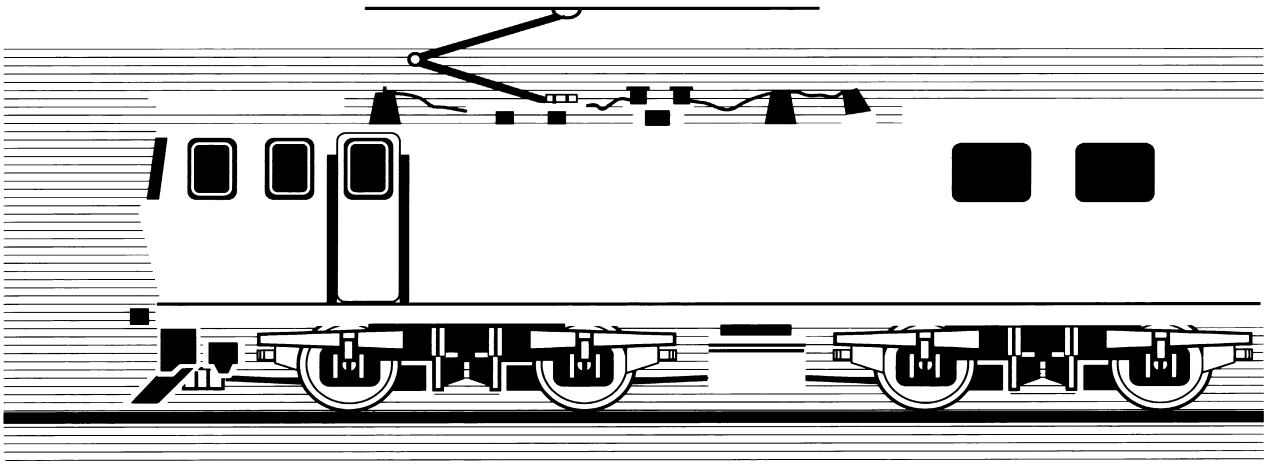
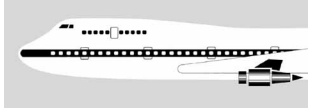
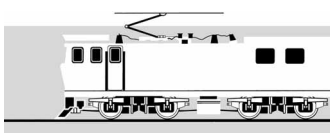


RAILWAY OCCURRENCE REPORT

04-103 **Report 04-103, shunting service Train P40, derailment, 43.55 km near Oringi, 16 February 2004** **16 February 2004**


TRANSPORT ACCIDENT INVESTIGATION COMMISSION NEW ZEALAND

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Report 04-103

shunting service Train P40

derailment

43.554 km

near Oringi

16 February 2004

Abstract

On Monday 16 February 2004 at about 0250 Train P40, a Palmerston North to Oringi return shunting service, derailed when it ran into a washout at the 43.554 km, between Oringi and Woodville on the Palmerston North – Gisborne Line. Six wagons derailed and about 150 m of track were damaged.

Surface water from intense rainfall ponded upstream of culverts at 43.554 km and 43.581 km and washed out about 5 m of track formation.

There were no injuries.

The safety issue identified was the running of trains in adverse weather conditions after special track inspections had ceased.

One safety recommendation was made to the Chief Executive of ONTRACK.

The derailment site

Contents

Figures

Abbreviations

Horizons MW	Manawatu – Wanganui Regional Council
km	kilometre(s)
km/h	kilometres per hour
m	metre(s)
mm	millimetre(s)
PNGL	Palmerston North - Gisborne Line
Toll Rail	Toll NZ Consolidated Limited
Transfield	Transfield Infrastructure Services Limited
Tranz Rail	Tranz Rail Limited
UTC	coordinated universal time

Data Summary

Train type and number:	Shunting service P40
Date and time:	16 February 2004 at about 0250[1]
Location:	Oringi
Persons on board:	crew: 2
Injuries:	nil
Damage:	extensive damage to infrastructure and rolling stock
Operator:	Tranz Rail Limited (Tranz Rail)
Investigator-in-charge:	D L Bevin

[1] Times in this report are New Zealand Daylight Saving Times (UTC+13) and are expressed in the 24 hour mode.

1 Factual Information

1.1 Narrative

1.1.1 On Monday 16 February 2004, Train P40 was a shunting service returning from Oringi to Palmerston North and consisted of 2 DX class locomotives coupled, hauling 8 wagons with loaded milk tanks, with a total gross weight of 464 tonnes and a length of 120 m. The train was crewed by a locomotive engineer and a rail operator. It was raining heavily as Train P40 departed from Oringi.

1.1.2 About 1100 m south of Oringi, the locomotive engineer saw a washout in the track formation about 25 to 30 m ahead of the train. He applied the brakes but could not stop the train short of the washout. The locomotives and the leading 2 wagons negotiated the washout but the trailing 6 wagons derailed.

1.1.3 After crossing the washout the leading 2 wagons parted from each other and from the locomotives and rolled to a stop, upright and still on the rails.

1.1.4 After the locomotives stopped, the rail operator went back to determine the extent of the damage. He radioed back to the locomotive engineer that the train had derailed. The locomotive engineer advised the train controller of the situation.

1.2 Site information

General

1.2.1 The washout occurred at a culvert at 43.554 km between Oringi and Woodville on the Palmerston North - Gisborne Line (PNGL).

1.2.2 The maximum authorised line speed through the area was 80 km/h.

1.2.3 Six OM class wagons with demountable milk tanks and 150 m of track were damaged in the derailment. About 5 m of track formation was washed away.

1.2.4 In the vicinity of the washout, the PNGL ran northwards towards Gisborne on low embankments through flat farmland. The formation was straight near the 43.5 km, with rising grades on either side of a 400 m long level section.

1.2.5 Two watercourses from adjacent catchments, running eastwards, passed under the railway through a culvert at 43.114 km (culvert 43.114), and beneath Rail Bridge 136 (Bridge 136) at 43.990 km. There were also culverts at 43.581 km (culvert 43.581) and 43.554 km (culvert 43.554) carrying excess water from smaller localised catchment areas and local drains beneath the railway.

1.2.6 Old Main Road level crossing was sited on higher ground, at about 43.200 km, just north of culvert 43.114

1.2.7 A stock underpass was situated immediately west of the level crossing and allowed cattle to move freely between a milking shed to the south and paddocks to the north.

