An earlier train on the Up line, 9Z53, a Eurostar test train, had passed the site of the incident at linespeed at about 05.43hrs. A freight train, 6N81, passed on the Down line at about 06.00hrs. All drivers confirmed that they had experienced nothing untoward.

6.7 In summary no track deficiencies were identified that may have contributed to the incident.

## Signalling

6.8 Signalling in the vicinity of the incident is track circuit block with four aspect colour light signals. The majority of signals in the area are automatic and will show aspects dependent upon the occupancy of track circuits, or otherwise. Semi-automatic signals are provided at level crossings, and for the connection to Plasmor Sidings.

6.9 The incident site is on the boundary of the area controlled by York Integrated Electronic Control Centre (IECC) and Doncaster Power Signal Box (PSB). The initial collision occurred in the area controlled by York IECC, but the secondary collision occurred partly within the Doncaster PSB area. All signals are fitted with signal post telephones and the area is covered under the National Radio Network (NRN).

6.10 Following the initial derailment of the IC225, after collision with the Land Rover, damage to signalling cables resulted in signals in the area being replaced to danger and equipment failure being evident to the signaller at York IECC. Evidence from data recording systems concerning train movements indicated that there was nothing irregular prior to the incident.

6.11 Event times derived from signalling records, the Class 66 locomotive data recorder, and monitored trackside fibre optic communication cable that was damaged in the incident, were all in agreement.

6.12 All evidence indicates that the signalling systems were functioning correctly at the time of the incident.

**Fencing**

6.13 Regulations related to fencing alongside the railway are contained in the Railway Safety (Miscellaneous Provisions) Regulations 1997. Guidance on fencing is contained in the HSE publication *Railway Safety Principles and Guidance, Part 2, Section A7*. In essence, the requirements relate to the prevention of trespass and require a standard of fencing commensurate with the degree of risk of trespass. Post and wire fencing in the vicinity of the incident, to prevent or deter trespass on the railway, was found to comply with current regulations.

## 7. TRAIN EQUIPMENT AND CRASHWORTHINESS

### The IC225

7.1 The passenger train involved in the incident was an IC 225 ECML, train set number BN 56 (this refers to maintenance depot and set number). It is owned by HSBC Rail (UK) Ltd and leased and operated by GNER. The sets entered service in 1989 following electrification of the ECML, and run in fixed formations, with a driving van trailer (DVT) at one end of the rake of passenger coaches, and a Class 91 locomotive at the other. Arrangements are such that the locomotive was usually at the North end of the train so that it was propelling in the Up direction, and hauling in the Down direction.

7.2 The composition and weights of the passenger train vehicles involved in the incident are given below:

| **IC225 Passenger Train (1F23)** | | | | |
|---|---|---|---|---|
| Vehicle designation | Vehicle description | Emergency services number | Vehicle number | Mass (tonnes) [unladen coaches] * |
| DVT | Driving Van Trailer | - | 82221 | 44.3 |
| Coach M | Trailer First Open | M | 11224 | 39.7 |
| Coach H | Trailer First Open | H | 11213 | 39.7 |
| Coach G | Service Vehicle | G | 10322 | 45.5 |
| Coach F | Trailer Standard Open | F | 12306 | 39.4 |
| Coach E (labelled B) | Trailer Standard Open | B2 | 12525 | 39.9 |
| Coach D | Trailer Standard Open | D | 12516 | 39.9 |
| Coach C | Trailer Standard Open | C | 12412 | 39.9 |
| Coach B | Trailer Standard Open | B1 | 12413 | 39.9 |
| Coach A | Trailer Standard Open (end) | A | 12206 | 39.5 |
| Class 91 | locomotive | - | 91023 | 84.1 |
| *Masses derived from HSBC Vehicle Data Booklet: Issue1 November 2001 | | | | |

7.3 The IC225 trains operate in a formation known as push-pull, that is, they have a Class 91 electric locomotive at one end and a non-powered DVT at the other. As is standard practice for southbound passenger trains, the DVT was leading the IC225 train at the time of the incident. The nine passenger coaches that formed the main body of the train were of Mark 4 type. All vehicles of this train were derailed in the incident.

7.4 There are maintenance schedules specific to each vehicle of the train, with information held on a central database. Examination of the records found no maintenance or defects outstanding that could have contributed to the incident, or adversely affected the performance of the vehicles.

**The IC225 DVT**

7.5 The DVT has a driving cab at its front end with a large compartment for luggage in the centre, and an office for the conductor at the rear. The vehicle is 18.6 metres long. It has no power equipment or traction motors.

7.6 The driving cab is constructed from substantial steel beams and pillars to give protection to the driver. This frame is stronger below waist level, and is welded to the main structural members at floor and roof level. All other structural elements are lightweight, and support the steel floor, sides and roof. There are two external driver's doors into the cab and four large 'cargo' doors, divided equally between sides. There are small windows in the doors and the conductor's office, and a windscreen in the cab.

7.7 Below floor level the main structural members have attachment points for the bogies. The bogies are similar to those fitted to the coaches. Mounted beneath the cab, and in front of the bogie, an obstacle deflector is also securely attached to the longitudinal elements. The purpose of this structure is to push obstacles aside without damaging the bogie or derailing the train.

7.8 The requirement for an obstacle deflector came as a direct consequence of a train derailment near Polmont, between Glasgow and Edinburgh, on 30 July 1984. In this incident a diesel-electric locomotive was propelling six coaches. The leading coach incorporated a driving cab, and accommodation for a guard, parcels and passengers. While travelling at about 85 mph the leading coach collided with a cow. Some part of the animal passed beneath the leading wheels and caused them to leave the rails. This resulted in the first two coaches being badly damaged, and derailment of the rest of the train. Thirteen people were killed in the incident. The leading vehicle, termed a *Driving Brake Second Open*, was 20.7 metres long and weighed 33.5 tonne. The report on the incident recommended an increase in the axle-load of the leading vehicle, and that a deflector be fitted appropriate to the maximum speeds involved. Further investigation into the collision protection necessary for speeds over 100 mph was initiated.

7.9 The Great Heck DVT was designed shortly after the Polmont incident, and was one of the first vehicles to be designed and built with an obstacle deflector. There are no significant differences between the original design specification and current standards.

7.10 As the DVT was the first vehicle to collide with the Class 66 locomotive it suffered massive structural damage, resulting in large sections of the vehicle becoming detached and dispersed over the crash site. The leading end cab structure was sheared off, and a 3 metre length of body section following this totally destroyed. The floor structure beneath the cab also became separated, as did the obstacle deflector. The trailing end vestibule structure (the vestibule is the area adjacent to the corridor connection) was also sheared off at the under-frame, flattened, folded over and impressed into the main central portion of flattened body shell. Both bogies were detached; the leading one lost its leading wheelset.

**DVT crashworthiness**

7.11 Crashworthiness refers to the ability of a vehicular structure to protect the occupants in potentially survivable collisions. Specific aspects of this are the limiting of impact forces, managing the energy of collision so that adequate survival space is maintained, protecting this space throughout the course of the event, and providing protection against likely post-collision hazards, such as fire.

7.12 The IC225 DVT suffered massive global impact damage during the collision with the freight train, as shown in **Figure 9**. This was a consequence of the relatively lightweight nature of the DVT (45 tonnes) in comparison to the freight locomotive (127 tonne), and also the lower ride height that was further reduced by the DVT being derailed prior to impact with the Class 66. The driver's cab was demolished and separated completely from the underframe. Any crashworthiness features of the DVT were totally compromised by the masses and speeds of the vehicles involved in the collision.

**The IC225 Mark 4 coach**

7.13 The Mark 4 coach was introduced as part of the IC225 sets that were brought into service in 1989. They have an integrally constructed 23 metre long body. The bogies have disc brakes with three discs on each of the two axles, swinging arm and coil spring primary suspension, and secondary air suspension. Doors are of the 'plug' type, and power operated. Door locking is conductor controlled. All the coaches are air-conditioned. There are eight large flush mounted double glazed picture windows per side. The coupling between coaches takes the form of a centrally mounted automatic unit that does not require side buffers to be fitted to the ends of the vehicles. Such couplers transmit all the traction and braking forces.

7.14 Coach M came to rest in an upright position on level ground, as shown in **Figure 10**. This coach had forty-six seats. The leading end contained a large piece of the leading Class 66 bogie that had broken away and entered on the right side, cutting through the body side and removing the leading four windows. This completely compromised survival space at up to six seat locations. Above this the central ceiling panel had fallen away. Four windows on the left side were missing. The headroom was reduced over the trailing half of the coach due to the floor structure being significantly buckled. Many of the seats were detached from the floor. Both bogies and most of the under-floor equipment were missing, as were all but one of the four exterior doors.

7.15 Coach H, a forty-six seat vehicle, came to rest almost upright on level ground but with a 15 degree lean to the right, as **Figure 11**. The trailing end was embedded in the trailing left side of Coach E. The roof had sustained damage over the whole of its length, and over the trailing half, it was flattened down to window level. Internally many of the ceiling panels had fallen away or become dislodged thereby reducing headroom. Buckling had also raised the floor level towards the trailing end. The trailing end had been crushed from the top on the right side. Much of the under-floor equipment had detached, as had the bogies. The leading left and trailing right external doors had become detached. All the windows on the right side were broken, as were four on the left side. The floor buckling had reduced clearances between the seat and floor at eight seat positions.

7.16 Coach G came to rest in an upright position on the face of the embankment, as seen in **Figure 13**. This vehicle had twenty seats in the leading half, and a kitchen and buffet. The leading end had been heavily damaged. The roof over the seated portion had been flattened, while that over the kitchen and buffet had been torn away. The body shell was bent about a deep vertical crease at the mid-point of the right side. All but one of the windows in the seated area was broken. Both bogies and the under floor equipment had become detached. Internally survival space was completely compromised in the staff toilet and rest area, and at four seat locations. Buckling of the roof in the seated area had brought down ceiling panels and electrical equipment, which together with the buckled floor seriously reduced headroom. Large amounts of debris filled the kitchen and buffet area.

7.17 Coach F, a seventy-two seat vehicle, came to rest on its left side on the face of the embankment, as seen in **Figure 8**, with the leading end supported by Coach G and a freight wagon. At the leading end about 2 metres of the right side were missing. There was very significant damage to the floor about the sixth window position from the leading end, as shown in **Figure 12**, such that the floor met the folded roof, which eliminated survival space associated with twelve seats. Many seats on the right side had come loose, or had been removed by the emergency services. Due to significant distortion of the right side relative to the floor, survival space associated with the window seats down that side was reduced. Some of the ceiling panels and luggage racks had become detached. Survival spaces in the leading vestibule and toilet were also totally compromised. All windows were broken, and all four external doors missing. The underfloor equipment and bogies were missing.

7.18 Coach E, a seventy-two seat vehicle, came to rest upside down on level ground, with its right side punctured by Coach H towards the trailing end, as can be seen in **Figure 11**. This caused a total loss of survival space associated with eight seat locations. All but three of the windows were broken, and the external doors at the trailing end were missing. A part of the roof had been torn off over a length of about 4 metres towards the trailing end. Much of the under-floor equipment had been lost, as had the bogies.

7.19 Coach D, a seventy-two seat vehicle shown in **Figure 14**, came to a stand on level ground leaning at about 30 degrees to the left. The DVT leading bogie was embedded in the leading end of the coach, resulting in a total loss of survival space in the vestibule at this end. The right side had been seriously damaged beneath the first two windows at the leading end. The under-floor equipment had been seriously damaged, and both bogies were missing. Six windows were broken.

7.20 Coach C, a seventy-two seat vehicle, came to rest on the embankment inclined at 10 degrees to the right. Forward of the mid-point the floor in the central gangway was deformed upwards over the distance of two windows. A total of four windows were broken. The leading external door on the right side was missing. Some of the under-floor equipment had detached and both bogies were missing.

