AUDITOR-GENERAL'S REPORT

PERFORMANCE AUDIT

Signal Failures on the Metropolitan Rail Network

RailCorp

The Legislative Assembly
Parliament House
SYDNEY NSW 2000

The Legislative Council
Parliament House
SYDNEY NSW 2000

In accordance with section 38E of the *Public Finance and Audit Act 1983*, I present a report titled **Signal Failures on the Metropolitan Rail Network: RailCorp.**

Peter Achterstraat
Auditor-General

Sydney
August 2007

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Contents

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Foreword

RailCorp provides almost a million metropolitan passenger journeys each day.

Signalling systems are critical for the safe operation of a rail network. They direct trains and ensure they do not collide. As a result, they are designed to be fail safe. This means that if there is a signalling failure, the signals go red and trains are brought to a stop or run at a reduced speed while staff investigate and fix the problem.

RailCorp's signalling system has many parts and uses a range of technologies, some dating back to the 1920s. It is a complex system with variable risks of failure depending on the signal's location, age and design.

Signalling failures can delay many trains and inconvenience many passengers. The audit looks at whether RailCorp is keeping the number and duration of signal failures low enough to support its on-time running target. It includes a review of signalling maintenance and RailCorp's response to signalling failures.

The government intends to significantly increase public transport usage over the next ten years, while maintaining on-time running. The signalling system will be critical to creating both the capacity and the demand needed to achieve this.

Peter Achterstraat
Auditor-General

August 2007

Executive summary

The focus of our audit

One of RailCorp's key performance targets is for 92 per cent of peak hour services to run on time. Signalling failures can delay many trains and inconvenience many passengers. Effective maintenance and response to signalling failures is therefore crucial to achieving on-time running.

Sydney's rail network is large and complex. The signalling system has many parts, including around 3,800 trackside signals, 2,900 train stops, 6,800 track circuits and 2,200 sets of points. The system employs a range of technologies, some quite old.

This audit examines whether RailCorp is effectively managing the risk of signal failures. It focuses on whether RailCorp is keeping the number and duration of signal failures low enough to support its on-time running target.

A train is defined as on-time if it arrives at its final destination within five minutes of schedule if a suburban train (four minutes prior to June 2005), and six minutes if an intercity train. If a train is not on-time, it is deemed to be delayed. A signalling incident occurs when a signalling failure causes at least one peak train to be delayed.

Peak services are those scheduled to arrive in the Sydney CBD between the hours of 6 am and 9 am (morning peak), and departing the Sydney CBD between the hours of 4 pm and 6 pm (evening peak) from Monday to Friday.

The NSW State Plan released in September 2006 targets a substantial increase in the use of public transport by 2016. RailCorp is due to make a submission to government later this year outlining what will be required of the network, including signalling, to allow it to meet patronage increases.

Audit opinion

Between 2004 and 2006, the number of signalling failures, signalling downtime and the number of trains delayed as a result of signal failures all fell. RailCorp's on-time running performance improved over the same period.

The fall in failures is a clear indication of improved performance. Changes in the definition of on-time and to the timetable during 2005 and 2006 however make it difficult to determine whether improvements in response downtime and signalling delays are due to a true performance improvement.

RailCorp has improved its management of signal assets and its response to signal incidents. For example, it now has an incident response framework and places key staff at critical locations to respond quickly to signal failures. This has contributed to these improved results.

To build upon this strong base, RailCorp needs to determine with more confidence the number and duration of signalling failures the network can tolerate without impacting on service levels. This would reduce the risk that it may focus too little or too much effort on signalling failures compared to other causes of delays such as train breakdowns.

RailCorp also needs to compare its signalling reliability and incident response practices and performance against other networks. This would give it another important perspective on its performance.

It needs to determine the signalling system required to meet the expected 2016 patronage levels, and how it will get there. This would reduce the risk of spending money on a signalling asset which will not meet projected service demands.

Over the next few years, RailCorp will also need to be vigilant to ensure maintenance does not lapse. Much work to upgrade and expand the network is planned, such as Rail Clearways and the new north-west and south-west rail lines. These projects will place pressure on RailCorp's maintenance spending and its pool of skilled staff.

Key audit findings

Is the number of signal failures low enough?

Between 2004 and 2006:

- the number of 24 hour signalling failures on the greater metropolitan network fell by nine per cent
- the number of signalling incidents fell by 45 per cent
- RailCorp met its monthly signalling failure targets most of the time.

Railcorp signalling asset management practices have improved. For example, RailCorp has adopted a good asset management model, improved its collection and analysis of data, and is on target to eliminate by 2011 the backlog which occurred in the late 1990's and early 2000's due to inadequate funding. The improvement in 24 hour signalling failures indicates that asset performance has improved.

RailCorp was not, however, able to say by how much the fall in peak incidents resulted from changes to the timetable in 2005.

We could not conclude whether RailCorp was keeping signalling failures low enough. It uses past performance to determine the number of signalling failures the network can tolerate while still retaining service levels, but should also trial reliability modelling.

RailCorp has yet to adequately compare the reliability of its signalling system to other networks.

RailCorp is working to determine the signalling system required to meet the State Plan's 2016 patronage targets. Without this, it could spend money on upgrading signal assets which may be replaced or removed from service shortly thereafter.