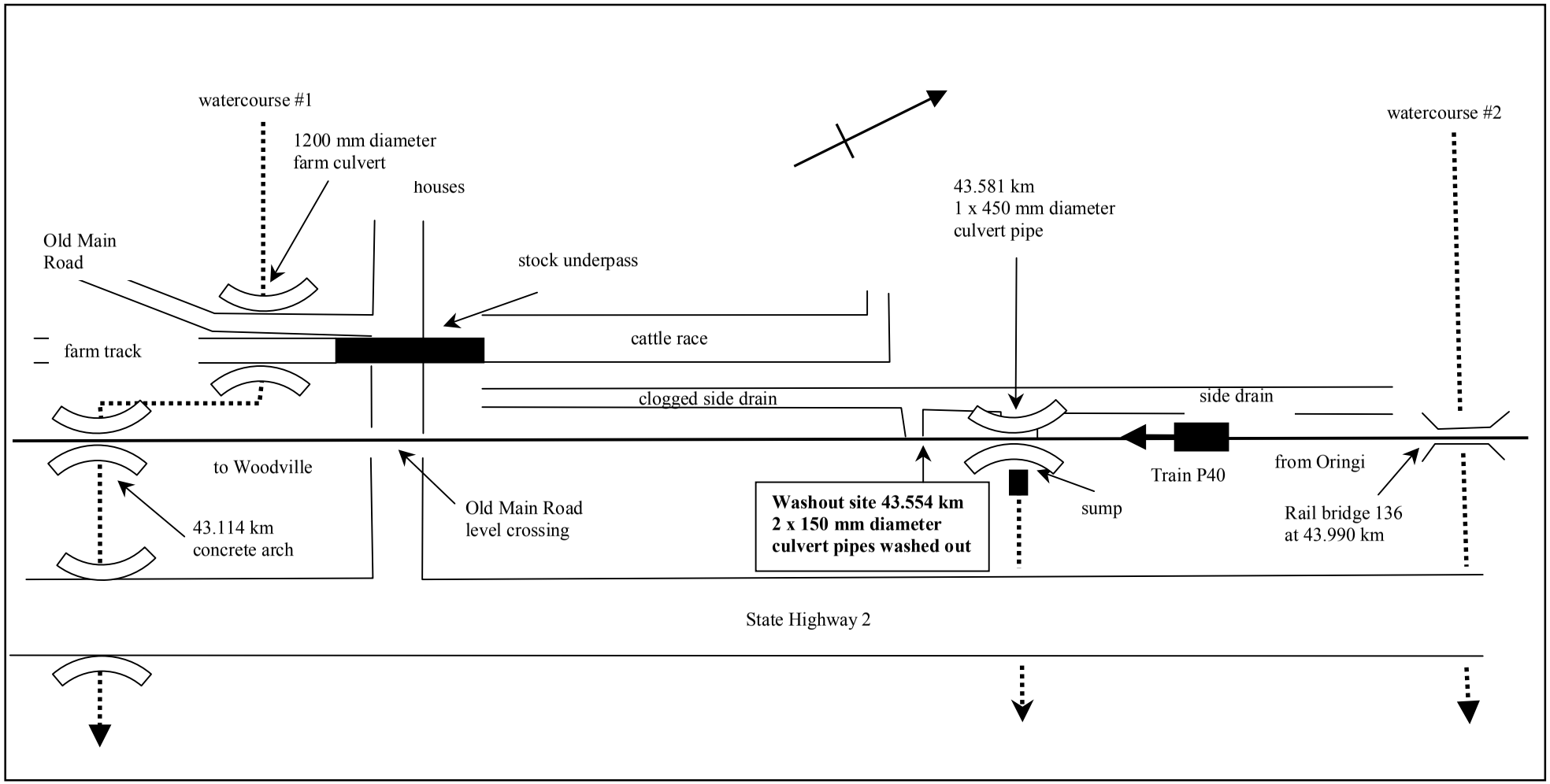


Figure 1
Washout site (not to scale)

The farm culvert

1.2.8 A 1200 mm concrete pipe culvert carried watercourse #1 beneath Old Main Road and the southern approach to the stock underpass (see Figure 1). After exiting this culvert (see Figure 2) watercourse #1 continued on and passed under the rail formation through culvert 43.114.

Figure 2
The outflow from the farm culvert towards the track formation

1.2.9 Although the entrance to the farm culvert was largely free of weeds (see Figure 3), flow in the watercourse had been impeded by an accumulation of weed and debris against a fence a few metres upstream (see Figure 4).

Figure 3
The entrance to the farm culvert after the flooding

Figure 4
The fence in front of the farm culvert after the flooding

Culvert 43.114

1.2.10 Culvert 43.114 was about 440 m south of the washout site and consisted of a 1200 mm diameter concrete arch. Built around 1880, such a culvert would then have been considered appropriate to a catchment of up to about 50 hectares.

1.2.11 The side drain leading to the culvert from the north was well defined and clear.

Culvert 43.554

1.2.12 Culvert 43.554 consisted of twin 150 mm diameter pipes, each barrel made up of 6 one metre sections with socket and spigot joints. Its invert was estimated to have been about one metre below rail level.

1.2.13 The pipes appeared to have been laid in a trench through the clay embankment filling on a gravel bed and with gravel backfill.

1.2.14 The culvert had no headwalls and was substantially shorter in length than the width of the embankment it pierced. The culvert was not shown on the original railway alignment plans, so was of more recent construction.

1.2.15 There was a side drain between Old Main Road level crossing and culvert 43.581, along the western (upstream) side of the formation, but its southern end was choked with growth and debris. The side drain continued past culvert 43.554 to the entry of culvert 43.581. A short lateral drain connected the side drain to the entry of culvert 43.554 (see Figure 7).

Figure 5
The upstream side of culvert 43.554 after the washout

Figure 6
The downstream side of culvert 43.554 after the washout

1.2.16 The last detailed inspection of culvert 43.554 was carried out in 1998, at which time its condition had been downgraded from "good" to "poor" with the comment "Inlet / outlet to clear" endorsed on the M128W Work Order Check Inspection Report. A letter "M" had also been endorsed on the inspection sheet alongside the culvert details to indicate a current work order was in effect. However, there was no record to confirm whether or not the work had been done prior to the washout.

Figure 7
The edge of the track formation at culvert 43.554

1.2.17 Culvert 43.554 did not appear on the M128W Work Order Check Inspection Report dated 7 May 2002 or on the essential features list[2] for the PNGL.

1.2.18 ONTRAC[3] was unable to provide historical details of culvert 43.554 other than detailed inspection records dated 1988 and 1990, which suggested that the culvert was at least 14 years old. When management of bridges and culverts was centralised, the records, if they existed, were probably lost. ONTRACK considered that the culvert had been installed in the days of the district railway offices and might have been installed in response to a previous flood. If a washout had occurred at that site, the pipes may have been installed as part of the clean-up, and in so doing bypassed the normal design and approval process.

1.2.19 Alternatively, the culvert may have been installed in an attempt to compensate for some of the lost discharge capacity of culvert 43.581 following the installation of the sump near its outlet and the possible filling in of that culvert's downstream surface watercourse. Since removing the sump and restoring the surface waterway, both on private land, were impractical, the installation of an additional culvert nearby was possibly seen as the next best option.

1.2.20 The use of small pipes in the culvert meant that they did not have to be buried as deep as the larger 450 mm or 600 mm diameter pipes.

1.2.21 The base of the track formation to the north and south of culvert 43.554 was about 10 m wide but reduced to 6 m at the culvert invert level to accommodate the length of the pipes through the formation. The pipes had been subjected to some movement from the floodwater but Figure 7 shows the approximate position of the barrel[4] of the end pipe in relation to the regular edge of the track formation on the upstream side.

1.2.22 Following the washout these pipes were found blocked with solid mud, clay and debris.

[2] Records any features on the track section that were to be checked during inspections and specifically monitored during special inspections e g inclement weather.
[3] Trading name for New Zealand Railways Corporation, the access provider from 1 September 2004.
[4] The conduit through which the water flows

Culvert 43.581

1.2.23 There was another culvert about 27 m north of culvert 43.554, at the 43.581 km, which consisted of one 450 mm concrete pipe with its invert about 2 m below rail level.

1.2.24 The culvert discharged into an open-topped sump outside the boundary fence, from which excess stormwater overflowed into the surrounding paddock (see Figure 8). The top of the sump was level with the ground surface, about 600 mm above the culvert exit invert level.

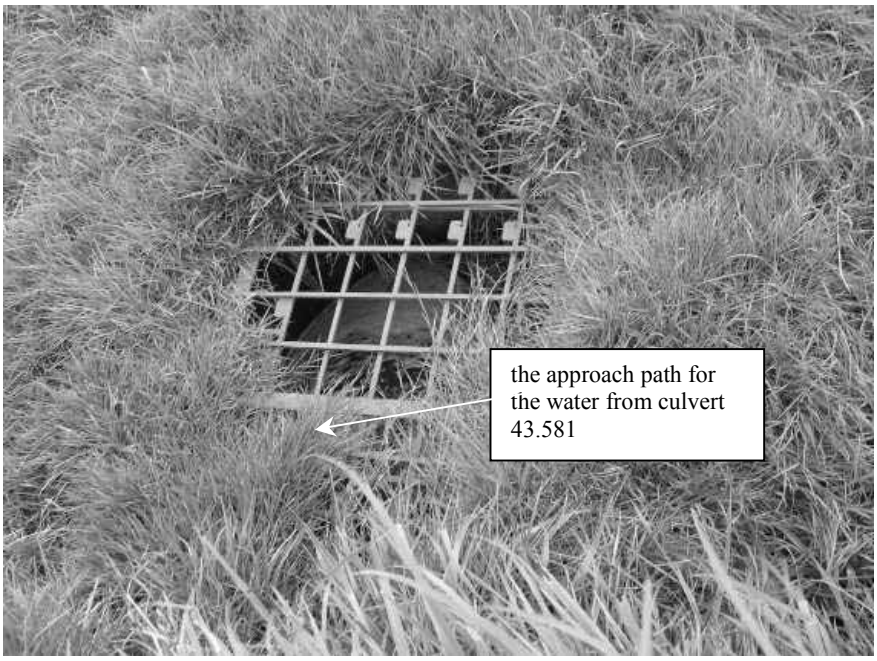


Figure 8
The sump near the exit to culvert 43.581

1.2.25 A plastic pipe of about 100 mm diameter led east from the sump and carried water underground to a discharge point several hundred metres away, on the downstream side of State Highway 2. There was no apparent watercourse in the paddock surface, though a watercourse was visible several hundred metres downstream, on farmland east of SH2.