7.21 Coach B, a seventy-two seat vehicle, remained at the top of the embankment, resting on both bogies, which had remained attached. The right side had a deep gouge, below window level, down most of its length, which ran into an area of significant impact damage covering the last two window positions and the external door, which had been torn off. The roof above this area was also flattened. Four windows were broken. The under-floor equipment was still in place. Internally the coach was relatively undamaged.

7.22 Coach A, a seventy-two seat vehicle, remained underneath the bridge on the level track bed, with the bogies in place, though the leading bogie had become detached. The right side had been ripped open below window level over most of its length. The leading right side had been heavily impacted, resulting in the survival space in a toilet being reduced. The two small windows associated with the toilet and the following large window had been torn out, leaving a large jagged hole. The following three windows were broken. Seats on the right side of the coach were pushed towards the aisle by the deformation of the body side. The under-floor equipment was retained.

**Mark 4 coach crashworthiness**

7.23 These coaches are constructed in the form of a long box, containing the passenger seating, that forms the survival space in a collision. Crush zones, in the form of vestibules, are located at the ends of each coach. In an end-on collision it is these zones that collapse and absorb energy with the intention of maintaining the volume and integrity of the survival space.

7.24 The coaches of the IC225 passenger train had 99 occupants at the time of the collision, and a total seating capacity of 544. The first five coaches had a total seating capacity of 256 passengers and at the time of the incident carried 58. Forty-five of the fifty-two seriously injured persons were travelling in these five coaches (the location on the train of three people is unknown). Eight occupants of coaches M, G, F and E were fatally injured.

7.25 Generally the coaches performed well in the collision when subject to end on impact, having regard for the high energies involved, and the path the vehicles followed down the embankment after impact with the freight train. The first five coaches (Coaches M, H, G, F and E) had some of their survival space completely or seriously compromised by roof, floor, and side deformation, or penetration by missiles or other vehicles. Their ability to protect the occupants would also have been compromised by the openings formed when window glass was lost, and parts of the roofs were removed by impact with the bridge.

7.26 The coupling between vehicles of the train parted at six locations. Three of these were due to the coupling drawgear parting. Similar behaviour was also observed at the Hatfield derailment in October 2000. At two locations the couplers had uncoupled. This can happen if the couplers are inverted, or subjected to a sudden vertical movement, as the coupling mechanism is reliant upon gravity locking. This behaviour was also seen at Hatfield. Both the Class 91 locomotive and the trailing end of Coach A were equipped with dual-purpose coupler units, that can provide an automatic coupler head or a traditional hook coupler. They were being used in the automatic mode. The coupler head of the unit fitted to Coach A had fractured during the collision, thereby severing the coupling between the two.

7.27 The first coach (M) was penetrated by a large piece of the leading Class 66 bogie, seen in **Figure 10**, that was associated with the loss of survival space equivalent to about six seats. The next coach (H) suffered significant roof lowering and floor raising, by bridge and bogie impacts respectively, throughout most of the seated space. Coach G, the service vehicle, which only had seats in the leading half, suffered serious body shell distortion in this area, together with roof lowering and floor raising. The roof above the trailing half of the coach was ripped off, in the kitchen and buffet areas. There was total loss of survival space in the staff toilet and rest area. Survival space in the toilet at the leading end of Coach F was totally compromised, as were twelve seat locations towards the trailing end associated with the suspected vertical penetration of a bogie on the right side. The penetration of Coach H into the right side of Coach E was responsible for the complete loss of survival space at eight, or more, seat locations.

7.28 The seats in the First class coaches were of a different design to those in the Standard class. Generally, the Standard class seat structures retained their integrity and position (except where adjacent walls or floors had deformed), whereas many of the First class seats did not.

7.29 Many of the First class seat structures buckled, resulting in loss of space under the seat. In Coach M most of the seats became detached from the floor through failure of the holding down bolts, unlike those in Coach H. Many of the chromed arm rests also detached, and when completely free became potential missiles. The majority of padded headrests also became detached, which increases the risk of head injuries, and also results in further missiles.

7.30 In the first five Coaches (M, H, G, F and E) most of the tables had failed structurally. The heavy detached table surfaces then became potential missiles, and the remaining protruding metal legs posed a hazard. In the less severely damaged coaches, a fifth of the tables had become separated from the metal legs, but still remained attached to the wall.

7.31 In the kitchen area of Coach G, there were a large number of unsecured items with the potential for becoming missiles. Though the large items of equipment were adequately secured in this area, many had sharp edges with the potential for serious injury, as had the counters. The equipment used for at-seat catering, including cutlery and crockery, was found scattered throughout Coaches M, H and G.

7.32 Other items with the potential for missile formation were the fire extinguishers from the vestibule area that were found within seated areas (Coaches G and E). Adhesive labels applied to decorative glass partitions in most coaches were found to have provided reinforcement such that they prevented the toughened glass from fragmenting, thereby forming missiles. Waste bins were also found to have detached from their housings, with some evidence of their causing injury.

7.33 In smoking carriages it was noted that the wall mounted ashtrays had readily opened to expose metal spikes with the potential to cause injuries. It was also found that damaged glass magazine racks exposed prominent metal parts that protruded from the wall at head height.

7.34 Coach A was the only vehicle that had both interior vestibule doors operable. Exit via the vestibule areas of Coaches G, F and E was difficult, or impossible, due to structural damage to their body shells. In a number of instances toilet doors were found damaged, dislodged and jammed.

7.35 Fifteen of the eighteen coach bogies detached during the collision. In all cases the bolted connection between the central pivot and the underframe mounting broke. Similar failures were observed with the Mark 4 coaches involved in the derailment at Hatfield in October 2000. Though there are other components connecting a bogie to the underframe they appear to have insufficient strength to retain the bogie beneath the coach during derailments. Loss of bogies is often associated with coaches becoming unstable in a collision. Bogies that become separated from vehicles can become large obstacles or missiles capable of significant damage, as do wheelsets that become separated from bogies.

7.36 Each Mark 4 coach bogie has two wheelsets. Out of the total of thirty wheelsets associated with detached coach bogies, eight became completely free from their bogie frame. All were from the first four coaches of the train (Coaches M, H, G and F). During the Hatfield derailment no wheelsets were shed from the bogies, an indication of the severity of the collision at Great Heck.

**The IC225 Class 91 locomotive**

7.37 The Class 91 electric locomotive is 19.4 metres long, and carried on two bogies, with two wheelsets in each bogie, and each of these is driven by a traction motor. The computer controlled traction power system ensures there is no wheel slip and that optimal control of acceleration and braking is carried out. The locomotive was not fitted with a data recorder, but these will be fitted during a current fleet refurbishment programme. This unit had not suffered any significant damage, other than to the bogies due to derailment. By coincidence this was the same locomotive that had been involved in the Hatfield derailment in October 2000 after which the locomotive was restored to full operating condition.

**The Freight Train**

7.38 The freight train involved in the incident was 6G34, the 05.00hrs Immingham to Ferrybridge service, conveying coal from Immingham docks to Eggborough power station. The train was operated by Freightliner Heavy Haul and consisted of a Class 66 diesel electric locomotive and sixteen bogie hopper wagons. The locomotive and first nine wagons of this train were derailed in the incident.

7.39 The locomotive and wagons were of recent manufacture, and entered service in December 2000. The consist of the train is detailed below:

| **Freight Train 6G34 (from the leading end)** | | | |
|---|---|---|---|
| Vehicle description | Emergency services number | Vehicle number | Nominal mass (tonne) [laden wagons] |
| Class 66 locomotive | - | 66521 | 127 |
| HHA wagon | N17 | 370003 | 102 |
| HHA wagon | N2 | 370006 | 102 |
| HHA wagon | N3 | 370009 | 102 |
| HHA wagon | N4 | 370017 | 102 |
| HHA wagon | N5 | 370016 | 102 |
| HHA wagon | N6 | 370018 | 102 |
| HHA wagon | N7 | 370015 | 102 |
| HHA wagon | N8 | 370004 | 102 |
| HHA wagon | N9 | 370013 | 102 |
| HHA wagon | N10 | 370010 | 102 |
| HHA wagon | N11 | 370008 | 102 |
| HHA wagon | N12 | 370002 | 102 |
| HHA wagon | N13 | 370011 | 102 |
| HHA wagon | N14 | 370014 | 102 |
| HHA wagon | N15 | 370005 | 102 |
| HHA wagon | N16 | 370007 | 102 |

7.40 The Class 66 was fitted with a Qu-Tron on train monitoring recorder that was fully operational at the time of the incident. Included in the record were details of time and date, speed, distance, brake and automatic warning system (AWS) operation.

**The freight train Class 66 locomotive**

7.41 The Class 66 diesel locomotive, which weighs127 tonnes and has a top speed of 75 mph, was first brought into service in late 2000. It has very robust bodywork and underframe that form an extremely stiff structure, with driving cabs at both ends. The engine is mounted centrally within the main body of the vehicle, and drives an electric alternator. It is carried on two bogies with three wheelsets in each bogie, and has an electric traction motor for each wheelset. A fuel tank of 6550 litre capacity is bolted to the underside of the underframe.

7.42 Following collision with the IC225 DVT the locomotive came to rest on its left side on level ground, as shown in **Figure 15**. It was heavily damaged on the front and right side, and below the cab in the vicinity of the missing right buffer, with part of the DVT embedded below the right front window. The interior of the leading cab was mainly intact, but all the windows were broken. The two drivers seats were undamaged and fixed to the floor. The survival space about the right-hand seat had been reduced below waist level. The trailing cab had also sustained impact damage, but the interior survival space had not been affected. Both the end windows were broken. All underframe equipment, fuel tank, and bogies had been stripped from beneath the locomotive during the course of the collision. The fuel tank was ruptured during the collision and released its contents, though none ignited. However, an oil film was found on many of the coaches and wagons.

7.43 The leading bogie of the locomotive sustained significant impact damage to its front and right side. A large portion of the leading end detached, and this came to rest in the leading end of Coach M. The bogie unit was deformed, and all the wheelsets and traction motor components had detached. The trailing bogie had also sustained heavy impact damage, to both the leading and trailing ends, on the right side. All the wheelsets and traction motor components were also missing from this bogie.

**Class 66 crashworthiness**

7.44 As a consequence of the robust construction and mass, the Class 66 locomotive body sustained only relatively minor structural damage in comparison to the DVT and Mark 4 coaches of the IC225. It has no energy absorbing design features. Its design does not appear to complement the crashworthy considerations that guide the construction of passenger vehicles that use the same rail network.

7.45 As noted above, the fuel tank, made from steel plate, had detached from the locomotive and been ruptured and all of the fuel lost. The tank had no design features that could prevent the potential total loss of contents upon rupture.

7.46 The only connection between the bogies and the body of the locomotive are a pivot pin for each bogie, each of which has a bolted retaining plate. This may account for the locomotive having so readily shed its bogies (particularly the trailing one), and in part explain why it came to rest on its side. Both of the bogies seem to have broken down into their main component parts. None of the six wheelsets remained within the bogies. As noted earlier, a large portion of the leading bogie frame broke away and formed a missile that entered the leading end of Coach M.

7.47 The exit for drivers from the locomotive cab is not easy. The driver has to move forward, around the control pedestal, before gaining access to the inward opening door in the rear wall of the cab. This opens into a cross passage that could be used as a refuge during a collision.

**The freight train hopper wagons**

7.48 The wagons were of a new design with a carrying capacity of about 74 tonnes (or a load volume of 90.5 cubic metres), a loaded wagon being a total of about 102 tonnes. Like the Class 66 locomotive, these wagons were also brought into service in late 2000. The main welded steel body structure is divided into four compartments that facilitate the unloading of cargo through openings in the floor. The body is supported on a robust steel underframe that is carried on two bogies. Each bogie has two wheelsets. The wagons were coupled to each other and the locomotive by traditional screw couplings that require a pair of buffers at each end of the underframe.

