



# Level Crossing Collision – Elizabeth River, NT

## 20 October 2006

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At about 1205<sup>1</sup> on 20 October 2006, a double trailer road-train truck drove into the path of a south bound freight train (6DA2) at a level crossing near the Elizabeth River Bridge, NT. The locomotive drivers sustained minor injuries while the truck driver was uninjured.

### Location

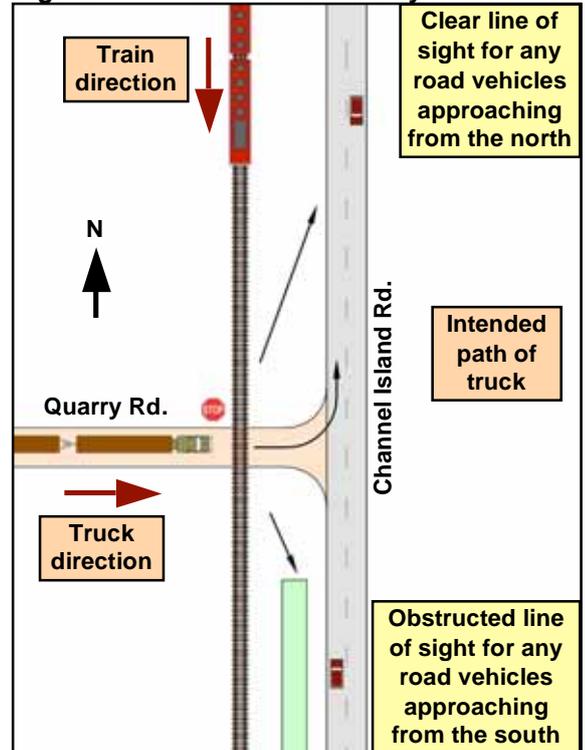
About 17 km south-east of Darwin (NT), a road bridge (Channel Island Road) and a rail bridge (Defined Interstate Rail Network) span the Elizabeth River. Together, the two 510 m parallel bridges are known as the Elizabeth River Bridge.

The accident occurred at a level crossing located about 520 m south of the Elizabeth River Bridge. The crossing provides road access between Channel Island Road and a quarry located a short distance to the west. The level crossing is categorised as an 'Occupational'<sup>2</sup> crossing, and is commonly referred to as 'Quarry Road' level crossing. At this location, the railway and Channel Island Road run almost parallel with about 20 m separation between them (Refer to Figure 1).

The Quarry Road level crossing comprised a single track crossed at right-angles by the roadway. Passive traffic control devices<sup>3</sup> were installed to warn, regulate and guide road users traversing the level crossing. Responsibility for the upkeep and maintenance of the level crossing, within the rail corridor, resided with

Freight Link Pty Ltd (FreightLink). Responsibility for the installation and maintenance of approach warning signage resided with the Northern Territory Department of Planning and Infrastructure (DPI).

Figure 1: Road-Rail Geometry



To assist with strategic co-ordination and oversight of railway level crossing safety, the NT Government has established a Level Crossings Safety Committee which comprises representatives from relevant government departments, Northern Territory Police, relevant rail organisations and the Australian Trucking Association (ATA).

1 The 24-hour clock is used in this report to describe the local time of day, Central Standard Time (CST).  
 2 An 'Occupational' level crossing is constructed for the exclusive use of the occupier of bordering land.  
 3 'Stop' signs and approach warning signs

## Freight Train 6DA2

Freight train 6DA2 was operated by Genesee & Wyoming Australia Pty Ltd (GWA) and consisted of three locomotives (FQ04 leading ALF24 and CLP16) and 27 wagons (13 of which were multiple-unit wagons). The train length was 1057 metres for a total train weight of 1913 tonnes.

The crew of train 6DA2 consisted of two sets of two drivers. The two crews worked rotating shifts with one crew driving and one crew resting. The resting crew were accommodated in a fully equipped crew van marshalled immediately behind the locomotives. The driver at the time of the accident had about 20 years train driving experience and had worked on the Alice Springs to Darwin rail corridor since 2004.

At the time of the collision, both train drivers were appropriately qualified, assessed as competent and medically fit for duty.

## Road-Train Truck

The road-train<sup>4</sup> consisted of a Mack prime mover towing two loaded side-tip trailers. This combination was approximately 27 m long from 'bull-bar' to the rear of the second trailer and had a loaded weight of approximately 70 tonnes.