Bridge 136

1.2.26 Bridge 136 was located at 43.990 km. It was about 15 m long and carried the railway line over watercourse #2 (see Figure 9).

1.2.27 When it was built, the bridge's waterway would have been considered adequate for a catchment of up to about 1500 hectares. However upstream growth in the channel would have reduced its discharge capacity (see Figure 9).

Figure 9
Watercourse #2 at Bridge 136

1.2.28 There was a drain running southwards alongside the track formation from near, but not connected to, watercourse #2 to the low point at culvert 43.554. If flood flows in watercourse #2 exceeded the discharge capacity of Bridge 136, the water would overtop the upstream southern bank and enter this drain to be carried towards culverts 43.554 and 43.581 (see Figure 10).

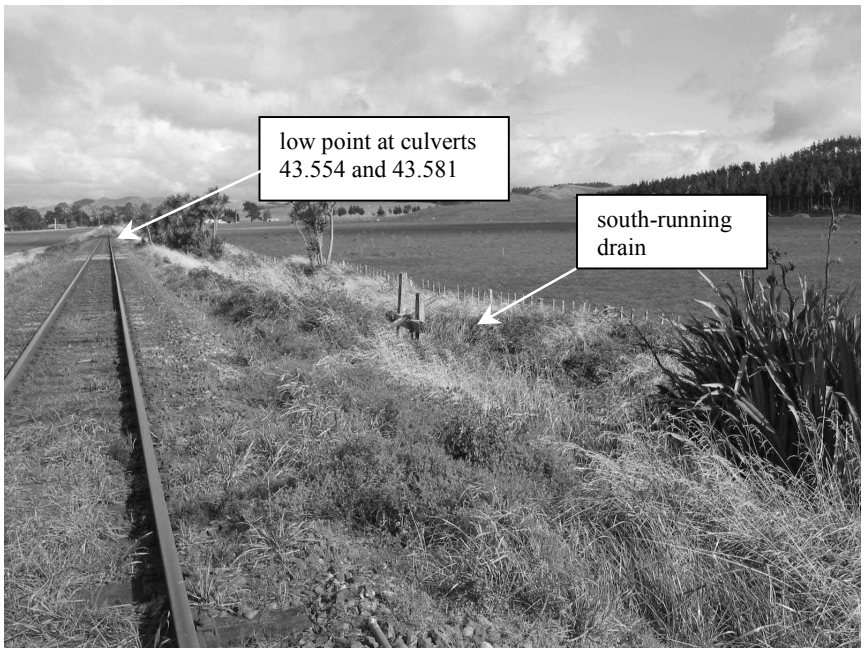


Figure 10
Looking south from Bridge 136

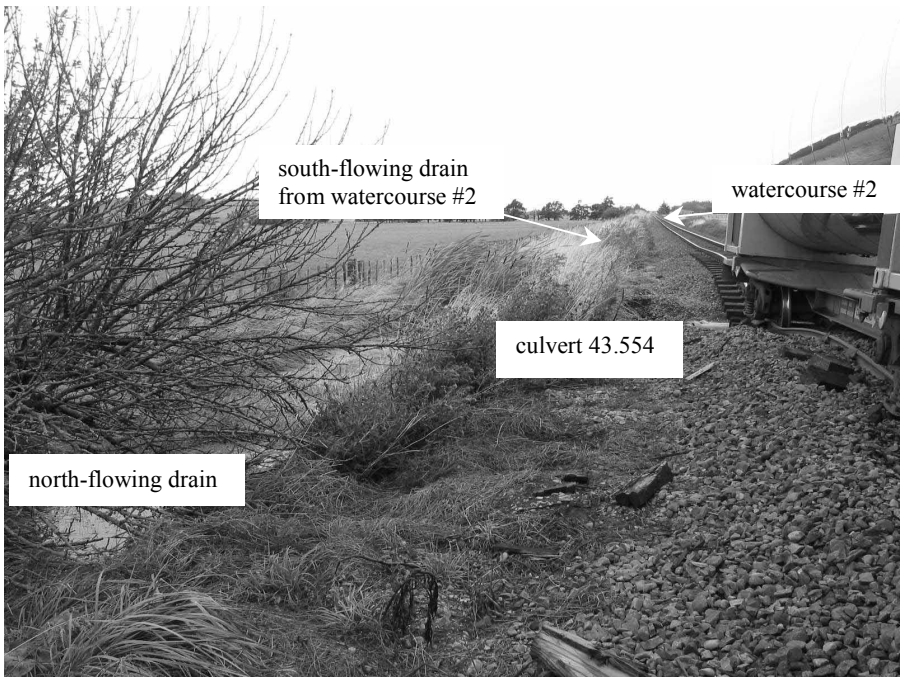


Figure 11
The drains converging at culvert 43.554

The stock underpass

1.2.29 There was a stock underpass beneath Old Main Road. The underpass was 22 m long, 3.5 m wide and 2 m deep, but did not cross under the track formation (see Figure 12). The northern end of the underpass was about 250 m from the washout site.

1.2.30 A pump was installed in the underpass to remove runoff from its immediate vicinity, but the pump was not designed to cope with large volumes of floodwater and eventually it broke down.

Figure 12
The southern end of the flooded stock underpass

1.2.31 The underpass was installed about 12 months before the flood. The Manawatu - Wanganui Regional Council (Horizons MW) and Tararua District Council advised that resource consent for the construction of the underpass was not required.

The cattle race

1.2.32 The stock underpass joined a cattle race to the north that provided access to paddocks about 100 m further on.

Figure 13
The cattle race looking north towards the washout site

1.3 Culvert information

General

1.3.1 Tranz Rail's Structures Code Supplement CSW/0701 Section 7 Culverts, dated 1 August 1995 stated that the minimum practical diameter pipe for new culverts was considered to be 600 mm although in some circumstances pipes of 450 mm diameter were considered appropriate if the culvert was short and could be readily cleaned. There was a requirement that the pipes be laid on a bed of gravel and the excavation backfilled with gravel.

1.3.2 Spun concrete pipes were introduced to New Zealand in the late 1920s. When the Oringi section of the PNGL was built in about 1880, larger culverts were made from mass concrete with either timber beam spans or concrete arches to support vertical loads. Small or shallow culverts were generally of native timber construction, which required constant maintenance and were subject to sudden collapse. By 1960 most of the timber box culverts had been replaced with the more durable and effective concrete pipes.

1.3.3 The minimum practical construction depth for a culvert was considered to be 1.3 m from rail level to the top of the barrel, although it was accepted that it might be necessary to install pipes at lesser depths at times.

Culvert inspection and maintenance requirements

1.3.4 Tranz Rail's Infrastructure Group Code infrastructure inspection requirements for the section of line included:

- twice weekly inspections by a track inspector from a hi-rail vehicle or on foot, including checks that drains and waterways were clear
- special inspections in times of possible danger from storm or flooding

- eight-yearly inspections of culvert structural elements or more often if specially directed by the Manager, Track and Structures Engineering
- annual general engineering inspections by a competent person, deemed suitable by the Infrastructure Manager, on foot or from a slow moving rail vehicle
- additional inspections by the Line Manager to ensure code requirements were being met

1.3.5 The culverts between the 25 km and 70 km on the PNGL were last inspected in February 1998. The 1990 inspection report was used as the base document for the 1998 inspection. Variations in the condition of the culvert since 1990 were endorsed by hand on a copy of the inspection report by the person carrying out the most recent inspection. The M183[5] provided 6 headings for inspections, namely "headwalls", "barrel", "waterway", "stream", "debris" and "overall". It also included a condition index for rating these parts of the culvert. The index was updated during the inspection to highlight priority work as follows:

1. As new
2. Good
3. Fair
4. Poor
5. Unacceptable

1.3.6 The condition index provided for a letter 'M' to be entered beside the condition grading when a work instruction was issued or a work instruction was current. Work orders were then generated from the entries on the M183 Inspection Report and a Work Order Check Inspection Report form M128W, for signing off once the work had been completed, was also generated at the same time.

1.3.7 Alterations arising from the February 1998 inspection had been made by hand to the 1990 version of the M183 Inspection Report for culverts 43.114, 43.554 and 43.581 as follows:

- 43.114 km — the 'M'6 endorsement for the waterway was deleted and replaced in condition indexes by rating 2 (good)
  the rating 3 (fair) for debris had been improved to rating 2 (good) and the endorsement "In/outlet to clear" deleted
- 43.554 km — the rating of the waterway was changed from 2 (good) to 4 (poor) 'M' and the endorsement "In/outlet to clear" included in the general comments column
- 43.581 km — the endorsement of the waterway was showing unchanged as 'M' with the comment "In/outlet to clear".