7.49 The first three wagons came to rest on their left sides on level ground, spilling some of their contents, and were embedded in each other. The second wagon had sustained significant structural damage. Some of the following four wagons had overridden each other, and had come to a stand on the track bed, the first was tilted to the left and the following wagons were tilted to the right. The leading bogie of the ninth wagon was derailed, but the trailing bogie was on the rails, as were all subsequent wagons.

7.50 Five of the wagons had lost both of their bogies, and one wagon lost one bogie. Of the eleven detached bogies, nine lost one or both wheelsets.

**Wagon crashworthiness**

7.51 A number of the Mark 4 coaches had extensive body side penetrations caused by impact with wagons. The strength and angular design of the wagon bodies, that includes aggressive edges and corners, do not appear to complement the crashworthy considerations that guide the design of passenger vehicles. Concern about wagon design in relation to the crashworthiness of passenger vehicles has previously been raised in the investigation of the Southhall derailment (September 1997).

7.52 The wagons and Class 66 locomotive were fitted with the more traditional screw coupling and buffers rather than automatic couplings. As noted earlier for the passenger coaches, automatic couplings (which require no buffers fitting) may provide greater crashworthy protection during a derailment. Such units are better at resisting the forces that would otherwise cause vehicles to override each other, and help to keep vehicles in line during the course of a derailment event. This matter was also commented on in the Southall investigation.

7.53 As a consequence of the wagon construction a significant number of bogies detached. Again, the loss of bogies can cause instability and allow wagons to overturn onto their side. The bogie units also appear to have not performed very well in retaining their wheelsets

## 8. TRAIN DRIVER COMPETENCY ISSUES

8.1 The driver of the IC225, Mr John Weddle, was killed in the collision. Mr Weddle was an experienced and competent driver, and fully qualified to drive the train on the day of the incident.

8.2 The driver of the freight train, Mr Stephen Dunn, was also killed in the collision. He was also an experienced and competent driver, who was undergoing route learning. Driver Dunn was fully qualified to drive the train on the day of the incident.

8.3 Instructor James Hill was accompanying Driver Dunn at the time of the collision. He is an experienced and competent driver, who was providing route instruction to Driver Dunn. Instructor Hill was fully qualified to instruct on route familiarisation, and indeed drive the train, on the day of the incident. He survived the collision.

8.4 Evidence indicates that the train drivers involved took all possible actions to reduce the serious nature of the incident.

## 9. HIGHWAY ISSUES

9.1 A detailed plan produced by the Transport Research Laboratory (TRL), from data captured using laser scanning equipment, shows the route taken by the Land Rover combination as its nearside front wheel hit the kerb at a distance of 50.2 metres from the start of the safety fence. The front offside wheel hit the kerb at a distance of 23.9 metres from the same reference point. The angle at which the vehicle was travelling at this time was between 5 and 6 degrees to the normal direction of the carriageway. The tracks indicate that the Land Rover combination travelled down a 3.5 metre high embankment. The vehicle demolished about 16.9 metres of wooden post and rail fence that formed the boundary of a level grass field. It then crashed through the railway boundary fence and dropped down onto the railway cutting, coming to rest on the East Coast Main Line.

9.2 The section of motorway involved in the incident was the westbound carriageway of the M62 at Little Heck Railway Bridge, between junctions 34 and 35. This section of motorway was built in 1974, and is managed by the Highways Agency (HA). Following the incident, the HA asked the TRL to undertake a detailed independent investigation into the highway issues.

9.3 The bridge design was inspected and found to meet the standards required at the date of construction. On the approach to the bridge a safety fence is installed in advance of, and connected to, the bridge parapet wall. The HA standard requires a minimum of 30 metres of safety fence, to normal containment standard, in advance of the hazard. The actual fence exceeded this standard in that it extended for 33.5 metres at full height, with an additional 9.2 metres of inclined fence to a concrete terminal. There was no collision between the Land Rover and the safety fence.

9.4 The motorway has been subject to regular monitoring since its construction. There are three main types of routine inspection:

- weekly safety inspections;
- detailed inspections every two years;
- daily safety patrols.

All these inspections had been carried out, and did not reveal anything that was relevant to the incident.

9.5 Other activities are also regularly carried out:

- gully emptying;
- hard shoulder sweeping;
- maintenance of a debris list.

Again, none of these indicated anything of concern.

9.6 A number of road surface maintenance surveys are also carried out, that include assessments of skid resistance. Further skid tests were carried out shortly after the incident that confirmed earlier findings. This concluded that, at the time of the incident, skid resistance of the road surface met or exceeded all HA standards.

9.7 The relevant section of the M62 is a typical section of three-lane motorway with a hard shoulder. In accordance with HA policy, this section is not lit during the hours of darkness.

9.8 The nearside lane is defined from the hard shoulder by a solid white line with raised rib markings. Such 'rumble' strips are required by the HA on motorways as an audible and tactile warning to drivers. In addition a row of reflective studs are also positioned at this boundary. These are red in colour and their spacing at 9 metre intervals is closer than the HA regulations require.

9.9 Just prior to the incident the boundary fence had been inspected and various repairs carried out. The purpose of such fences is to prevent animals from straying onto the motorway. These fences are maintained by the HA.

9.10 As part of the winter maintenance put in place by the HA, a precautionary salting had been carried out late in the evening of Tuesday 27 February. As rain was falling heavily, and weather forecasts suggested that ice would not be a problem, further gritting was stopped in the early morning of the 28 February. Inspection of measurements for the actual weather and temperature, and road surface salinity, demonstrated that this action had been appropriate. It was concluded that the motorway at Little Heck Bridge was unlikely to be affected by ice or snow at the time of the incident.

9.11 Examination of the accident record for the westbound carriageway concerned, showed that for the previous year the personal accident injury rate was less than the national average.

9.12 In summary, there was no deficiency of the motorway design or maintenance, and it was free from debris or defect of any kind that may have contributed to the Land Rover leaving the carriageway.

## 10. VEHICLE STRIKE AND OBSTRUCTION ISSUES

10.1 Following the incident at Great Heck, the Deputy Prime Minister asked the Health and Safety Commission (HSC) to look into the circumstances of incidents where road vehicles have blocked railway lines and whether there were features in common that might have been preventable. In parallel the Highways Agency undertook a review of its standards for safety barriers.

10.2 The approach adopted by the HSC was:
- to understand the scale and context of the risk;
- to understand the nature of the risk;
- to examine how these risks are managed today;
- to consider options for reducing risk;
- to consider the practicalities of making improvements.

10.3 Obstruction of the railway by road vehicles can happen because a road vehicle, of any type, gains access to the railway in any of four ways:
- from bridges crossing over the railway or adjacent to it;
- from roads running alongside railways;
- from adjacent property;
- from level crossings.

10.4 It was concluded that preventing road vehicles getting onto the railway, rather than preventing trains hitting them once they are there, is likely to be the best approach to reducing risk. In terms of current arrangements for managing this risk, very different powers and duties of road and railway authorities were found. The two main problems these may cause are in:
- reporting and recording of incident information;
- devising and putting in place the best engineering measures to prevent vehicles that leave the road from getting onto the railway.

10.5 The HSC has concluded that the risk, though small in relation to other road and railway risks, is not negligible. The risk is spread across many thousands of sites, most of which are considered likely to present low risk. Blanket measures at all locations where roads run over, or close to, railways would therefore waste large amounts of time and effort that could be used to achieve much greater improvements elsewhere on roads and railways.

10.6 Seven recommendations are made by the HSC as to what should be done, who should take responsibility for seeing it is carried out, and what the timescales should be for putting into practice. These recommendations are reproduced in **Appendix 3**.

## 11. EMERGENCY MANAGEMENT

11.1 The driver of the Land Rover was the first person to contact the emergency services at about 06.13hrs. The emergency operator of the North Yorkshire Police control room took the call and relayed the information to the BTP. From 06.15hrs onwards passengers and lineside residents made numerous emergency calls. All three emergency services responded in force and began to arrive on the incident site from 06.33hrs.

11.2 Initial control of the site was effected by Humberside Fire Service, and maintained during the rescue phase of the operation. An initial casualty clearing station was set up in nearby Heck Hall farm, from which ambulances soon removed casualties. East Yorkshire Accident and Emergency Control contacted the military authorities and two helicopters from RAF Leconfield attended the scene, as well as the West Yorkshire Ambulance Service's own helicopter. This provided effective transport for the most seriously injured direct to hospital. Following the rescue and transfer of survivors to hospital the site was handed over to BTP at 12.45hrs.

11.3 Railtrack Zone Control became aware that a major incident had occurred from 06.27hrs. The nominated Rail Incident Officer arrived on site at 06.57hrs. From 07.20hrs a dedicated Railtrack incident response team was functional. The Up and Down lines in the vicinity of the incident were protected by signals reverting or placed to danger during the course of the incident, and by formal protection arrangements.

11.4 An unusual aspect of the emergency response was the need to set up disinfecting procedures for the site due to the foot and mouth epidemic in existence throughout much of the UK at the time of the incident.

11.5 Assessment of recovery requirements commenced at 08.30hrs when the supervisor of the recovery service retained by Railtrack arrived on site.

11.6 Overall the emergency response was well co-ordinated, timely and highly effective in dealing with a large scale and serious incident located in a relatively remote location.

## 12. CONCLUSIONS AND RECOMMENDATIONS

### General findings

12.1 The derailment of the IC225, its subsequent collision with the freight train, and the deaths and injuries caused, were a consequence of the Land Rover obstructing the Up line and the IC225 running into this obstruction.

12.2 Investigations on behalf of the Highways Agency, who have responsibility for the M62 motorway, found that there was no deficiency in its design or maintenance that contributed to the Land Rover leaving the carriageway.

12.3 The AEA Technology Rail investigation into the way in which the DVT impacted the Land Rover suggests that derailment was not a certainty, but an unfortunate combination of marginal circumstances, and that a similar event may well not result in derailment.

12.4 Had the Class 91 locomotive been leading the passenger train then the possibility of derailment in similar circumstances could not be dismissed, though the course of the event may have been different. The severity of the subsequent collision may have been as catastrophic, or more so, in terms of damage to the passenger vehicles, as the locomotive would have absorbed less energy. If a collision with the freight train had occurred north of the Pollington Lane bridge, then the severity of the incident may well have been much worse. The IC225, irrespective of the DVT or locomotive leading, could have run into the bridge abutments and the embankment that forms the road approach to the bridge, with similarities to the incident at Eschede, Germany in 1998.

12.5 Evidence indicates that the train drivers involved took all possible actions to reduce the serious nature of the incident.

12.6 There were no deficiencies in the railway infrastructure (track, signals or fencing) that contributed to the incident.

12.7 With an estimated closing speed of 142 mph, the collision between the IC225 and the freight train is the highest speed incident that has occurred in the UK.

12.8 Overall the emergency response was well co-ordinated, timely and highly effective in dealing with a large scale and serious incident at a relatively remote location.

**The IC225**

12.9 The obstacle deflector fitted to the DVT had been designed shortly after the derailment of a 'push-pull' train at Polmont in 1984. The design of the obstacle deflector conformed in all main respects to current standards, with only minor differences.

12.10 The crashworthiness displayed by the passenger coach body shells, when subjected to end impact, was adequate. The first five coaches had some of their survival space reduced by roof, floor and side impacts, or penetration by large missiles or other vehicles. Impact with the underside of the road bridge was responsible for roof damage. The ability of the vehicles to protect their occupants was compromised by the loss of some roof sections and window glass.