The driver of the truck, also the owner of the truck and business, was a 45 year old male from Darwin. He was appropriately licensed and had approximately 20 years experience driving road-train trucks.

## Occurrence

Train 6DA2 departed the Berrimah terminal, Darwin, at 1145. About 15 minutes later it approached the Elizabeth River Bridge, travelling at a speed of approximately 87 km/h. At the same time a double trailer road-train, fully loaded with quarry rubble, was

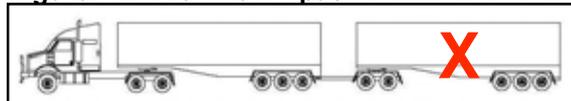
approaching the Quarry Road level crossing from the west.

As they were crossing the bridge the train drivers saw a truck, partially obscured by trees, approaching the Quarry Road level crossing from their right. The train driver sounded the whistle shortly before the train came off the bridge. This was normal practice since the whistle board<sup>5</sup> was located at this point.

The train driver saw that the truck was travelling slowly and even appeared to be coming to a stop at the crossing. He sounded the whistle again in an attempt to draw the truck driver's attention to the approaching train. However, since the truck continued to enter the crossing he immediately placed the train brake in the emergency position. The train drivers realised that a collision was inevitable, so they attempted to protect themselves by laying on the cabin floor. At this point, the train was about 200 m from the level crossing.

The truck driver stated that when approaching the level crossing he looked both left and right, predominantly looking for road traffic on Channel Island Road, and did not notice the approaching train. Just before he reached the crossing, he looked left again, this time seeing the approaching train. Given that the truck was still in motion, the driver felt he would be unable to stop before entering the crossing so he made the decision to accelerate in an attempt to clear the crossing before the train arrived. The truck was unable to clear the crossing and the leading locomotive collided with the second trailer of the road-train at a speed of about 85 km/h.

**Figure 2: Point of Impact**



The force of the impact derailed the leading locomotive and a portion of the truck's load (quarry rubble) entered the locomotive cabin through the broken windscreens. The second trailer of the road-train became detached from

4 Road-train – A combination road vehicle consisting of a prime mover towing two or more trailers, where the second and subsequent trailers are drawn by drawbar connected dollies.

5 The whistle board is a trackside sign installed to remind train drivers to sound the locomotive whistle.

rest of the truck and was pushed off to the side of the track while train 6DA2 travelled a further 560 m before stopping.

The leading locomotive was significantly damaged while the second trailer of the road-train was destroyed. The leading portion of the road-train was largely undamaged, as was the remainder of train 6DA2. Approximately 800 concrete sleepers required replacement due to damage caused by the derailed locomotive.

Both train drivers received minor injuries (abrasions), mostly due to the quarry rubble entering the locomotive cabin<sup>6</sup>. The truck driver was uninjured. The two train drivers and the truck driver were tested for the presence of alcohol. The breath test, administered by an officer of the NT Police, returned a zero reading for all drivers.

## ANALYSIS

An examination of the vehicles (train and truck) involved in the collision revealed no mechanical defects or deficiencies which would have contributed to the accident. Similarly, neither fatigue nor the performance of the train crew was considered to be causal in the collision. Thus the majority of the analysis is focused on the factors which may have influenced the actions of the truck driver and the effectiveness of the level crossing traffic control system.

### Level Crossing Traffic Control

Passive traffic control devices, as installed at Quarry Road level crossing, rely on the road user detecting the approach or presence of a train at the level crossing through direct visual observation. A 'Stop' sign is commonly used where it may be difficult for a motorist to sight an approaching train when approaching a level crossing. Motorists are required to stop in order to sight a train and make an informed decision whether it is safe to proceed over the crossing.

### Traffic control system effectiveness

Given the size and weight of most trains it is not possible to brake at anywhere near the rate of a road vehicle. Heavy freight and locomotive hauled passenger trains normally take several kilometres to slow from high track speeds. Therefore, a train driver is required to plan a stop and start a brake application several kilometres before the required stopping point.

A train driver is unlikely to sight an approaching motor vehicle, and determine its intent not to stop, until both vehicles are relatively close to the crossing and a collision is imminent. By this time, the train driver is unable to take any avoiding action to prevent the collision other than sounding the whistle and (if time permits) make an emergency brake application. Even if the train driver had initiated emergency braking, the train will probably traverse the crossing well before the braking effort becomes effective.