1.3.8 Tranz Rail's Infrastructure Group Code required that maintenance of culverts was to be arranged as programmed work and that satisfactory completion of the work was to be verified by the Structures Inspector.

[5] The general inspection report for culverts.
[6] Work instruction current.

1.4 Weather

1.4.1 Rainfall figures for Sunday 15 and Monday 16 February from 3 measuring stations surrounding the washout site were supplied by horizons mw (see Figure 14).

1.4.2 The rainfall in the Oringi area both for the 12 and 24-hour periods leading up to the washout were assessed to be greater than a 150-year return period.

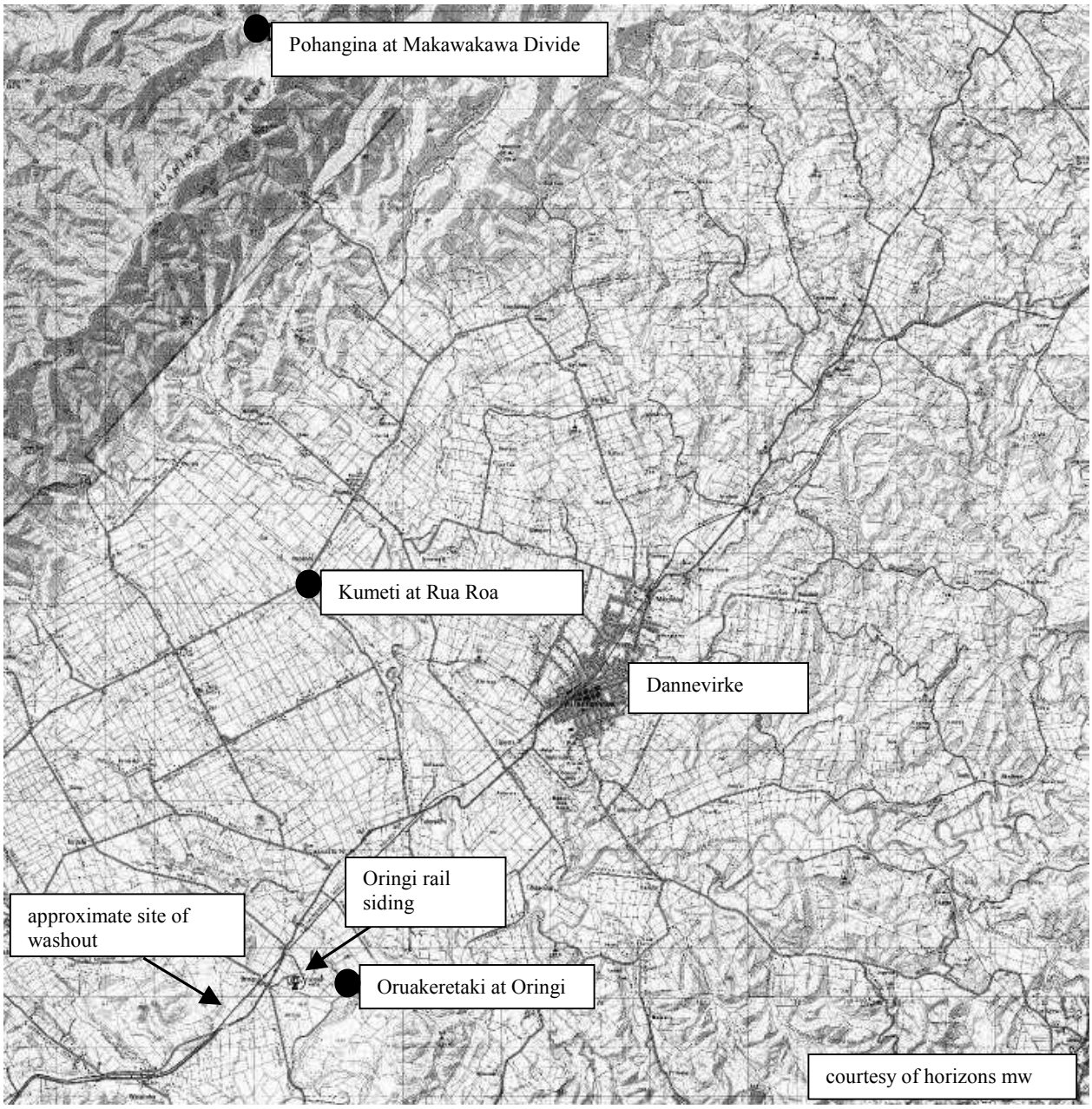


Figure 14
The locations of the rainfall measuring stations in relation to the washout

1.4.3 The following rainfall figures were recorded:

Time Span		Pohangina	Kumeti	Oruakeretaki
0001 Sunday 15 February to 0200 Monday 16 February	26 hours	231.5 mm	150.5 mm	100 mm
1900 Sunday 15 February to 2359 Sunday 15 February	5 hours	79 mm	72.5 mm	46 mm
0001 to 0100 Monday 16 February	1 hour	21.5 mm	11.5 mm	4 mm

1.4.4 Nearly 50% of the rain recorded at the measuring stations during the 26-hour period fell in the 6 hours between 1900 on Sunday and 0100 on Monday.

1.4.5 Average monthly rainfall recorded for February at these sites were Pohangina 222 mm, Kumeti 90 mm and Oruakeretaki 64 mm.

1.5 Localised drainage and catchment information

Watercourse #1

1.5.1 Watercourse #1 carried the runoff from several properties including Farm A. It flowed in an easterly direction, crossing the western boundary of Farm A before flowing into a dam. After leaving the dam the watercourse continued to meander through Farm A before it turned south briefly then west again to run down the boundary to the farm culvert and ultimately to culvert 43.114.

1.5.2 Upstream of the farm culvert, runoff from adjoining properties and from another drain from Farm A had flowed into watercourse #1 faster than the watercourse and downstream culverts could discharge it. The resulting floodwaters overflowed onto paddocks and ponded against the farm culvert before entering the stock underpass and continuing on to 43.581 (see Figure 15).