12.11 Most of the coach bogies were detached during the course of the collision. Vehicles that lose bogies generally become unstable which also puts additional strain on their couplings. Detached bogies can form large and heavy missiles or obstacles, as do wheelsets that become separated from bogies. These have the potential to seriously damage coach floors, so displacing seats, or penetrating sides. A bogie is believed to have been the cause of the observed side damage to Coach F. However, as the energy involved in the collision was so great it is unlikely that improved bogie retention would have had any great effect in this incident.

12.12 The automatic type couplings of the IC225 showed a tendency to uncouple when subject to sudden vertical motion, or when inverted. During derailments it is important for vehicles to remain coupled as this can reduce the likelihood of end collisions with other structures and help maintain vehicles in an upright condition.

12.13 Within the passenger coaches it was observed that generally the standard class seat structures retained their integrity and position, whereas the first class seats did not to the same degree. In particular a number of floor fastenings failed, the seat structures buckled, and arm rests and headrests detached.

12.14 Within the coach interiors it was found that many tables detached and became potential missiles, as did fire extinguishers, waste bins and areas of toughened glass reinforced by adhesive labels. Table legs, broken magazine racks and ashtrays also posed potential hazards.

12.15 In the kitchen area of Coach G large quantities of displaced cutlery and crockery had the potential to form missiles. Also, within the kitchen there were many sharp edges on the large items of equipment and work surfaces, all with the potential for causing injury.

12.16 Many of the interior vestibule doors were found to be inoperable, thereby making escape from the coaches difficult. Toilet doors were also found to have jammed.

## The freight train

12.17 The Class 66 locomotive and the wagons that formed its train did not incorporate any designed energy absorbing features. However, the high speed of the IC225 made it unlikely that any such features would have significantly affected the outcome of this collision.

12.18 The layout within the driving cab of the Class 66 made it difficult for drivers to leave, particularly from the driving position.

12.19 The construction of the Class 66 locomotive was such that the bogies appear to have readily detached during the collision. A large fragment parted from the leading bogie during the collision, and formed a missile that penetrated the side of the leading Coach M, and seriously compromised a significant area of survival space. Fracture of such a large component would not normally be expected. Both bogies were found stripped of wheelsets, transmission equipment and motors, a feature not conducive to good crashworthiness.

12.20 Though there was no evidence of any fire following detachment and rupture of the large Class 66 fuel tank, such fuel spillage had the potential for a significant fireball to have formed. The HSE, with assistance from the HSL, is currently taking forward research into how such dangers can be mitigated, following the fire that occurred at Ladbroke Grove on 5 October 1999, as recommended by Lord Cullen in his report of 2001.

12.21 Future designs of wagon could be made less aggressive if angular sharp edges are avoided.

12.22 The method of wagon construction was such that a significant number of bogies detached, even though the freight train experienced a relatively slow-speed collision and derailment. Again, the loss of bogies can cause instability and allow wagons to fall onto their side more readily. The bogie frames also appear to have performed poorly in retaining their wheelsets.

12.23 The locomotive and wagons were fitted with screw couplings and buffers. As was recognised in evidence given to the Southall Inquiry, vehicles fitted with such couplings tend to detach more readily in a crash than those fitted with automatic couplers (such as those fitted to the IC225 coaches). Wagons fitted with automatic couplers are more likely to remain connected and in line in the event of a derailment.

## Railway Safety recommendations

12.24 Railway Safety operates as an industry centre for all matters relating to railway safety and is a not-for-profit wholly owned subsidiary of Railtrack Group PLC.

12.25 Railway Safety conducted the rail industry inquiry to which all the investigating bodies gave evidence. A set of recommendations resulted from this inquiry. HSE has reviewed and accepted these recommendations, and with the permission of Railway Safety, they are summarised in **Appendix 2**.

## HSC report of the working group on obstruction of the railway by road vehicles

12.26 The HSC inquiry into the circumstance by which road vehicles have blocked railway lines, instigated by the Deputy Prime Minister, has concluded that the risk of such occurrences is small, but not negligible. Recommendations as to how best the responsible bodies could collaborate to make improvements to reduce such risks is set out in the HSC report *Obstruction of the railway by road vehicles* and reproduced in **Appendix 3**.

## HSE recommendations

12.27 Details of the investigation by HSE are described in section 4. As explained in paragraph 4.7, work undertaken by railway company consultants has been subject to critical review by HSE supported by HSL. This review also considered and accepted the recommendations developed by both Railway Safety and the HSC Inquiry. The recommendations are reproduced in **Appendices 2 and 3.**

12.28 HSE has recommended and initiated further research into the initiators and subsequent events associated with derailment. This research will consider a wide range of issues such as train formation and construction, the effectiveness of obstacle deflectors, bogie retention and axle loading. The research should include appropriate sharing and evaluation of research with projects taking place within the industry.

12.29 Concerns related to freight train design have featured in a number of recent accident investigations. Functionality can conflict with features conducive to good crashworthiness when freight trains are involved in major derailment events. Where reasonably practicable future designs of freight locomotives should incorporate energy absorption features, good emergency exit routes for drivers, and bogie and wheelset retention. Similar consideration should be given to freight vehicles by seeking improvements at the crashworthiness interface with passenger vehicles by the avoidance of aggressive edges and corners. The design of bogie wagons should also ensure good bogie and wheelset retention. HSE and industry will work together on these concerns as part of their ongoing discussions on design issues.

12.30 Simple trip wire systems in the vicinity of airport runways have been in use in the UK for a considerable time. France and other countries are utilising equipment interfaced with train control systems that monitor the integrity of bridge and lineside infrastructure at high-risk locations. Such devices may be of limited effectiveness when a train is in close proximity to a location where a road/rail incident could occur, but do offer a degree of protection at high-risk locations on high-speed lines. HSE believes that this may warrant some further research, looking at an evaluation of the systems available to determine their practicability.

12.31 HSE will review the railway safety principles and guidance series and consider changes where appropriate to reflect the issues raised in the recommendations arising from this incident investigation and ongoing further research activity.

## **Appendix 1: Listing of reports and other sources of information**

Published reports:

Department of Transport, *Railway Accident - Report on the derailment that occurred on 30th July 1984 near Polmont in the Scottish Region, British Railways*, HMSO, (1985).

Health and Safety Commission, *Obstruction of the railway by road vehicles. Report of the Working Group set up by the Health and Safety Commission*", HSE Books, ISBN-0-7176-2294-0, (February 2002).

HSE Interim Report, *Train collision at Great Heck Selby, 28 February 2001*, made available on the Internet, (6 March, 2001).

Professor John Uff, *The Southall Rail Accident Inquiry Report*, HSE Books, ISBN-0-7176-1757-2, (2000).

Lord Cullen, *The Ladbroke Grove Rail Inquiry, Part 1 Report*, HSE Books, ISBN 0-7176-2056-5, (2001).

Unpublished reports and other sources of information available to HSE:

AEA Technology Rail, *A report into the derailment of a passenger train and its subsequent collision with a freight train at Heck, 28 February 2001*, a report written for Railtrack London North Eastern Zone by Richard H. Billinge, Report No. AEATR-T&S-2001-097, (May 2001).

AEA Technology Rail, *Investigation of a collision between an IC225 Train and a Landrover at Great Heck*, a report produced for Railtrack by JH Lewis, A Minnis & P Rogers, Report No. AEATR-T&S-2001-122 (Issue 1), (September 2001).

HSE photograph collections associated with the Great Heck rail incident, (HSE0103-002/ -008/ -015/ -016/ -017/ -027/ -036 & -125).

Interfleet Technology, *Great Heck ECML Rail Incident 28 February 2001*, by SR Buxton, Report No. ITLR/T9921/001 (Issue C), (October 2001).

Railway Safety, *Formal Inquiry: Final Report. Derailment of passenger train 1F23 04 45 Newcastle to London, by a road vehicle and subsequent second Collision with 6G34 05 00 Immingham to Ferrybridge At Great Heck on 28 February 2001*, Report No. RS/2001/GH, (December 2001).

WS Atkins Consultants Ltd., *Selby Incident Crashworthiness Investigation, Volume 1 - Report, Volume 2 - Figures*, Report prepared on behalf of HSBC Rail (UK) Ltd., Report No. BK0636/R001 volume 1 & 2 (Issue 01), (July 2001).

**Appendix 2: Summary of the main recommendations of the Railway Safety Formal Inquiry Final Report (from Railway Safety report RS/2001/GH)**

The following is a summary of the recommendations being progressed by Railway Safety, with the full support of the HSE.

(1) The Highways Agency and the rail industry to review the suitability of current technical standards for safety barriers at road over rail bridges, with emphasis on those associated with high-speed lines (RS/2001/GH para. 16.1.1)

(2) The rail industry to encourage the fitting of safety fences to any road/rail interface were there is a high risk of vehicles accidentally obstructing railway lines (RS/2001/GH para. 16.1.2).

(3) Railtrack, the Highways Agency and local highway authorities should agree responsibilities for controlling risks of mutual concern relating to the interplay of railways and roads, and participate in risk assessment and the sharing of information. A unique numbering system, applicable to the national road and railway networks, should be developed to allow structures of mutual concern to be identified (RS/2001/GH para. 16.2.1).

(4) Railway Safety and the Highways Agency to agree a memorandum of understanding relevant to all aspects of managing the road/rail interface effectively (RS/2001/GH para. 16.2.2).

(5) Railtrack should provide signs at places were there is a risk of road vehicles encroaching on the railway so that their drivers can readily identify their location. Such signs should be visible at track level (RS/2001/GH para. 16.3.1).

(6) Railway Safety should ensure that the reporting of future road vehicle encroachment incidents form part of a national database and should include details of how the vehicle got from the highway to the railway and the nature of the intervening constraint measures (RS/2001/GH para. 16.3.2).

(7) At locations where the risks of road vehicle encroachment and subsequent rail collision are high and the consequences of such collisions being catastrophic, Railtrack should consider installing vehicle detection systems (RS/2001/GH para. 16.3.3).

(8) Railway Safety should constantly review the use of emerging technologies in controlling road/rail interface risks (RS/2001/GH para. 16.3.4).

(9) Railway Safety should lead a study into the prevention of derailments during collisions, including the role of bogie retention straps, and the findings included in Railway Group Standard GM/RT 2100 (RS/2001/GH para. 16.4.1).

(10) Railway Safety should lead research into the dynamics of high-speed whole-train crashes, and how the vehicles within such trains can be kept in line (RS/2001/GH para. 16.4.2).

(11) A re-assessment of the risks associated with the mixed operation of freight and passenger trains should be carried out by Railway Safety (RS/2001/GH para. 16.4.3).

(12) The benefits of fitting auto-couplers to freight locomotives and vehicles should be reviewed by Railway Safety (RS/2001/GH para. 16.4.4).

(13) Railway Safety and the owners and operators of IC225 Mark 4 coaches and DVT vehicles should investigate the practicability of strengthening the vehicles so that they have greater ability to withstand the consequences of a high speed collision. If reasonably practicable bogie attachment loads should be brought in line with current standards (RS/2001/GH para. 16.5.1).

(14) The owners and operators of IC225 Mark 4 coaches and DVT should incorporate modifications guided by (13) above, where reasonably practicable (RS/2001/GH para. 16.5.2).

(15) If reasonably practicable anti-climbers should be fitted to the ends of IC225 Mark 4 coaches by their owners and operators to help prevent coaches coming out of line during a collision (RS/2001/GH para. 16.5.3).

(16) Improvements to the exits from Mark 4 vehicles should be made by their owners and operators (RS/2001/GH para. 16.5.4).

(17) The standards relating to the construction of coaches should be reviewed by Railway Safety to include specific crashworthiness requirements, including the integrity of bogies (RS/2001/GH para. 16.5.5).