By comparison, a road vehicle (including heavy trucks) can stop relatively quickly. It is for this reason that, regardless of the type of level crossing traffic control, the onus to take appropriate action is very much on the motorist. Consequently, it is important that road signage is effective at warning a motorist that they are approaching a level crossing and provides sufficient distance to stop safely. Similarly, it is important that from the stopped position there is sufficient sighting distance available for the motor vehicle driver to decide whether it is safe to proceed across the level crossing.

### Level crossing compliance

At the time of the accident, Australian Standard AS1742.7-1993 *Manual of uniform traffic control devices Part 7: Railway crossings*, prescribed the standard for traffic control devices that were to be used at level crossings throughout Australia<sup>7</sup>.

Occupational crossings, that are accessible to the general public, are required to comply with AS1742.7. It was evident that road signage on the western approach to the Quarry Road level crossing (Figure 3) was consistent with the

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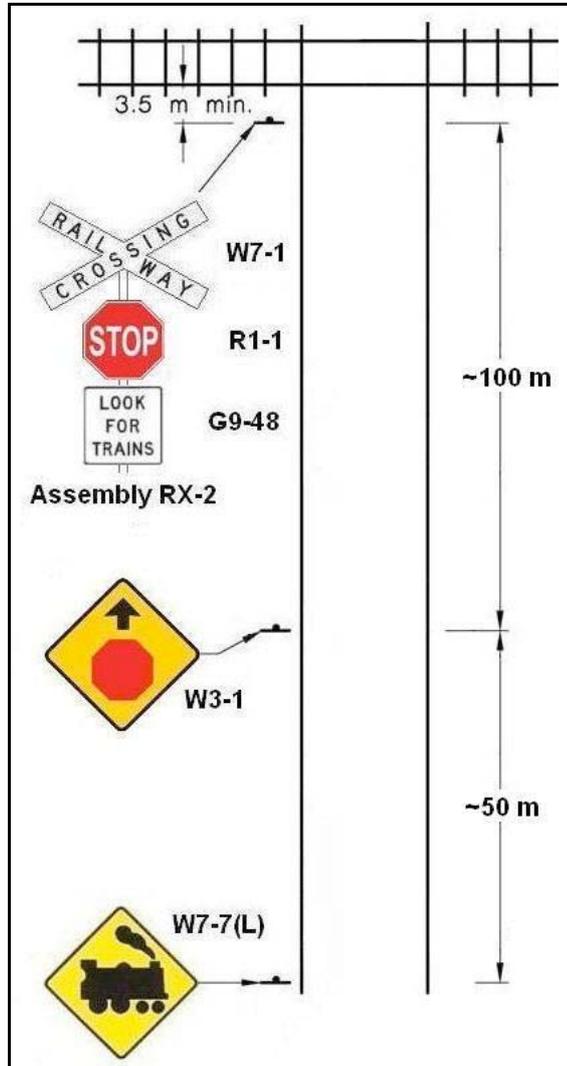
6 By seeking protection on the cabin floor, the two train drivers probably avoided more serious injuries.

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7 During the investigation, a revised version of the Australian Standard was published, AS1742.7 - 2007.

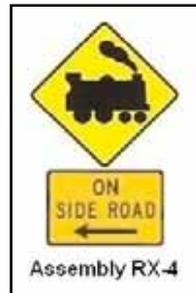
requirements of AS1742.7-1993, noting that road markings on unsealed roads are not required.

**Figure 3: Signage as installed at Quarry Road on 20 Oct. 2006**



While not a contributing factor in this accident, it was noted that the 'Railway crossing on side road assembly' (RX-4, Illustrated in Figure 3) was missing on both Channel Island Road approaches. All other signage was found to be compliant.

**Figure 3:**



The investigation concluded that there was no deficiency in signage along the western approach to the Quarry Road level crossing that would have contributed to the collision.

**Sighting distance**

Australian Standard AS1742.7-1993 does not prescribe the requirements for sighting distance at level crossings protected by 'Stop' signs. However, a design criteria commonly used throughout Australia is documented in Austroads publication AP-G1/03, *Rural Road Design - A Guide to the Geometric Design of Rural Roads*. This guide is largely consistent with the newly revised Australian Standard, AS1742.7-2007.