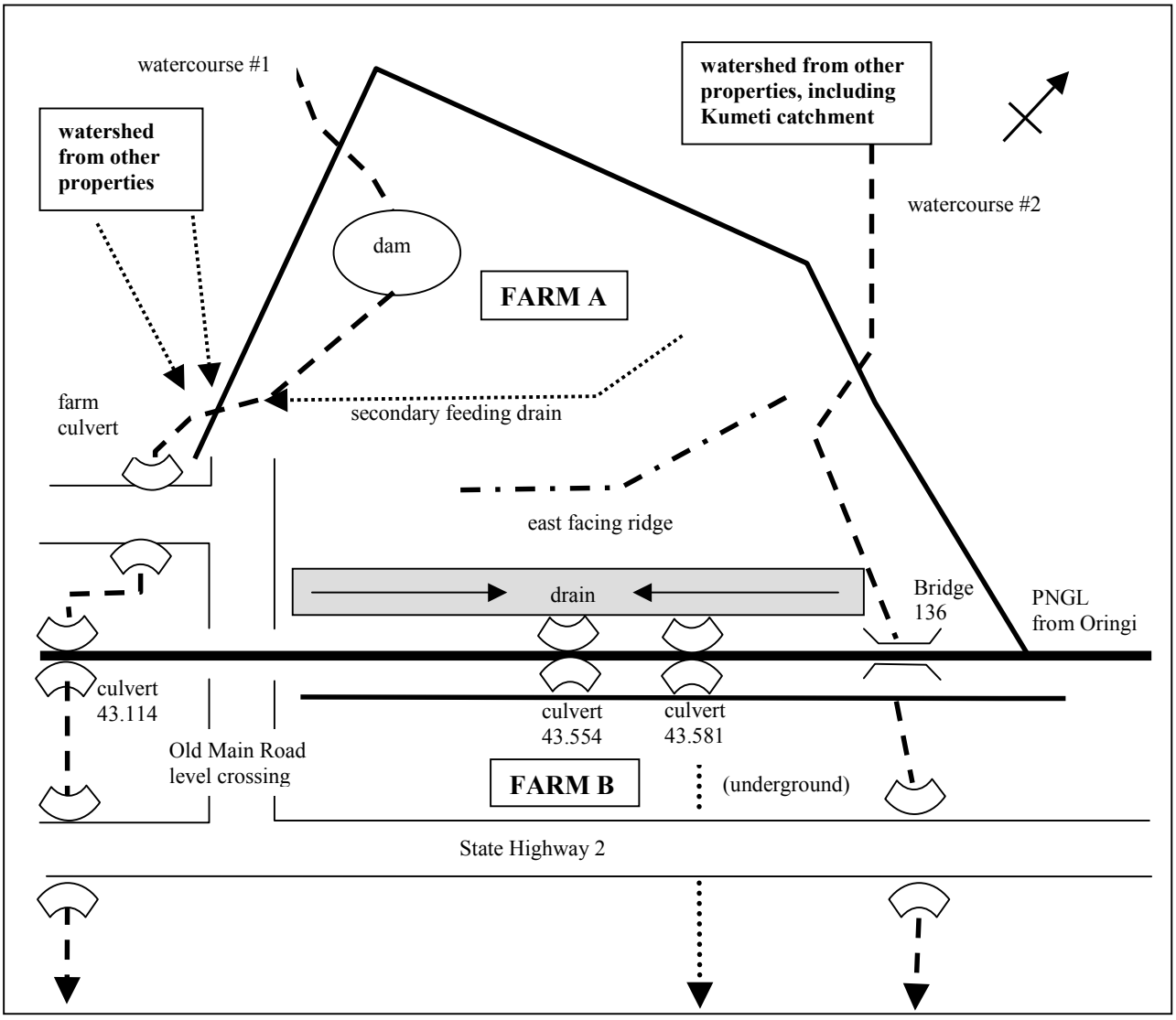


Figure 15
Drainage patterns in the vicinity of the washout
(not to scale)

Watercourse #2

1.5.3 Watercourse #2 carried runoff from several farms and the Kumeti catchment area where it originated. It flowed in an easterly direction, crossing the northern boundary into Farm A, and ran through the farm until it passed under Bridge 136 (see Figure 16). At this point the watercourse bed was about 2 m wide and 2 m deep.

1.6 Surrounding properties

Farm A

1.6.1 Farm A was located on the western side of the PNGL. The farmer (Farmer A) said he had farmed it for about 30 years and the rainfall experienced at the time was the worst he had seen.

1.6.2 The side drain between his cattle race and the track formation had never worked as a drain and had not been cleared in his memory. He was unaware of the existence of culvert 43.554 prior to the washout and could offer no information on when or why it had been installed. The culvert had always been overgrown so he doubted that it had ever carried any water.

1.6.3 During his time on the farm, drainage patterns had been altered by diverting drains to more suitable watercourses but he had not previously encountered flooding problems.

1.6.4 Farmer A did not know if watercourse #2 had breached its banks and overflowed into the drain running south. He had been unable to get to the watercourse because of the conditions.

1.6.5 Farmer A thought that culvert 43.581 would have coped with the surface flooding from the rainfall alone as its catchment area was not especially large, but it was the overflow from watercourse #1 that had caused the washout.

Farm B

1.6.6 Farm B included a paddock on the eastern side of the PNGL, between the track formation and State Highway 2. The farmer (Farmer B) said he had lived in the area for about 50 years and he considered the rainfall at the time to be the worst he had experienced.

1.6.7 Farmer B was unaware of the existence of culvert 43.554 because it was so overgrown. As a result he had not developed any drainage to accommodate water entering the paddock from the culvert's outflow. This absence of drainage had not created any problems such as surface flooding following periods of rain, so he felt that the culvert had probably never carried any water.

1.6.8 The farmer had been present when the 150 mm diameter pipes were removed from the washout site. He noticed they were full of mud, clay and debris. The clay and mud was solid, which further supported his belief that the culvert had never worked.

1.6.9 The underground drain from culvert 43.581 had been in place for as long as he could remember, and there had never been a surface drain to remove water from the paddock.

1.6.10 Farmer B confirmed that on the night of the washout watercourse #2 overtopped its banks upstream of, and at Bridge 136, and the overflow entered the railway side drain and flowed south. Although flows in the watercourse were usually small, about one metre wide, it drained a large area and, on the night of the washout, the flow was much larger and spilled over onto farmland both upstream and downstream of the bridge, flooding both the surrounding paddocks and SH2.

1.6.11 Farmer B considered that culvert 43.581 could have coped with the stormwater runoff from its own relatively small catchment, but not when combined with the overflow.

1.7 Reporting of severe and adverse weather conditions

1.7.1 Tranz Rail's documented procedures for the Reporting of Severe and Adverse Weather Conditions stated in part:

> Train crews and other staff encountering severe or adverse weather conditions likely to affect the safety of operations are to inform Train Control. Train Control must immediately initiate the procedures required to ensure the continued safe operation of trains.
>
> Two Weather Warning "state levels" have been established. These are:
>
> **Level 1 Severe** – weather conditions, which may result in damage to the line due to storm, flooding or other cause that could result in a significant safety risk for Locomotive Engineer, maintenance staff and the public.
>
> Examples are:
>
> - Above average rainfall, or high winds
> - Rivers flowing from catchment areas with heavy rainfall
> - Consistent periods of poor weather
>
> **Level 2 Adverse** – Transfield have assessed the situation and impose an escalation in the level of response required.

1.7.2 Tranz Rail's Rule 6(c) Action When Line may be Damaged or Obstructed stated in part:

> If train crews or any other staff have reason to believe that there is any likelihood of damage to or obstruction of the line as a result of storm, floods … they must immediately advise train control and if required take steps to prevent any train from preceeding in the direction of the damaged or obstructed line until the line has been examined and is clear and safe for the passage of trains.
>
> Gangers must arrange for inspections as they consider necessary and provide track clearance to Train Control authorising resumption of train operations.

1.7.3 Tranz Rail's Infrastructure Group Code, Instruction P22 Special Inspections stated in part that in times of possible danger the Infrastructure Maintenance Service Provider must arrange for such special inspections to be carried out as he considers necessary to safeguard the passage of trains when there was a likelihood of damage to or obstruction of the line due to storm, flooding etc.

1.8 Personnel

The locomotive engineer

1.8.1 The locomotive engineer held current certification for Grade 1 locomotive engineer's duties. He had 31 years experience in locomotive running duties. He commenced his shift at 1555 and was rostered to run Train P40.

1.8.2 The shunting services operating between Palmerston North and Oringi were usually allocated a single locomotive only, and the locomotive for Train P40 was rostered off Train P46, an earlier Palmerston North to Oringi and return shunting service. However, because of the late supply of milk at Oringi to connect with Train P46, and the adverse weather conditions between Oringi and Woodville, Train P46 was delayed and the locomotive engineer thought that Train P46 had not arrived back in Palmerston North until 2030[7].

1.8.3 The locomotive engineer from Train P46 told the locomotive engineer of Train P40 that a creek just north of Woodville had burst its banks and the water was flowing over the balloon loop[8] at Woodville. He also advised the train controller of the conditions at Woodville.

Figure 16
A section of the washed out balloon loop at Woodville

1.8.4 The train controller advised the locomotive engineer of Train P40 that he would arrange for a special inspection of the track ahead of Train P40. In the meantime the locomotive engineer should organise for an additional locomotive to be coupled back-to-back to his original locomotive before departing Palmerston North as they would not now be able to turn the single locomotive on the balloon loop at Woodville on the return journey.

1.8.5 The trip from Palmerston North to Woodville was uneventful even though it was raining heavily and the streams they passed over were running high. At Woodville, the locomotive engineer received a track warrant from train control authorising his train to travel to Oringi and return to Woodville.

[7] The train control diagram did not show the time Train P46 arrived in Palmerston North but recorded it as passing through Woodville at 1847 so an approximate arrival time at Palmerston North would have been about 1930.
[8] This loop provided a connection between the Wairarapa Line and the Palmerston North to Gisborne Line. It was also used for turning locomotives on the Palmerston North to Oringi shunting services to avoid long-hood running through the Manawatu Gorge.

1.8.6 On arrival at Oringi the locomotive engineer learned that there was only enough milk in the storage tanks to load 2 of the 8 tanks on the train so, with the assistance of the rail operator, the train was placed to the loading facility and they waited for the arrival of road milk tankers to complete the loading of the train.

1.8.7 During this time the locomotive engineer heard a radio conversation between the train controller and the Palmerston North ganger, who had arrived in Woodville after carrying out a special inspection from Palmerston North through the Manawatu Gorge. The ganger informed the train controller of the adverse weather conditions and the possibility that the Manawatu Gorge might need to be closed and said he would wait at Woodville for a while before heading back by rail to Palmerston North.