(18) Railway Safety and the owners and operators of Class 66 locomotives should review fuel tank design and attachment and implement reasonably practicable improvements as soon as possible. The means of escape from locomotive cabs should be reviewed, if necessary appropriate standards changed and reasonably practicable modifications carried out (RS/2001/GH para. 16.6.1).

(19) The operators of Class 66 locomotives should share safety related information (RS/2001/GH para. 16.6.2).

(20) The observed deficiencies in the interior fixture and fittings of the coaches are to be used as a guide in the preperation of new standards by the Association of Train Operating Companies (ATOC) concerning the interiors of passenger vehicles (RS/2001/GH para. 16.7.1).

(21) Railtrack is to systematically review and manage effectively the risks at the fringes of its responsibilities (RS/2001/GH para. 16.8.1).

(22) Through regular reviews Railway Safety is to ensure that it is aware of changes to the risks associated with Railtrack operations (RS/2001/GH para. 16.8.2).

(23) Railway Safety and Railtrack are to encourage the Highways Agency to consider the future suitability of the rock gabion wall erected at Great Heck to prevent other road vehicles gaining access to the railway from the motorway (RS/2001/GH para. 16.8.3).

(24) Railway Safety should amend the rule book to make it clear where the responsibility for calling Emergency Services lies (RS/2001/GH para. 16.9.1).

(25) Railtrack should amend the Zone Control Manual to clarify the interfaces between the Signaller and Zone Control with respect to calling Emergency Services (RS/2001/GH para. 16.9.2).

(26) Freightliner to review their remote crew signing-on arrangements to ensure that they are robust (RS/2001/GH para. 16.10.1).

(27) Freightliner to formulate and issue printed instructions to control staff at Crewe in respect of train crew signing-on and off duty (RS/2001/GH para. 16.10.2).

## Appendix 3: Health and Safety Commission report recommendations summary

The following is a summary of the recommendations made by the Health and Safety Commission's Working Group on obstruction of the railway by road vehicles:

**(1)** The Department for Transport, Local Government and the Regions (DTLR) should lead, with the involvement of relevant interested parties, the development of tools and data for use at local level by highway and railway professionals to carry out comparative assessments of the risks of road vehicles obstructing the railway at specific sites. The tools should be useable for both locally and nationally managed roads, and for locations including road bridges over railways, locations where roads and railways run close together as well as locations where road vehicles can gain access to the railway via adjoining land. The tools should recognise the large numbers of assessments to be carried out and the large numbers of sites likely to be low risk. They should provide the simplest and fastest possible way to separate low risk sites from those requiring further assessment. The aim should be to complete this work within a year of acceptance of the report.

**(2)** DTLR should lead a collaborative initiative involving HSE, railway infrastructure controllers and relevant police authorities to ensure that relevant information in respect of both rail and road aspects of any incident (broadly equivalent to that contained in the data fields of Safety Management Information System (SMIS) and STATS-19 (the form used by police to record data about road accidents) is collected as far as practicable for all incidents in which road vehicles get onto railway property. The aim should be to complete this work by April 2002.

**(3)** Railway Safety, London Underground and other railway infrastructure controllers should adapt their incident recording systems to enable collection and analysis of all such relevant information. The aim should be to complete this work by April 2003.

**(4)** Those responsible for road and rail infrastructure, listed below (Table 1), should lead programmes of risk assessment work to achieve coverage of those sites identified by application of the tools required by Recommendation 1, as requiring further attention. The parties should collectively establish a consistent basis for classifying locations into higher risk (those where an assessment of options for improvement should be made) and lower risk (those where no action need be taken). At many locations there may be no reasonably practicable measures to be taken beyond what is already in place. Where reasonably practicable measures are identified, they should normally be implemented within two years of identification. DTLR should maintain general oversight of this programme.

Table 1: Principal Parties for Risk Assessment Programme

| Cause/Location | Locally managed roads | Nationally managed roads |
|---|---|---|
| Road traffic accidents – road bridges over railway | Local Authorities | Highways Agency, Scottish Executive, National Assembly for Wales |
| Road traffic accidents – roads alongside railway | Local Authorities | Highways Agency, Scottish Executive, National Assembly for Wales |
| Accidents on private roads or land adjoining railway | relevant railway infrastructure controller or premises controller | |
| Vandalism | relevant railway infrastructure controller | |

**(5)** DTLR should lead, in collaboration with HSE, railway infrastructure controllers and the highway authorities, the development of guidance on the proportionate application of available measures suited to different circumstances for the management of risk at specific locations where roads meet, cross or run close to railways. This initial work should be developed to the status of good practice guidance, paying particular regard to ensuring that the practices recommended are those, which are appropriate and provide the most effective control of risk for a given use of resources, regardless of which party will then carry responsibility for implementation. The aim should be to have the main elements in an initial suite of guidance available by April 2003 and refined in the light of experience.

**(6)** DTLR should lead, in collaboration with HSE and others with a relevant interest, the development of a protocol for apportioning responsibility and costs of improvements made at locations where roads meet, cross or run close to railways. The aim is to have this developed by April 2003.

**(7)** Once the protocol recommended above (Recommendation 6) is in place and action on the other recommendations in this report is underway, DTLR should conduct a review of progress to determine that the response is proportionate to risk and to see what further action (if any) is required. This should include review of arrangements for governance and management of safety risks at interfaces between roads and railways. The review should consider the nature and scale of the risks involved, alternative possible models for governance of those risks, and the effectiveness of the protocol developed in response to Recommendation 6.

## <u>Appendix 4:</u> <u>Figures</u>

The following Figures are contained in this Appendix:

**Figure 1** **The location of Great Heck**

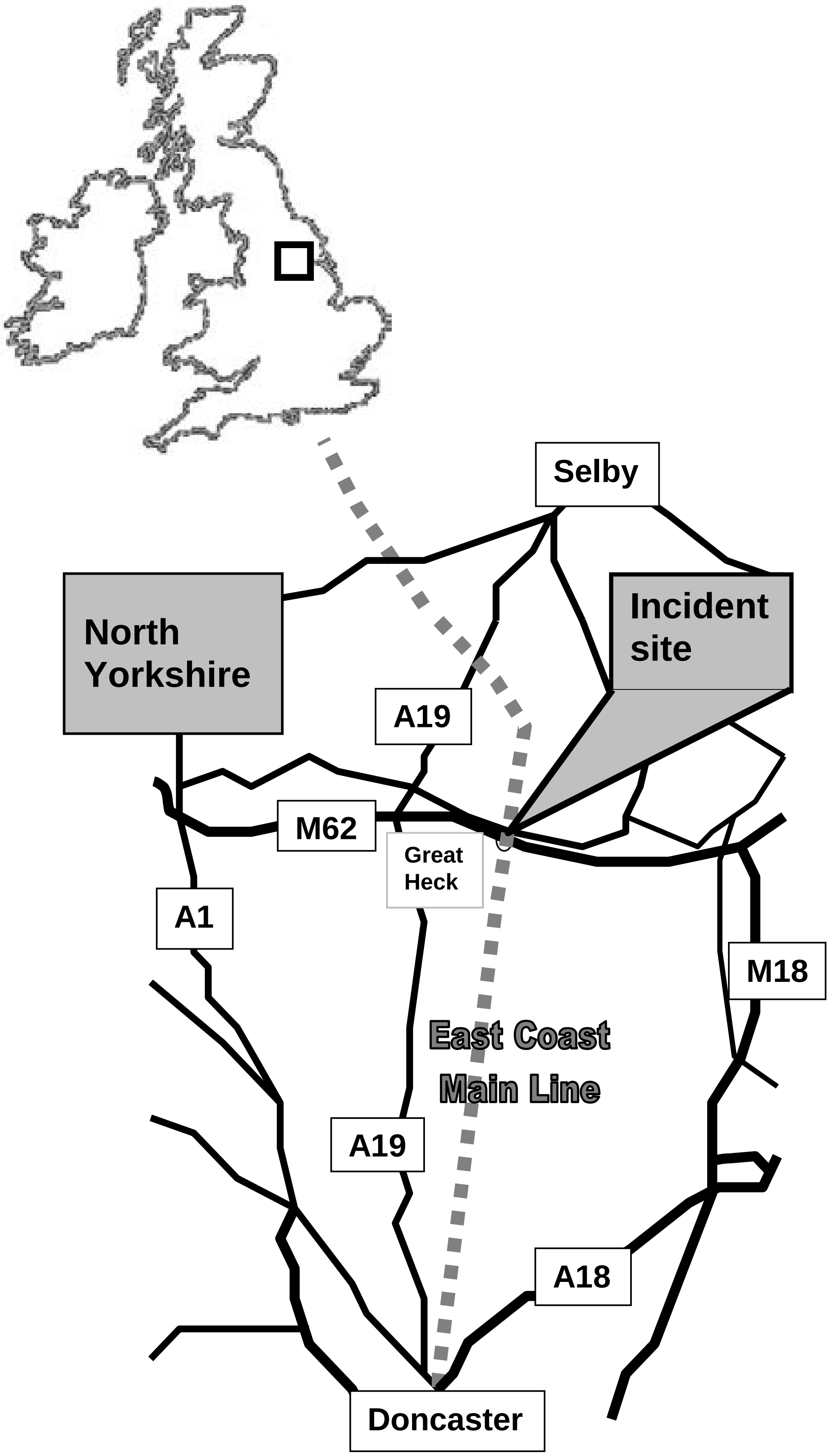


**Figure 2** **Schematic diagram of the track layout between the M62 motorway and Great Heck**

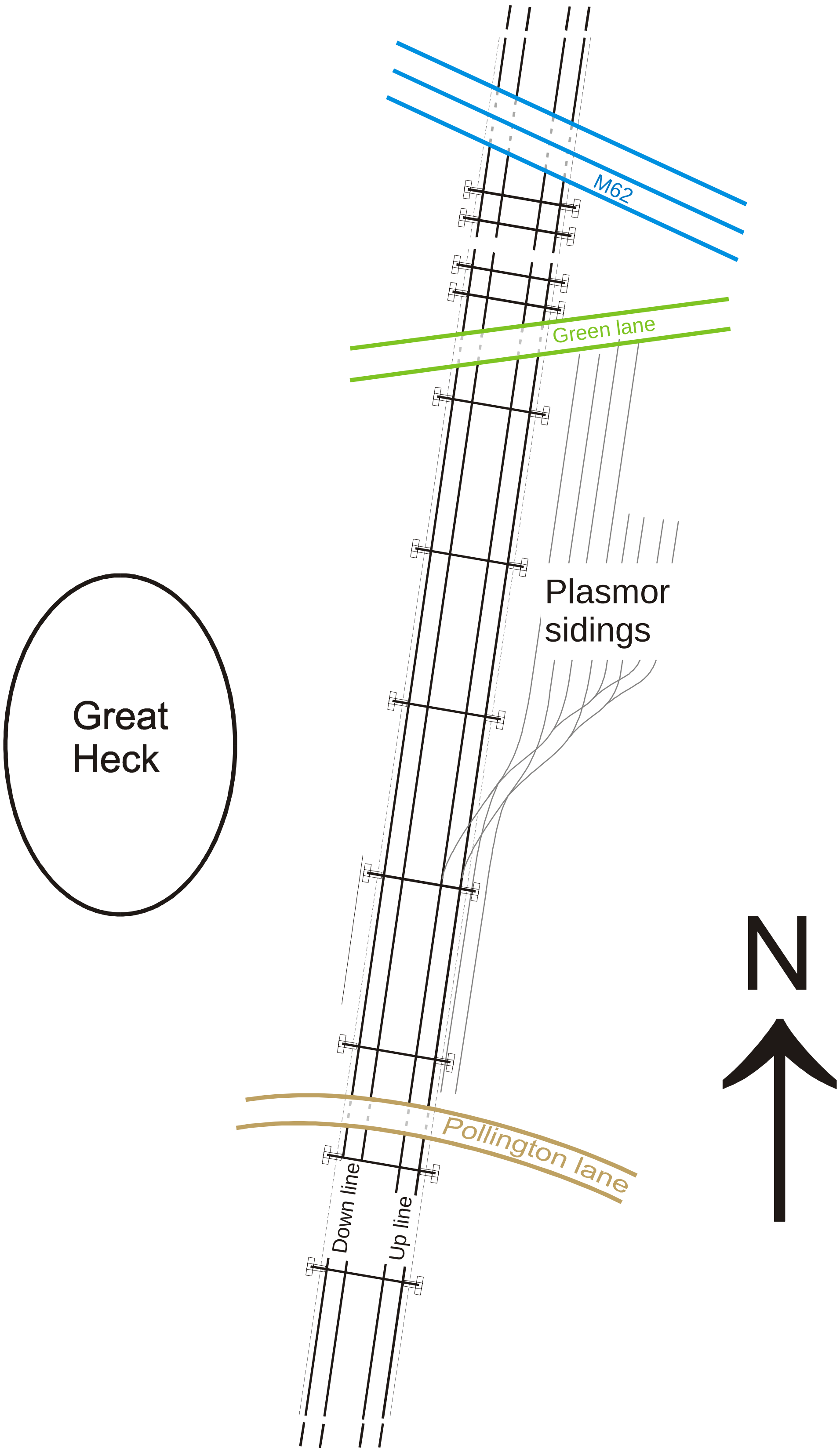


**Figure 3** **Trackside terminology**


CESS: the space alongside the railway lines

FOUR FOOT: the space between the rails

SIX FOOT: the space between one line and another

**Figure 4:** **Diagrams showing the make up of the trains as running prior to the collision**

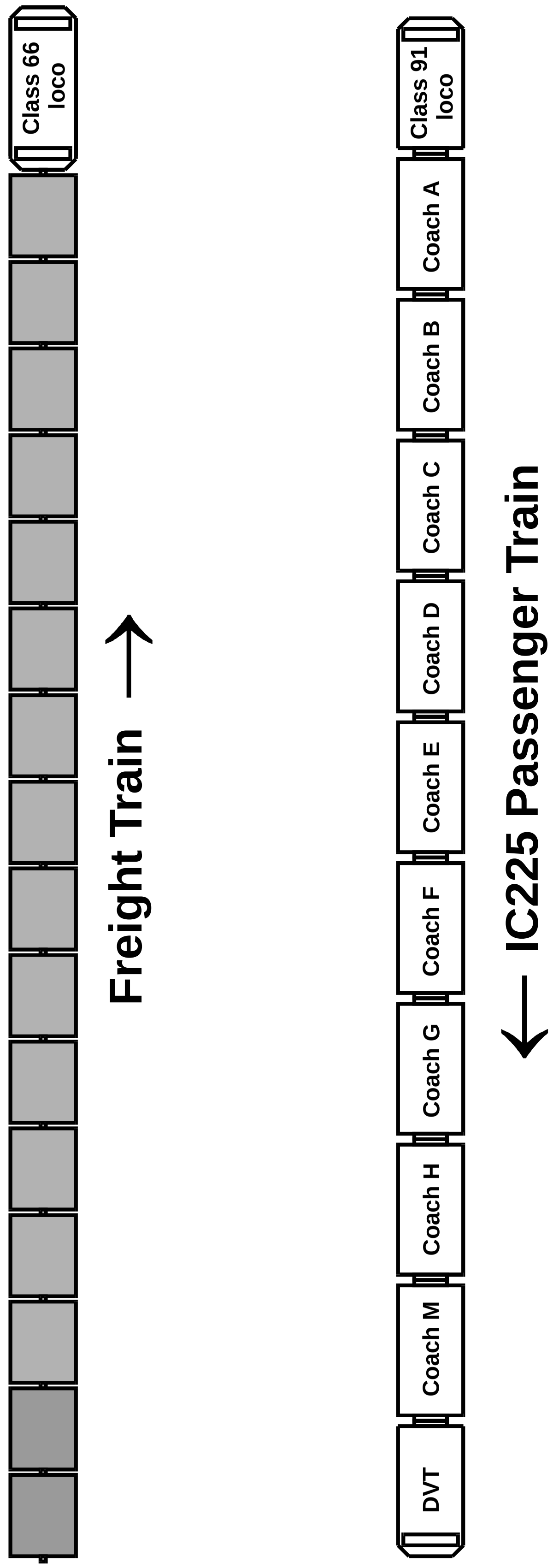


**Figure 5:** **Photograph of the M62 road bridge incident site showing the remains of the Land Rover next to the Up line**