The 'worst case' scenario at Quarry Road level crossing is for a driver of a triple road-train stopped at the 'Stop' sign, attempting to determine if it is safe to cross the tracks before the arrival of an approaching train travelling at 115 km/h. Under these conditions the calculated minimum sighting distance is about 766 m. The sighting distance for a train approaching Quarry Road level crossing from the north was greater than 1000 m with the centre point of the Elizabeth River Bridge being 780 m from the crossing.

**Figure 4: Sighting distance**



At 1205, when the accident occurred, the sun was almost directly overhead. The elevation and angle are unlikely to have contributed to any significant level of glare or have affected the truck driver's ability to sight the approaching train. The level crossing was observed on the following day, at the same time of day. The environmental conditions were considered similar to the day of the accident and verified that the effects of the sun were unlikely to have contributed to a reduction in sighting at the Quarry Road level crossing.

The investigation concluded that there was no deficiency in sighting distance at Quarry Road that would have contributed to the collision.

## Motor Vehicle Driver Behaviour

Analysis of motor vehicle driver behaviour focused on two main questions:

- why didn't the truck driver stop at the 'Stop' sign, and
- why didn't the truck driver stop for the approaching train?

### *Failure to stop at the 'Stop' sign*

At Quarry Road level crossing, the approach warning signs were clearly visible as was the 'Stop' sign itself. More importantly, the truck driver was familiar with the road, travelled it regularly and was aware that a 'Stop' sign was located at the level crossing. Consequently, an error due to unawareness is considered to be unlikely.

Fatigue can have a profound effect on driver performance. It can reduce attention, increase reaction times and affect memory. It can also affect a person's ability to judge distance, speed and time. However, an examination of the truck driver's work-sleep behaviour established that fatigue was unlikely to have contributed to this accident.

It is common in the NT for road-trains to measure up to 53.5 m in length and be permitted to haul up to 140 t gross combined mass. Stresses on driveline components (engine, transmission etc.) are generally highest on these vehicles when starting from rest, increasing the risk of a failure under some conditions (inappropriate driving or clutch operation). Consequently, truck drivers will, at times, attempt to avoid a complete stop and commonly execute a 'rolling stop'. A rolling stop at a 'Stop' sign is where a driver slows their vehicle such that they can make the decision to safely proceed without coming to a complete stop.

The truck driver stated that, when approaching the Quarry Road level crossing, he slowed to a 'virtual stop', describing the truck's speed as 'walking pace'. This statement is consistent with the train drivers' observations.

It is likely that the truck driver regularly executed a rolling stop at the 'Stop' sign protecting Quarry Road level crossing.

### *Failure to stop for an approaching train*

The truck driver stated that it was not until a second look in the direction of the approaching train that he observed the flashing ditch lights<sup>8</sup> on the locomotive by which time it was too late to stop the truck. The train drivers' statements support this account since their observations were that the truck driver did not seem to perceive or initially respond to the approaching train.

There are two probable explanations for why the truck driver failed to see the approaching train, even though he apparently looked in that direction:

- when the driver first looked to the left, view of the train was physically obstructed; or,
- the driver looked and had a clear view of the train but failed to notice it.

### *Obstructed view*

There was a clear unobstructed view of the Elizabeth River Bridge (approximately 780m, Figure 4) for vehicles travelling along Quarry Road from the tree line, about 20m before the level crossing, to the crossing itself. These observations were supported by the truck driver's statement. When approaching the crossing, there was 'good vision' of the bridge (rail and road), firstly through the front windscreen then through the side window as the truck came closer to the crossing.

For these reasons it is considered that direct sighting of the approaching train was unlikely to have been physically obstructed.

### *Looked but did not see*

Research has shown that, in road accidents, critical/important information may have been detectable but the motorist did not attend to or notice it because their mental resources were elsewhere<sup>9</sup>. Furthermore, research into a

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8 Ditch lights are a pair forward facing lights, in addition to the headlight, used to light either side of the track in front.

9 Green, M. & Senders, J. (2004). *Human error in road accidents*. Retrieved 13 March 2007 from [www.visualexpert.com](http://www.visualexpert.com)

phenomenon known as 'inattentional blindness'<sup>10</sup>, has shown how a person may fail to detect an object even though they were looking directly at it.