1.8.8 The locomotive engineer said that the ganger had then asked for information about trains in the area and was advised by the train controller that Train P40 was due away from Oringi about midnight. When the locomotive engineer heard this he contacted the rail operator, who was at the loading point, and suggested that he advise the train controller their departure had been delayed because of the lack of milk. The rail operator later confirmed to the locomotive engineer that this had been done and that the train controller had advised the ganger of the delay.

1.8.9 About 20 minutes later, the locomotive engineer heard the ganger speaking with the train controller by radio and saying that he had decided to return to Palmerston North by rail because the weather was deteriorating and he wanted to check the Manawatu Gorge. He said that given the conditions he would probably close the Manawatu Gorge to rail traffic after his inspection.

1.8.10 As they waited for more milk to arrive, the locomotive engineer continued to monitor the train control radio channel. He heard the locomotive engineer of a train travelling on the North Island Main Trunk advising train control of minor slips, fallen trees and flooding at various places on that line. Another train had run into a slip on the Marton - New Plymouth Line immediately north of Wanganui.

1.8.11 At about 0245 the loading was completed and the locomotive engineer called the train controller and advised him they were ready to depart. He had earlier heard that the line between Woodville and Palmerston North had been closed and the train controller confirmed this and told him that Train P40 would be running to Woodville only.

1.8.12 It was still raining heavily and visibility was poor when Train P40 departed. The train had travelled about one kilometre when the locomotive engineer noticed water building up on each side of the track, and a few metres further ahead he saw water running across the track formation from his right to left. The flow was about 3 m wide at that stage and was just below the top of the sleepers. He could see the rail and the tops of the sleepers but little else.

1.8.13 The locomotive engineer initially thought he was approaching a small bridge but then realised he had already passed that bridge and was closer to Woodville. The train was about 25 m away when he first saw the washout and applied the brakes. However, they had no effect and the locomotives dropped, bottomed out, then rode through the washout and climbed back on to stable track formation on the other side. As this happened, the automatic brake valve exhausted so he knew the train had parted.

1.8.14 The locomotives eventually stopped south of Old Main Road level crossing and the rail operator took his radio and went back to check the train. He advised the locomotive engineer that there were no wagons attached to the locomotive. The locomotive engineer turned on the rear headlight then walked back with the rail operator to find the rest of the train. About 100 m from the locomotives they could see a wagon on the rails so the locomotive engineer went back to the locomotives and the rail operator piloted him back to the wagon.

1.8.15 After the locomotives coupled on to the wagon, the rail operator had a look around it and he realised that the demountable tank had broken free of its mountings, so the wagon could not be moved. While the locomotive engineer stayed in the locomotive, the rail operator attempted to make his way further back towards the rear of the train but he could not get beyond the second wagon, about 50 m beyond the first wagon, because of the debris from the derailed wagons and the floodwater.

1.8.16 The locomotive engineer was adamant that the washout had not happened under the locomotives but had occurred prior to the train arriving at the site. He said he did not think there had been any ballast under the sleepers when the train went into the washout, although the weight of the locomotives as they crossed the washout had probably made it worse.

1.8.17 On the outward journey to Oringi there had not been any sign or prior warning of flooding or rising water, although they had noticed that the Manawatu River, and many of the creeks through the Manawatu Gorge and around Woodville, were running high. The locomotive engineer said he had not felt particularly comfortable on the outward journey through the Manawatu Gorge, knowing the problems there had been there in similar conditions in the past.

1.8.18 The locomotive engineer said that he had never seen flooding where the washout occurred before but was aware of other potential flooding sites and had kept an eye on them as the train travelled through them.

The rail operator

1.8.19 The rail operator had been employed by Tranz Rail since 1992.

1.8.20 His rostered shift on Sunday 15 April was 1800 – 0200 (Monday 16 April). Before Train P40 departed the rail operator had spoken with the incoming crew off Train P46 who told him of the condition of the balloon loop at Woodville and suggested they (the Train P40 crew) may require a second locomotive because it would not be possible to turn a single locomotive at Woodville on their return journey.

1.8.21 As they were travelling from Palmerston North to Woodville they noticed the rising river levels and planned to continue cautiously. They were concerned about 2 bridges near Woodville but noticed that the water was not alarmingly high when they passed over them. However, they decided to be cautious on their return journey.

1.8.22 On arrival at Oringi, the rail operator positioned the train to the loading facility and began loading the tanks. There was a delay to loading as the road tankers had difficulty getting to Oringi in the adverse weather conditions, so the rail operator advised the train controller of the situation.

1.8.23 He maintained regular contact with the train controller during the loading operations and was told at about midnight that the Palmerston North ganger was checking the Manawatu Gorge, and the train controller did not like their prospects for getting back to Palmerston North. The rail operator told him that they would be trying to get back to Woodville as that was where their relief was "going to end up eventually".

1.8.24 After the loading was completed, the rail operator returned to the locomotive cab. Although there weren't usually any problems in the area, he suggested to the locomotive engineer that they take it cautiously. He considered they were in one of the safer areas but they agreed to go at reduced speed and take it easy.

1.8.25 As they approached the washout he could see the head of the rails above the water level. They agreed that the rail was still there so they didn't take much more notice. Suddenly he felt the locomotives jump and knew they had run into a washout.

1.8.26 The locomotives stopped about 350 m beyond the washout site. The rail operator immediately left the cab and walked back to assess the situation. He radioed the locomotive engineer and told him that the train had derailed and that there were wagons "all over the place".

1.8.27 He walked back as far as he could until he was up to his knees in water and could hear the water roaring when he decided to retreat and made his way to an adjacent farm paddock from where he rang his manager and advised him of the situation.

1.8.28 The rail operator also rang the milk company to advise them that the milk tanks had tipped from the wagons and some were leaking. They dispatched a truck to the site and the rail operator accompanied the truck driver towards the washout. However, because of the depth of the water and the darkness, the milk company employees decided to wait until daylight to assess the situation.

1.8.29 The train crew was eventually rescued when it became possible for a 4-wheel drive vehicle to access the site.

The Palmerston North ganger

1.8.30 The ganger carrying out the special inspections was a Transfield[9] employee and was responsible for the Otaki to Palmerston North and Palmerston North to Woodville sections. On Sunday 15 February 2004 he made 3 return inspection trips through the Manawatu Gorge as follows:

- first trip 1030 – 1500
- second trip 1700 – 2259
- third trip 2259 - 0200 (Monday 16th February)

1.8.31 On arrival at Woodville on his second trip he checked the water levels around the balloon loop[10]. He spoke to the train controller, who asked him to do an inspection to Oringi but the ganger said that he was not certified for that area and that the train controller would have to contact the acting ganger based in Dannevirke.

1.8.32 Before leaving Woodville on his third trip, the ganger advised the train controller that it was still raining heavily. He was returning through the Manawatu Gorge at about 2349 when he came across a slip. He could not get past it so he told the train controller that Train P40 would not be able to get through, and he returned to Woodville[11].

1.8.33 The ganger said that he always tried to time his inspection runs as close as possible to expected train times. On this occasion he had been told by train control that Train P40 was expected to depart from Oringi at about midnight.

1.8.34 The Palmerston North ganger had maintained close communication with the train controller during the special inspections and advised him of line closures as they occurred. These notifications were endorsed on the train control diagram by the train controller.

[9] Transfield became the infrastructure maintenance service provider to Tranz Rail on 22 March 2002.
[10] The train control diagram showed the ganger arrived in Woodville at 1905 and, after inspecting the balloon loop, closed it at 1910.
[11] The train control diagram showed the Manawatu Gorge was closed to rail traffic from 0005 on Monday.

The Dannevirke acting ganger

1.8.35 The Dannevirke acting ganger was a Transfield employee. He said that he had completed his last inspection run from Woodville to Dannevirke and return at about 2130 on Sunday 15 February[12]. He had made this run at the request of his manager, the Napier area co-ordinator, because of the adverse weather conditions and because the milk trains were running to and from Oringi. Because it was the worst weather he had seen since living in Dannevirke, he was already preparing to do the run when the area co-ordinator called.

1.8.36 The acting ganger said that after completing his special inspection by hi-rail vehicle to Oringi he had returned to Woodville by road to prepare for a special inspection to Pahiatua.