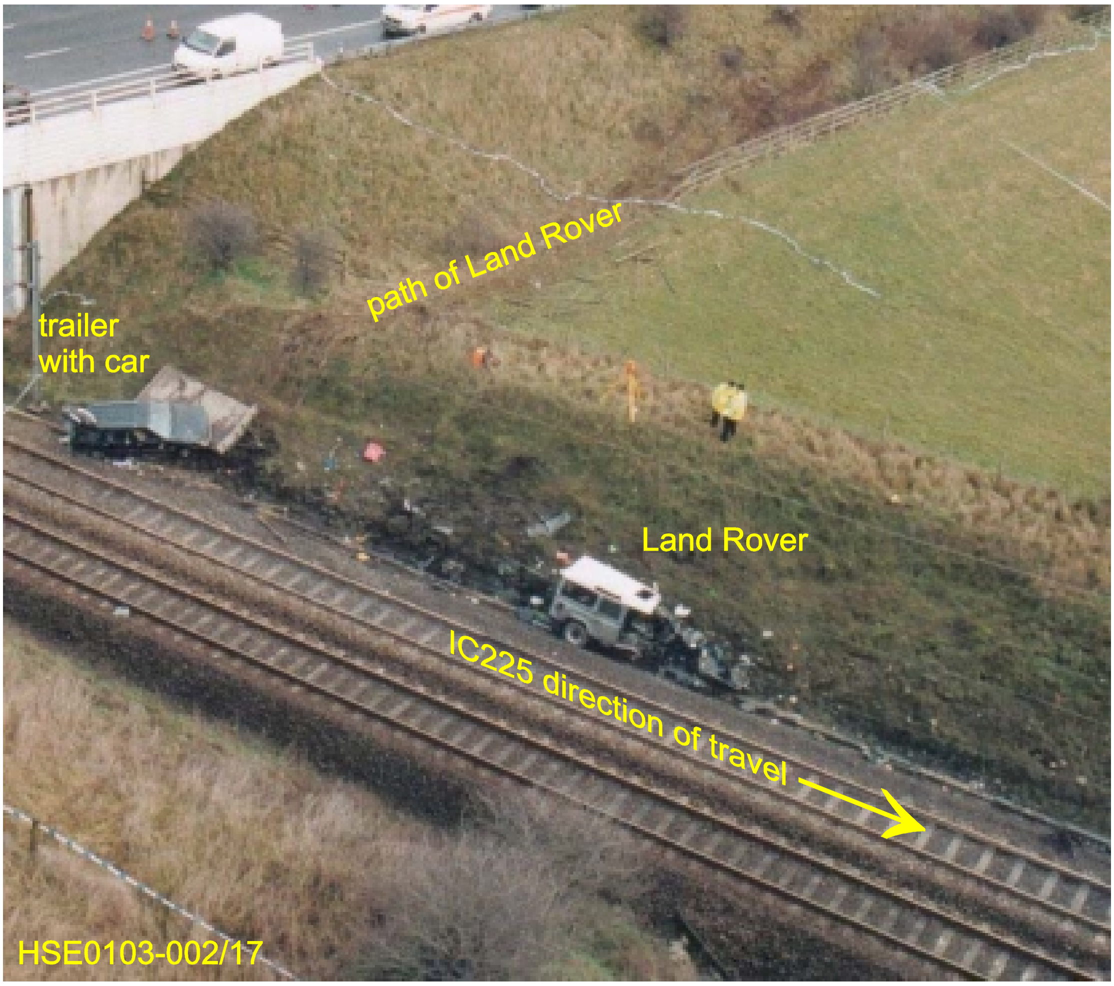


**Figure 6:** **Photograph of the Plasmor Sidings turnout looking south towards the Pollington Lane bridge**

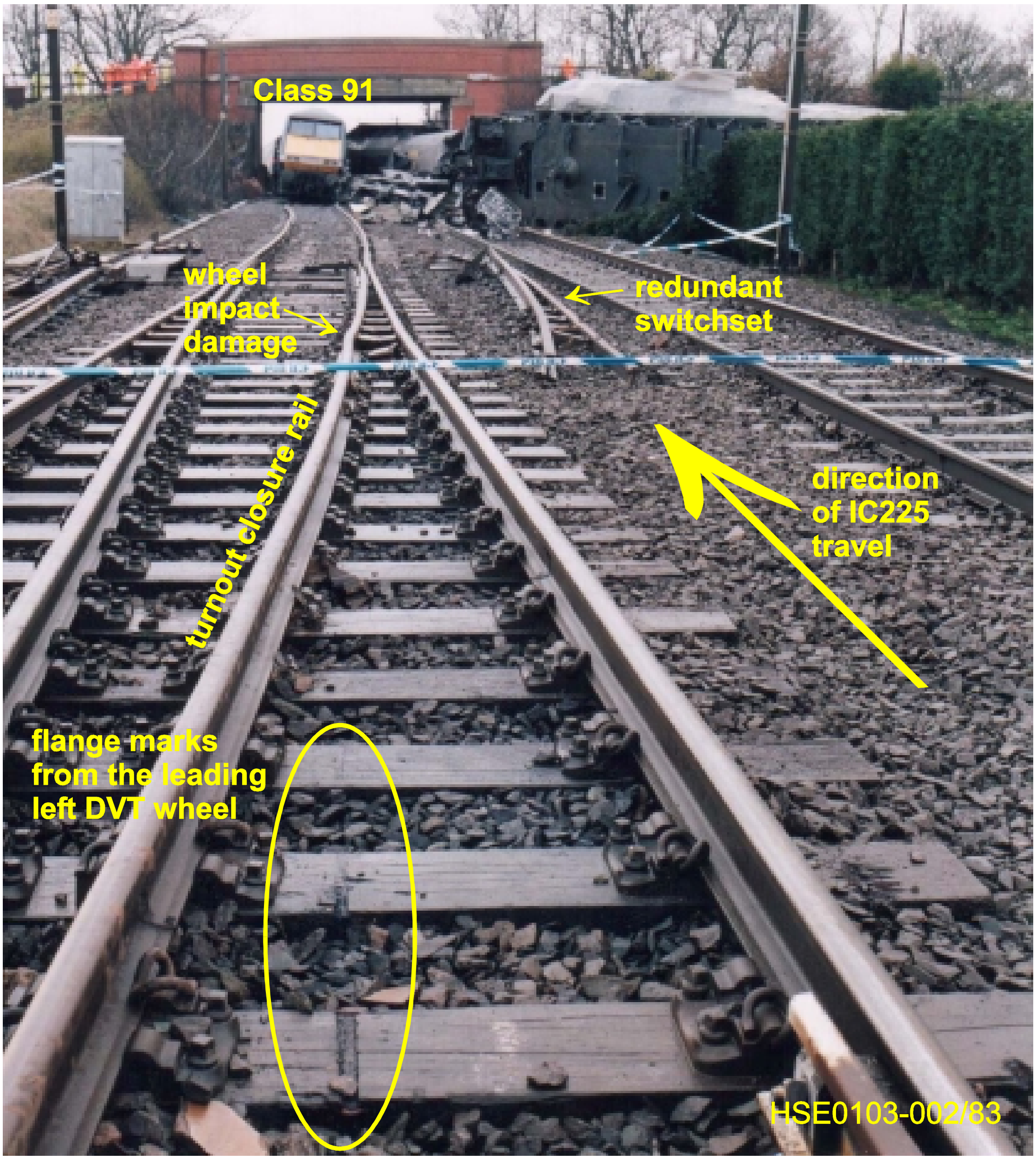


**Figure 7:** **Aerial photograph of the collision site between the IC225 and the freight train**

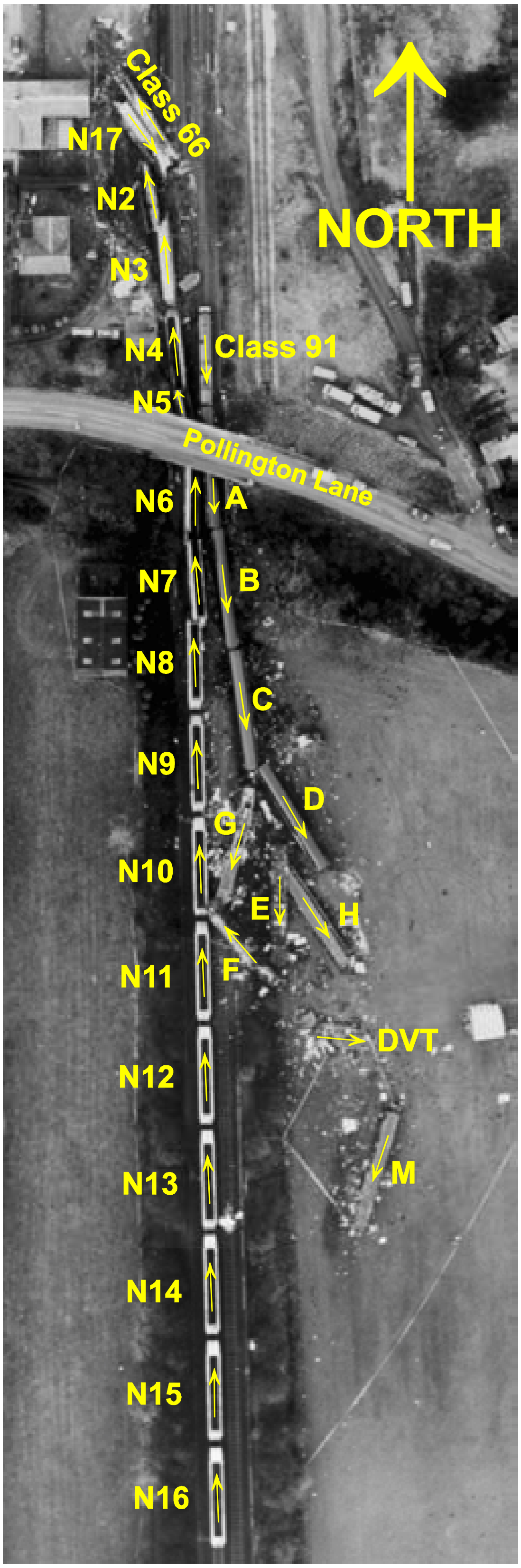
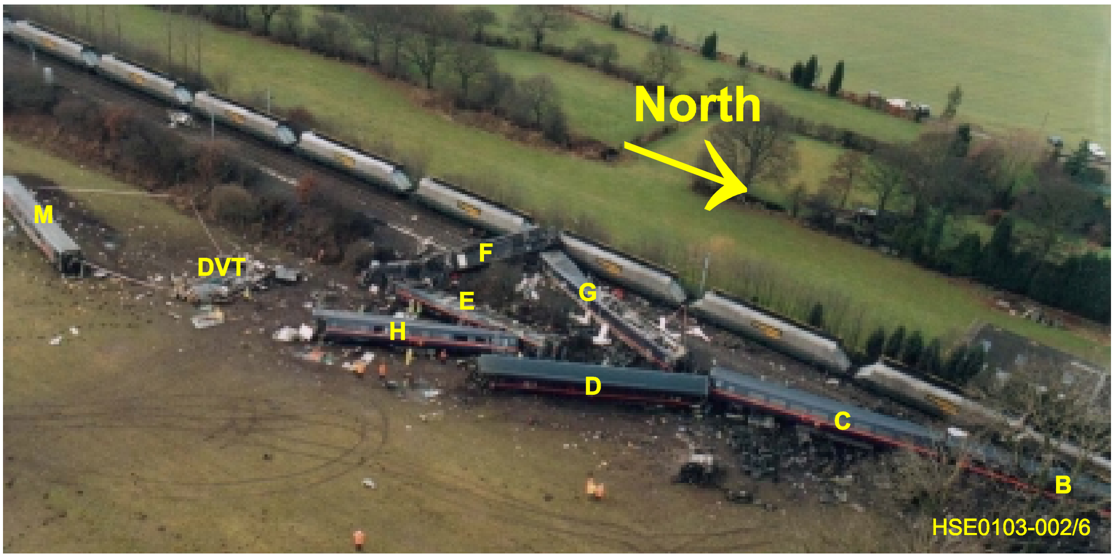
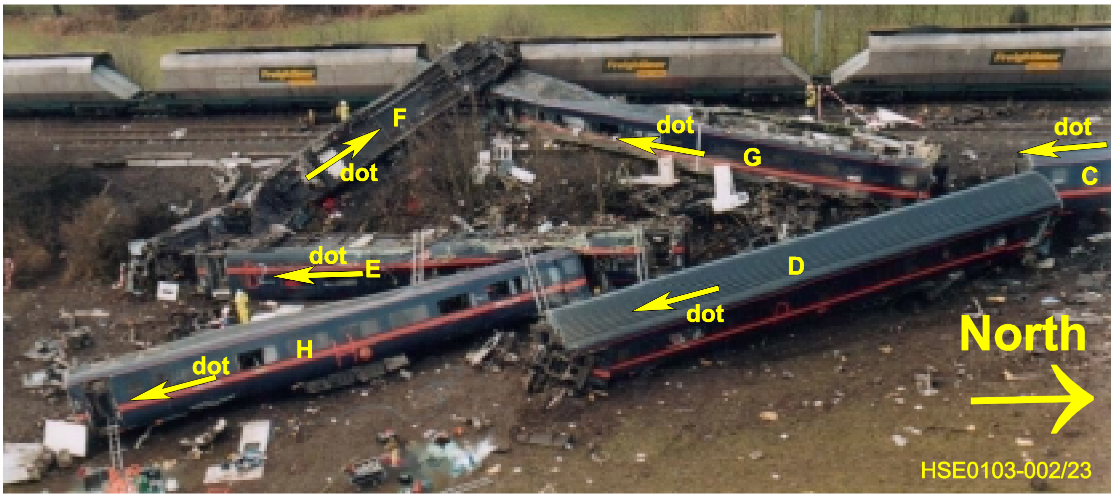