The human mind has limited resources for perceptual and memory processing. To cope with this limitation, a mechanism called 'attention' acts as a filter to focus this resource on specific tasks. Research suggests that inattentional blindness can occur when attention is mistakenly filtered away from important information<sup>11</sup> and can be affected by mental workload, expectation, conspicuity and capacity.

The T-junction between Quarry Road and Channel Island Road is located only 20 m from the level crossing (Figure 1). This allows insufficient space for a road-train truck to fit between the level crossing and the junction. Research has shown, when faced with this configuration, a motorist's attention could be drawn towards the intersection and away from the crossing<sup>12</sup> simply because the motorist is aware of it and the requirement to negotiate the intersection safely.

The truck driver stated that when approaching the level crossing, his intended path was to turn left (north) onto Channel Island Road and his attention was directed towards safely navigating the T-junction rather than on the level crossing itself. This was probably exacerbated by roadside vegetation partly obstructing his view of any road traffic approaching from the right (south).

It is likely that the truck driver's attention was focused in the direction of highest perceived risk, being that of traffic approaching from the right and not in the direction of the train approaching from the left. Even when he first looked to the left, the truck driver's attention was probably focused on road traffic and not the relatively infrequent rail traffic. This does not

mean that the driver was not attending to the driving task, only that the majority of his attention resources were probably directed towards the road, to his right in particular, and not towards the train approaching from his left.

#### *Expectation*

Crossing familiarity combined with an expectation that a train won't be present has the potential to lull motorists into becoming complacent or developing poor looking habits<sup>13</sup>. In short, a road user's expectation that a train is unlikely to be at the level crossing is reinforced every time that road user traverses the level crossing without seeing a train.

The truck driver stated that he traversed the Quarry Road level crossing on a regular basis and had only ever seen a few trains. It is likely that familiarity and low expectation of an approaching train combined to mistakenly filter his attention away from the importance of looking for a train.

#### *Conspicuity*

Conspicuity refers to an object's ability to capture attention. Physical factors that affect the conspicuity of an object include size, contrast and movement. The approaching train was large and travelling relatively quickly. However, from the truck driver's perspective when first looking towards the bridge, the perception of size and speed are likely to have been low due to its distance away (>500m) and angle of approach (almost directly towards the truck driver). Similarly, the front of the locomotive was ochre in colour (burnt orange) and unlikely to contrast greatly with the surrounding environment in the Northern Territory.

While the leading locomotive (FQ04) complied with existing standards for visibility, it is likely that low conspicuity may also have contributed to the truck driver's failure to initially notice the approaching train. Conversely, the locomotive ditch lights, which were flashing when the whistle was sounded, are a conspicuity factor that eventually captured the driver's attention,

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10 Mack, A. & Rock, I. (1998), *Inattentional Blindness*. MIT Press: Cambridge, USA

11 Green, M (2004), *Inattentional Blindness & Conspicuity*. Retrieved 13 March 2007 from [www.visualexpert.com](http://www.visualexpert.com)

12 NTSB (1998). *Safety at passive grade crossing. Volume 1: Analysis*. NTSB/SS-98/02.

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13 Caird, Creaser, Edwards, and Dewar (2002) *A human factors analysis of highway-railway grade crossing accidents in Canada*

noting also that the train was much closer by this time.

## Occupational level crossings

The Northern Territory's *AustralAsia Railway (Special Provisions) Act* makes provision to specify rail safety procedures for occupational level crossings. These procedures are documented in the *Protocol for use of Occupational Crossings*, gazetted in March 2004.

With respect to vehicles, the *Protocol* is relevant only if they have more than one articulated vehicle or trailer attached. The procedure states that a person must notify and request approval to use the occupational crossing, at least two days before its intended use. At the time of the accident, the truck driver (owner of the trucking business) was unaware of the *Protocol*, and consequently, did not follow its requirements.

The quarry accessed by Quarry Road was managed by the Northern Territory Department of Primary Industry, Fisheries and Mines (DPIFM), and was leased to multiple tenements. Following the accident at Quarry Road, all tenement holders were advised of their obligation to meet the requirements of the *Protocol*. Similarly, the NT Level Crossings Safety Committee (including the Australian Trucking Association) was briefed on the requirements documented in the *Protocol*.