1.8.37 On arrival back at Woodville the Dannevirke acting ganger did an inspection run down the Wairarapa Line as far as Pahiatua in preparation for a shunt service scheduled to run early the next morning. He said he returned to Dannevirke by road, arriving about midnight, having passed through Oringi about 20 minutes earlier, and finished work, as he had reached his maximum driving hours.

1.8.38 There were no endorsements on the train control diagram to indicate that any problems had been encountered during the special inspection. The acting ganger had cancelled his track warrant for the Woodville to Oringi special inspection with the train controller at about 2045. Train P40 travelled safely through the section about 75 minutes later.

1.8.39 Likewise, when the Dannevirke acting ganger completed his special inspection to Pahiatua and cancelled his track warrant with the train controller there were no endorsements on the train control diagram to indicate that any difficulties had been experienced.

The Napier area coordinator

1.8.40 The Napier area coordinator was the Transfield employee responsible for infrastructure maintenance and renewal from Masterton to Woodville on the Wairarapa Line and from Woodville to Gisborne on the PNGL. He had a staff of 20, including the acting ganger at Dannevirke.

1.8.41 He had received a telephone call from the network control manager advising him that the weather was going to deteriorate. He found out what trains were running and arranged for the acting ganger at Dannevirke to undertake special inspections ahead of those trains.

1.8.42 The coordinator said the Dannevirke acting ganger was the only person in the area certified to undertake special inspection runs and the area co-ordinator said that once the acting ganger had exceeded his maximum hours for the day there was no other staff available to continue the special inspections.

1.8.43 He said that he was called by the network control manager about 0400 on Monday 16 February and advised of the derailment. He said the area was not known for washouts and he was unsure of what could have caused it. The stock underpass had only been in place for about a year and, as it was the heaviest rain in the area since it had been installed, he said he thought it might have contributed to the washout.

1.8.44 The area coordinator advised that two 475 mm diameter pipes were to be installed to replace the pipes at the washed out culvert.

[12] The train control diagram showed the acting ganger had returned to Woodville about 2040 and had undertaken the special inspection to Pahiatua between 2045 and 2145.

The network control manager

1.8.45 The role of the network control manager included in part the management of the network on a continuous roster or callout basis to maintain effective mainline rail operations.

1.8.46 He was at work from 1830 on Sunday 15 February because of concerns regarding inclement weather across the rail network. He had left work at 2030, at which time the train controller was arranging for a special inspection to be run from Woodville to Oringi. At about 0115 he returned to work because the train controller told him that there were weather-related problems arising in areas across the lower North Island.

1.8.47 Although he had the authority to close down operations on the network during inclement weather, there was no procedural requirement for him to do so. He said he had not done so as the information he received had not indicated conditions were as bad as they later proved to be. He said that he felt that a call to close down operations rested with staff in the field as they had a better idea of conditions and were best placed to advise him in that regard.

The train controller

1.8.48 The train controller had commenced his shift at 2300 on Sunday 15 February. By that time, the special inspection between Woodville and Oringi had been completed and he recalled that no problems had been reported over that section, although the Manawatu Gorge had already been closed to rail traffic by the Palmerston North ganger during the previous train controller's shift[13].

1.8.49 Train P40 at Oringi was the only train in the area and at about 0230 the crew advised him that they were ready to depart. They confirmed they were happy to proceed to Woodville, where they were expecting to be relieved.

1.8.50 About 15 minutes later, the crew of Train P40 advised him by radio that they had hit a washout and derailed. He immediately started to arrange assistance to go to the site.

1.9 Locomotive event recorder

1.9.1 The locomotive event recorder data was downloaded and supplied for analysis.

[13] The train control diagram showed that in fact it was the balloon loop at Woodville that had been closed on the previous train controller's shift. The Manawatu Gorge was not closed to rail traffic until about 0010 on Monday.

2 Analysis

2.1 The storm in February 2004was notable for its severity and long duration. The rainfall for 12- and 24-hour periods was assessed as greater than for a 150-year return period and severely affected several catchment areas. Farmer A and Farmer B, both of whom were long-term residents, confirmed that they had not experienced such a period of heavy rain during their time in the area.

2.2 Although the recorded rainfall measurements for the 26-hour period reduced from Pohangina in the Ruahine Ranges to Oruakeretaki (nearest to Oringi), the rainfall trend was reflected in the data from all sites, each of which recorded figures in excess of the average monthly rainfall for the site during the 26-hour period. Similar reports of flooding and damage from other parts of the lower North Island showed that the weather conditions were not limited to the Woodville and Oringi areas.

2.3 Runoff from already saturated catchments resulted in large flood flows, but especially streams and rivers from bigger catchments because of their longer times of concentration. Flood levels in watercourse #2, fed from a catchment extending back to the Ruahine Ranges, caused the water to overtop its banks both upstream and downstream of Bridge 136. The bridge's design waterway was reduced by growth and other obstructions in the channel, but considering the high volumes being discharged, the loss of section was unlikely to have been a significant factor in the surface flooding that resulted upstream of the railway embankment to the south.

2.4 Water levels also rose in watercourse #1, to the extent that floodwater overflowed onto paddocks some distance upstream of the farm culvert. It is likely that its escape through culvert 43.114 was impeded by the farm culvert and debris against the fence just upstream, which may have caused surface flooding. This surface flooding probably made its way northwards through or past the stock underpass and added to the ponding on the upstream side of the railway.

2.5 The floodwater from watercourses #1 and #2 arrived faster than it could discharge through culvert 43.581 and, with no relief from the blocked culvert 43.554, it ponded and rose against the track formation, probably over the whole of the 400 m level section. Had the floodwater not broken through at culvert 43.554 it might have stabilised without overtopping the formation and drained away when further overflow diminished and stopped. Alternatively, depending on the volumes and flow rates, the rising water might, in time, have overtopped the level section, possibly with little or no track damage on such a long front, but also possibly still causing enough damage to derail Train P40. Flows through the comparatively small cross section twin barrels of culvert 43.554, had they not been blocked by debris, would probably have slowed the rate at which the ponding floodwater rose but would have been insufficient to halt it.

2.6 Scour damage to the clay fill embankment was confined to the short length around culvert 43.554 that had been excavated and backfilled with gravel. It is therefore likely that the gravel filling scoured as result of internal erosion before the rising floodwaters overtopped the track ballast. The hydraulic gradient through the gravel was steeper than through the clay fill of the embankment, because the 6 m long culvert barrels were short compared with the 10 m or so wide at invert level clay formation. The clay filling was also more impervious.

2.7 Culvert 43.554 was the weak point because the other culverts were longer, deeper and of greater diameter. With culvert 43.554 blocked, the water would have seeped through the gravel bedding around the pipe.

2.8 ONTRACK was unable to establish the history of culvert 43.554. It did not appear on the original alignment plans for the PNGL and was unusual in that:

- it consisted of twin small pipes rather than the normal option of one larger pipe
- the diameter of the twin pipes, 150 mm, was smaller than the 450 mm or 600 mm standard minima
- it was not located on a watercourse
- it was only 27 m from existing culvert 43.581
- it was much shorter than required for the embankment it pierced.

2.9 Culvert 43.554 was possibly installed either as part of a clean-up following an earlier flood, or to compensate for some of the lost discharge capacity of culvert 43.581 following the installation of the sump. For whatever reason, such work was permissible without specific engineering design, and was also likely to have been within the delegated financial authority of a supervisor. There may therefore have been no formal records of the culvert's installation. Unfortunately neither Farmer A nor Farmer B had been aware of the existence of culvert 43.554 prior to the washout so they could not provide or confirm details of the culvert's history.

2.10 The culvert's installers appear to have failed to appreciate the risk of failure of the gravel bedding and backfill from internal erosion if water ponded against the embankment. The twin 450 mm diameter replacement pipes appear to be similarly vulnerable, and with inverts below ground level, prone to silting.

2.11 The increased pipe diameter sizes at culvert 43.554 will reduce the chances of blockages but will also increase the amount of water flowing into the adjacent paddock under similar conditions so, while the larger pipes will reduce the chances of a further washout at 43.554 the risk of flooding on the downstream side of the track formation will remain.

2.12 Prior to departing from Palmerston North, the crew of Train P40 had obtained up-to-date track and weather information from the inbound crew on Train P46 and were aware of the potential trouble spots en route. At each of these places they had travelled cautiously and had kept a sharp lookout for any signs of formation failure. While the milk tanks were being loaded at Oringi, the locomotive engineer had appropriately monitored the train control radio channel and gathered information relating to the weather situation.