**Figure 8:** **Aerial photographs of the collision site showing the coaches of the passenger train**




dot ~ direction of travel

**Figure 9:** **The driving van trailer**


**Figure 10: Coach M**

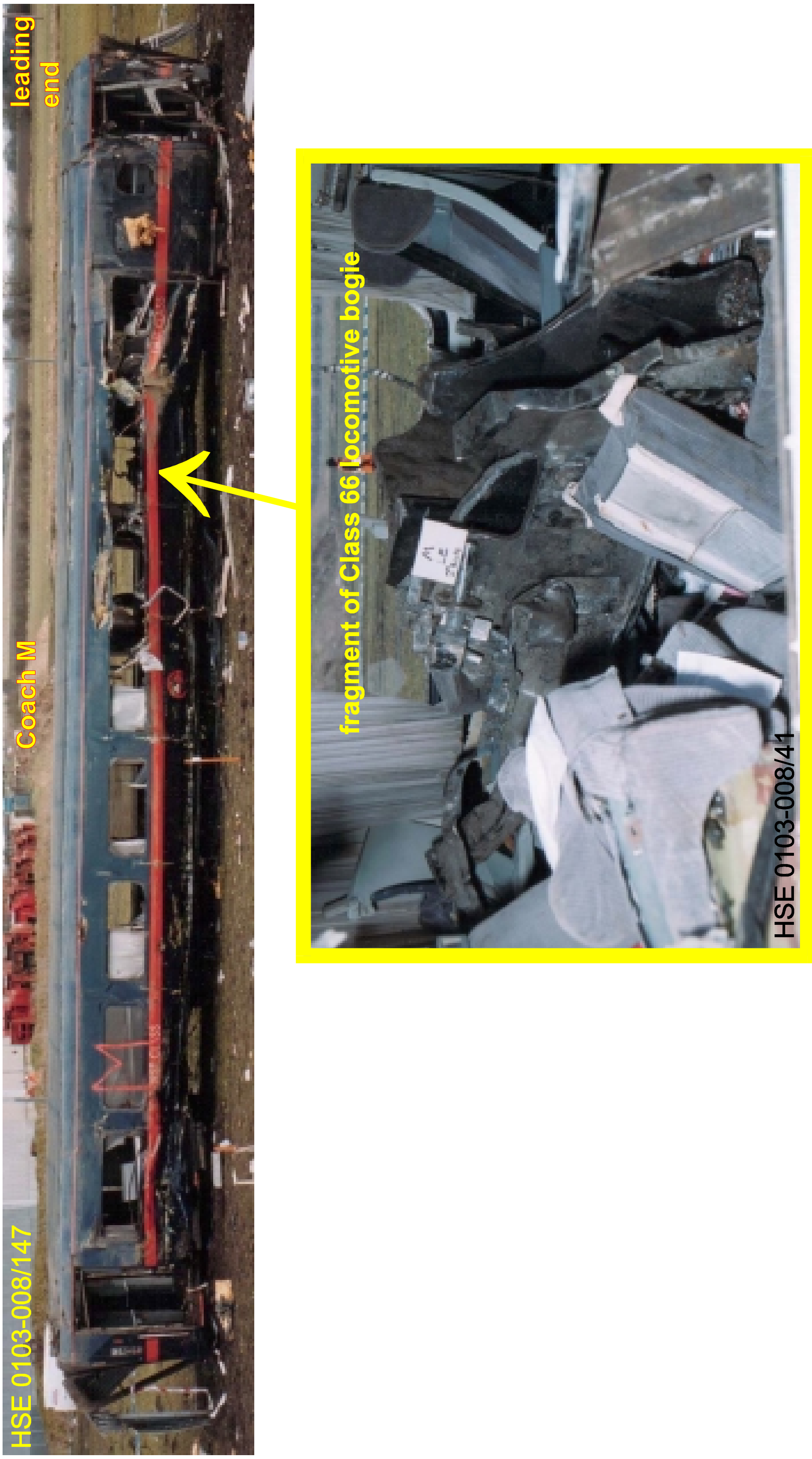


**Figure 11:** **Coaches H and E**

**Figure 12:** **Coach F**

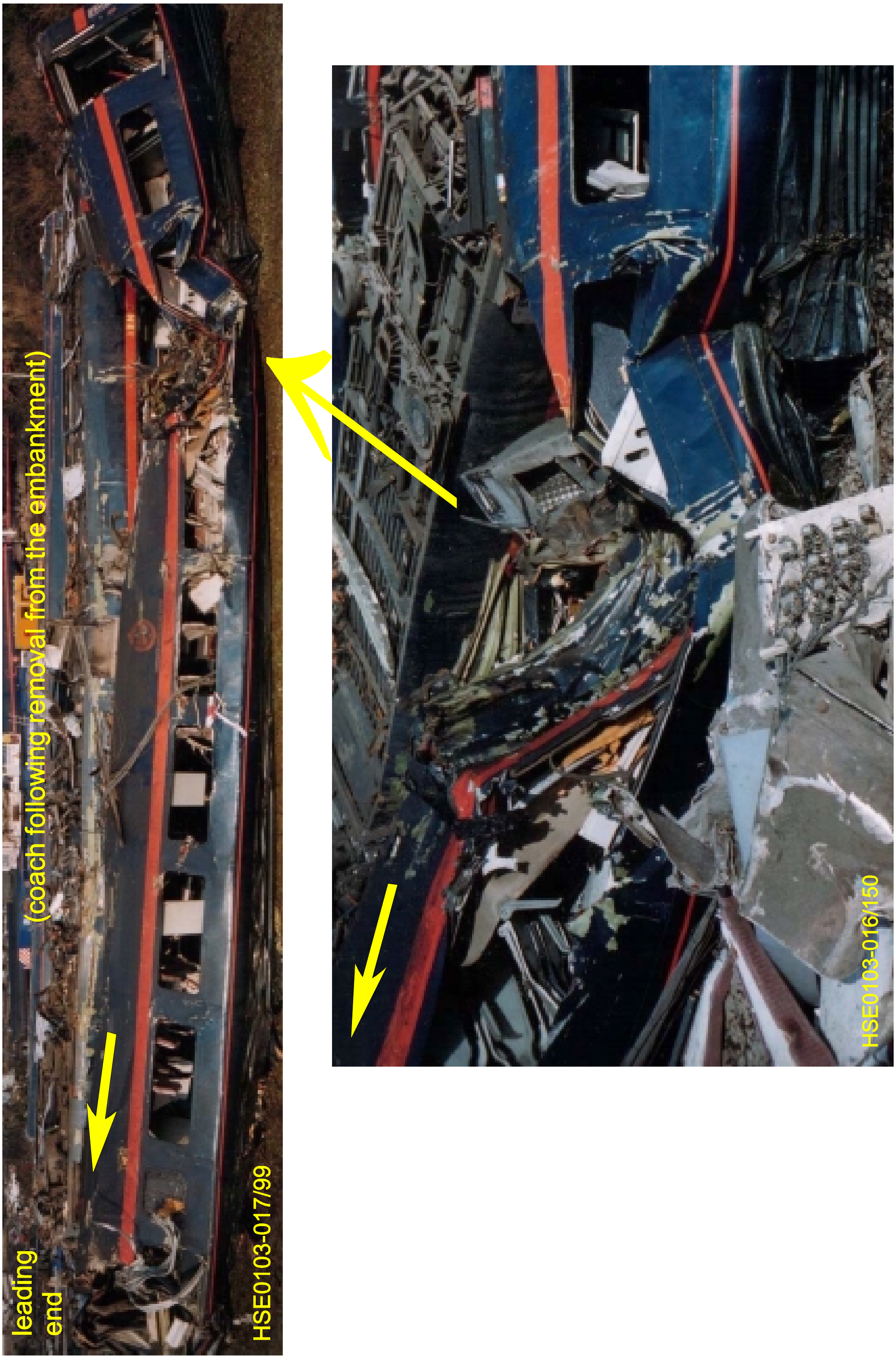


**Figure 13:** **Coach G**

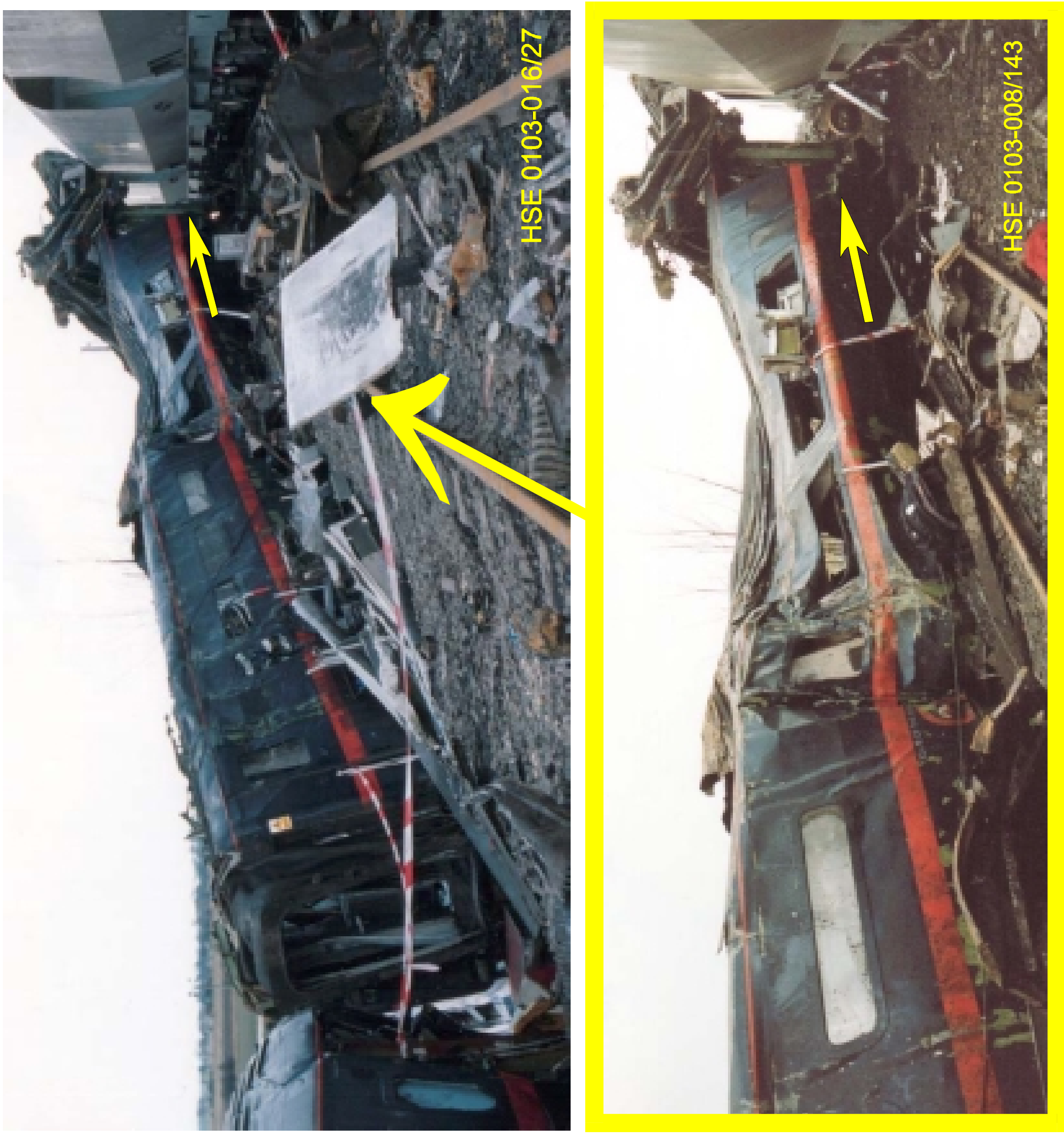


**Figure 14:** **Coach D**

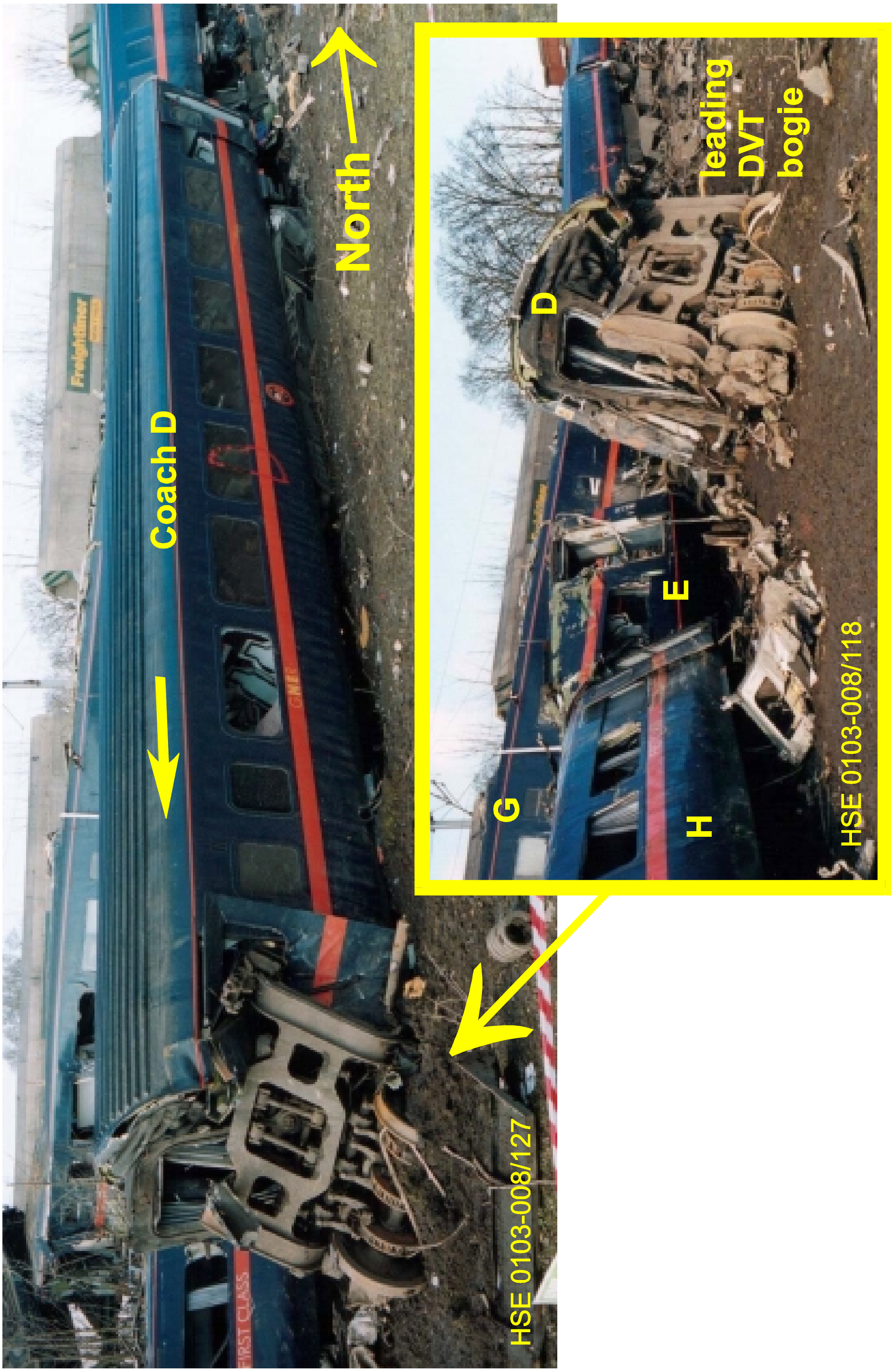


**Figure 15:** **The Class 66 freight locomotive**


## Glossary

| | |
|---|---|
| BTP | British Transport Police |
| Cl66 | Class 66 freight locomotive |
| Cl91 | Class 91 electric locomotive |
| CPS | Crown Prosecution Service |
| CV | Letters defining the radius and type of turnout design |
| DTLR | Department for Transport, Local Government and the Regions |
| DVT | driving van trailer |
| ECML | East Coast Main Line |
| GNER | Great North Eastern Railway |
| HA | Highways Agency |
| HMRI | Her Majesty's Railway Inspectorate |
| HSC | Health and Safety Commission |
| HSE | Health and Safety Executive |
| HSL | Health and Safety Laboratory |
| IC225 | Inter City 225 |
| IECC | integrated electronic control centre |
| NRN | National Radio Network |
| PSB | power signal box |
| Qu-Tron | on train monitoring recorder |
| SMIS | safety management information system |
| STATS-19 | form used by police to record data about road accidents |
| TRL | Transport Research Laboratory |

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