In addition, signs were erected at the Quarry Road level crossing stating that vehicles exceeding 19m are not permitted to traverse the level crossing. Under these restrictions, a semi-trailer (single trailer, total length less than 19m) may access the quarry and not be subject to the requirements of the *Protocol*. For vehicles longer than 19m, the procedures in the *Protocol* must still be followed.

While the actions taken in relation to the *Protocol* are likely to improve safety at the Quarry Road level crossing, it is unlikely to have prevented the collision. The requirements of the *Protocol* are likely to discourage access by trucks longer than 19 m, but not prohibit their access entirely.

## Other Accidents

There were no records of any previous significant level crossing occurrence at the Quarry Road level crossing. However, there are approximately 180 level crossings in the Northern Territory, many of which are only protected by stop or give way signs. The train drivers stated that they had often experienced near-miss occurrences while operating over this rail corridor, especially in relation to road-trains and other heavy vehicles.

About two months after the accident at Quarry Road, a similar accident occurred at the Ban Ban Springs level crossing about 130 km south-east of Darwin (NT). Again, the accident involved a road-train truck entering the path of a train (Ghan passenger train) at a 'Stop' sign controlled level crossing. The ATSB investigation into this accident includes broader issues of level crossing accidents and motorist behaviour at level crossings in general.<sup>14</sup>

## FINDINGS

These findings identify the various events and conditions that increased safety risk and contributed to the occurrence.

1. It is likely that the truck driver slowed but did not stop at the 'Stop' sign protecting Quarry Road level crossing and this behaviour had become his normal practice.
2. It is likely that a phenomenon known as 'inattentive blindness' contributed to the truck driver's failure to see the approaching train, even though it is likely that he looked in that direction. The road junction, road traffic, low train conspicuity and a low expectation of seeing a train probably combined to mistakenly filter attention away from the importance of looking for a train.

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<sup>14</sup> ATSB Report 2006/015 - Level Crossing Collision between Ghan Passenger Train (1AD8) and Road-Train Truck, Ban Ban Springs (NT), 12/12/06

## SAFETY ACTIONS

Safety actions are taken and/or recommended with the intention of improving railway operational safety. Rather than provide prescriptive solutions, recommendations are designed to guide interested parties on the issues that need to be considered.

Both actions already taken by an agency and recommendations directed to an agency are not necessarily reflective of deficiencies within those agencies. They are taken by, or directed to, those agencies that should be best placed to action the safety enhancements.

### Safety actions already taken

- FreightLink and the NT Department of Primary Industry, Fisheries and Mines have implemented strategies to ensure users of occupational crossings are aware of the *Protocol for use of Occupational Crossings*.
- Road signage has been erected stating that vehicles exceeding 19m are not permitted to traverse the Quarry Road level crossing.
- The NT Government has initiated a campaign to increase public awareness and enforcement of level crossing behaviour.

### Recommended safety actions

#### **RR20070013**

The NT Level Crossings Safety Committee should consider further strategies to reinforce public awareness of risk and encourage safe motorist behaviour at railway level crossings.

#### **RR20070014**

FreightLink should consider strategies to make approaching trains more conspicuous to motorists stopped at, or approaching, railway level crossings.

## SUBMISSIONS

Section 26, Division 2, and Part 4 of the *Transport Safety Investigation Act 2003*, requires that the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate, for the purposes of:

- Allowing the person to make submissions to the Executive Director about the draft: or
- Giving the person advance notice of the likely form of the published report.

The final draft of this report was provided for comment to directly involved parties whose comments have been incorporated into the final report where appropriate.

## MEDIA RELEASE

The ATSB has found that a collision occurred at level crossing near Elizabeth River (NT) on 20 October 2006 because the driver of a road-train truck did not stop at a 'Stop' sign to give way to an approaching freight train.

The Australian Transport Safety Bureau investigation established that an adjacent road junction, low train conspicuity and a low expectation of seeing a train probably combined to mistakenly filter the truck driver's attention away from the importance of looking for a train. Consequently he did not see the approaching train, even though it is likely that he looked in that direction.

The ATSB also concluded that it had become normal practice for the truck driver to slow but not stop at the level crossing 'Stop' sign.

The ATSB report makes recommendations relating to public awareness and visibility of approaching trains and acknowledges that the rail operator and the NT Government have implemented strategies to prevent similar collisions at this location.