2.13 The gap created by the missing track formation was below water level and would have been impossible to detect because of the darkness and the rain. The rails and sleepers were unsupported, hanging with no ballast or track formation beneath them, when the train approached. The rails and tops of the sleepers were visible above the water level, as were the lengths preceding and beyond the washout.

2.14 Analysis of the locomotive event recorder data showed that the train was travelling at about 57 km/h when it encountered the washout. While this may have seemed excessive for the conditions at the time, it was well below the maximum line speed, and it was probably because of the speed that the locomotives safely traversed the washout site. Without any forewarning of the washout, it is doubtful that had the train been travelling any slower the train crew could have identified the washout and stopped short of it. The speed of the train was therefore not a contributing factor to the incident.

2.15 A basic assumption of railway operation is that tracks are safe at all times for the passage of trains, subject to specified conditions. Tranz Rail engaged Transfield to provide inspection and maintenance services to ensure that trains could operate safely at all times and required that Transfield's length gangers carried out such inspections as they considered necessary in bad weather and provided certification of safety to train control. By late evening on Sunday 15 February the extent and intensity of the storm over the lower North Island was widely

recognised, and special inspection procedures had been implemented. Half of the very heavy rain which fell on southern Hawke's Bay and northern Wairarapa during the storm occurred in the 6-hour period between 1700 on Sunday 15 February and 0100 on Monday 16 February but flows in the larger streams and rivers were still to peak. The peak in watercourse #2 probably occurred after Train P40 had arrived in Oringi.

2.16 The fact that the Dannevirke acting ganger, despite completing his hours, felt he could go home without closing the track, believing that there was no one else to continue the special inspections, may indicate that the weather conditions had not got any worse, and may have improved somewhat. Certainly the willingness of the crew of Train P40 to travel back to Woodville would suggest that, although it was still raining heavily and visibility was poor, their concerns regarding the conditions had not increased to the extent that they were no longer prepared to proceed to Woodville.

2.17 Despite the running of special inspections there was always the chance that a washout or slip could occur some time after the inspection and before a train passed through that area, as was the case at culvert 43.554. This risk could be minimised, but not completely removed, by ensuring that special inspections were run as close as possible to the passage of a train through the area. In this regard the special inspection carried out prior to Train P40's outward journey to Oringi was not undertaken in a reasonable time of the train passing through the area. No further special inspection was done before Train P40 departed Oringi on its return journey some 5 hours later. Even if Train P40 had departed on or close to the train controller's original anticipated time of about 0001, this would still have been 2 hours after the arrival of the inward Train P40 and more than 3 hours after the last special inspection. In the continuing adverse weather conditions these were excessive and inappropriately long periods of time.

2.18 Because a shunt service was scheduled to operate to Pahiatua early the following morning, the Dannevirke acting ganger was required to undertake a special inspection of the track from Woodville to Pahiatua on the Wairarapa Line so, after completing his rail inspection to Oringi, he returned to Woodville by road. He was in Pahiatua when Train P40 travelled through Woodville en route to Oringi. However, the time between the special inspection and the planned running of the shunt to Pahiatua was excessive and that special inspection should also have been done closer to the running of the train.

2.19 Transfield's inspection staff had been aware of the storm's localised severity. This was reinforced by the damage that occurred to the balloon loop at Woodville leading to its eventual closure at about 1910, and of the potential for further damage, yet there appeared to have been no communication between them regarding conditions in their respective areas. Such communication would have confirmed, if indeed that was necessary, the intensity of the storm and the damage being caused locally and may have led to a decision by them to close the track to all train movements. However, at the time the Manawatu Gorge was closed the Dannevirke acting ganger had finished his shift and gone home. The eventual closure of the Manawatu Gorge meant that Train P40 was not going to be able to reach Palmerston North anyway.

2.20 The train control diagram contained endorsements for the track closures made by the Palmerston North ganger, as well as accurate details of the movements of the respective track inspectors. The fact that there were some discrepancies between times remembered by the inspecting staff and train controller and those recorded on the train control diagram was probably understandable given the work loads generated by the conditions. These variations were not an important issue in the context of this investigation as the events of that evening were accurately documented on the diagram.

2.21 The continued availability of qualified personnel, together with the length of track to be covered, determined the level, duration and frequency of special inspections possible in extended adverse weather conditions. Because such resources are limited, if adverse conditions are such that continued on-going special inspections are required, but no qualified staff are available to undertake them, the running of trains through such affected areas should be halted until the recommencement of special inspections was possible. A safety recommendation covering this issue was made to the Chief Executive of New Zealand ONTRACK.

2.22 Although the network control manager had the authority to close any line to rail traffic, he lacked the necessary information on which to base such a decision. He relied on Transfield's organisation to arrange whatever special inspections were necessary, and in the absence of information to the contrary, reasonably assumed that the lines were clear and safe. He knew that special inspections had been initiated, and had no reason to believe that they would cease without him being notified.

3. Findings

Findings are listed in order of development and not in order of priority.

3.1 Train P40 derailed when it passed over a site where the track formation had been washed away by floodwaters.

3.2 Exceptionally heavy rainfall caused floodwaters to overflow from watercourses #1 and #2 upstream of the railway and to flow to the low point of the track. The water ponded against the railway embankment because the rates of discharge of culvert 43.581 could not cope with the increased water volumes.

3.3 There was no record of the clearing of the inlets or outlets of culvert 43.554.

3.4 Culvert 43.554 was blocked and could not therefore assist culvert 43.581 with the discharge of the water ponding against the track formation.

3.5 Ponded water rose to a level where it seeped through the gravel bedding and backfill of an additional culvert, which had been installed at 43.554 km, and resulted in a washout of the gravel by the process of internal erosion.

3.6 The resistance of the gravel bedding and backfill to internal erosion was reduced because culvert 43.554 was only 6 m long, whereas the embankment it pierced was about 10 m wide at invert level, making this culvert the weak point.

3.7 There were no records for the design, approval or construction of the culvert at 43.554 km.

3.8 The level of response by track staff to the adverse weather conditions up to midnight was adequate. However, a lack of appropriately qualified personnel meant it was not possible for the running of special inspections to continue once the inspecting ganger had reached his maximum driving hours, and the track should have been closed.

3.9 Considering the severity of the storm, the interval between the arrival of Train P40 at Oringi and its subsequent departure for Woodville was too long without a special track inspection.

3.10 Train P40 was being operated correctly at the time and the actions of the locomotive engineer did not contribute to the incident.

4. Safety Actions

4.1 On 27 September 2004 ONTRACK advised that culvert 43.554 had been reinstated using 2 new 450 mm diameter pipes on 18 February 2004.

Figure 17
The replacement pipes installed at culvert 43.554

5 Safety Recommendations

5.1 On 4 August 2005 the Commission recommended to the Chief Executive of ONTRACK that he:

> ensure adequate suitably qualified personnel are available to provide coverage for special inspections during adverse weather conditions, and for an appropriate period afterwards while a threat of flooding exists, or if not make arrangements to close- the affected line to rail traffic (072/05).

5.2 On 1 August 2005 the Chief Executive Officer of ONTRACK responded to the preliminary safety recommendation, which was subsequently adopted unchanged as the Commission's final safety recommendation as follows:

> ONTRACK accepts this recommendation. We believe that our current safety system covers this. Closure of line due to non availability of staff to carry out inspections is covered in semi permanent bulletin 379

5.3 On 11 August 2005 the Chief Executive of ONTRACK advised, in part:

> On 6 June 2005 ONTRACK issued Semi Permanent Bulletin 379 containing specific instructions on reporting and actions to be taken in the event of adverse weather conditions. This includes specific instruction to stop all trains in the affected area until inspection and remedial action is completed. This bulletin supplements the instructions contained in Rail Operating Code Rule 6C 'Action When Line may be Damaged or Obstructed'.

5.4 On 18 August 2005 the Commission wrote to the Chief Executive of ONTRACK:

> On 4 August 2005 the Commission recommended that you:
>
> ensure adequate suitably qualified personnel are available to provide coverage for special inspections during adverse weather conditions, and for an appropriate period afterwards while a threat of flooding exists, or if not make arrangements to close the affected line to rail traffic (072/05).
>
> The Commission is satisfied that the recommendation has been acted upon and the status of the safety recommendation is closed – acceptable.
>
> The Commission commends you on this positive course of action to improve transport safety and thanks you for your co-operation.

Approved on 18 August 2005 for publication

Hon W P Jeffries
Chief Commissioner

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