Much work on expanding and improving the network is planned over the next few years. This could put pressure on signal maintenance spending and staffing. In particular, RailCorp and the rail industry is facing a worldwide shortage of signal engineers and electricians.

Recommendations

We recommend that RailCorp:

- use both past performance and reliability modelling to estimate the number of signal failures the network can tolerate and set targets accordingly (page 15)
- determine the signalling system it needs to meet the government's 2016 patronage target as soon as possible, and documents by the end of 2008 how it intends to get there (page 20)

- ensures that it balances the resource demands of maintaining the existing network and eliminating the backlog against those arising from planned network expansion and improvement projects (page 22)
- where possible redesign work practices to help address the emerging shortage of signal engineers and electricians (page 22)
- benchmark the reliability of its signalling assets against other railway operators with similar operating environments (page 23).

Is the duration of signal failures low enough?

Between 2004 and 2006 the average:

- number of peak trains delayed per month due specifically to signalling failure fell by 64 per cent (280 to 102)
- signalling downtime per month fell by about 17 percent.

RailCorp's incident response procedures and practices have improved. RailCorp has implemented an incident management framework. It locates key staff across the network to respond to signalling failures, and during peak times places staff on standby at vulnerable parts of the network.

RailCorp is not able to determine how much the fall in delays resulted from changes in the definition of a delayed train and to the timetable.

We could not conclude whether RailCorp was keeping the number of delays and the duration of signalling failures low enough. It uses past performance to determine what the network can tolerate while still retaining service levels, but should also trial reliability modelling.

In relation to signalling, RailCorp is yet to review how well its incident response framework is implemented, whether it results in satisfactory outcomes and how it captures lessons for continuous improvement.

While it locates response staff around the network, it needs to undertake a systematic risk assessment to ensure it has the right people, at the right place, at the right time. It also needs to do more to ensure staff possess the skills to respond well to signal failures.

RailCorp is yet to benchmark its response performance with other networks.

It reports its performance in regard to on-time running and delays that occur during the peak hours, but should also report this on a 24 hour basis.

We recommend that RailCorp:

- use both past performance and reliability modelling to estimate the duration of signalling delays the network can tolerate and set targets accordingly (page 29)
- review by the end of 2008 how its incident response framework impacts on signal incidents (page 31)
- base incident response strategies on a systematic risk assessment (page 33)
- review competencies of staff involved in signal asset management or incident response by the end of 2008 and address skills gaps (page 33)
- benchmark incident response against other railway operators with similar operating environments (page 35)
- implement in 2007-08 its plans to move to 24 hour on-time running reporting (page 35)
- monitor and report on asset performance and its impact on on-time running on a regular basis (page 35).

Response from RailCorp

I am pleased to have received the Final Report from the Audit Office on "Performance Audit, Signal Failures on the Metropolitan Rail Network" for 2007.

The fact that delays relating to signalling equipment have decreased by 9 per cent over a 24 hour period, and 45 per cent during peak times, highlights the work done in this important area.

RailCorp has invested much time and expertise in providing solutions that limit the number of signal related incidents on the rail network.

By reducing the total number of signal issues on our infrastructure, our passengers benefit from a more reliable service and face less delays.

The improvements to our signalling system have contributed to CityRail meeting its on-time running benchmark of 92% for 2006/07.

I also note that we are encouraged by six of our initiatives being highlighted as good practice in the report, including:

(i) initiatives to address vandalism;

(ii) asset management process initiatives;

(iii) training initiatives such as the clawlock points example to improve reliability;

(iv) initiatives to improve incident response;

(v) continuous improvement initiatives aimed at improving skills of staff responsible for signalling maintenance and failure response; and

(vi) initiatives aimed at monitoring asset and response performance which include many forums and detailed reports.

*Whilst RailCorp has demonstrated that signalling performance has improved, we acknowledge that further work is still required "*to build upon this strong base*" to continually improve the service that is provided to our customers.*

It is also pleasing that the Auditor's recommendations to achieve this outcome are consistent with RailCorp's designated objectives and future direction. In particular, the following initiatives currently being pursued by RailCorp, are focussed on meeting the common goal of improved customer service:

(i) benchmarking our performance against other networks;

(ii) increasing the use of reliability modelling throughout the network;

(iii) ensuring our signalling resource demand is balanced between our maintenance and expansion projects;

(iv) risk assessing our signalling incident response strategies;

(v) implementing plans to move to 24-hour performance reporting;

(vi) determining future signalling system requirements after the Automatic Train Protection trial; and

(vii) using past signalling incidents to learn lessons and review the incident management framework.

Once again, the outcome of the audit is a positive one and I would like to extend my thanks to the audit team for the open and professional manner in which they conducted the audit. We look forward to meeting the challenge of improving our customer service performance in the future.

(signed)

Vince Graham
Chief Executive Officer

Dated: 6 August 2007

1 Why is signalling important?

1.1 The metropolitan rail network

RailCorp has responsibility for the safe operation, crewing and maintenance of passenger trains and stations on the greater metropolitan network.

The rail network is large and complex

This network is large and complex. RailCorp provides 2,300 services daily which carry 900,000 passengers to and from 302 stations. To achieve this, RailCorp operates a fleet of more than 1,500 carriages over more than 2,000 kilometres of track.

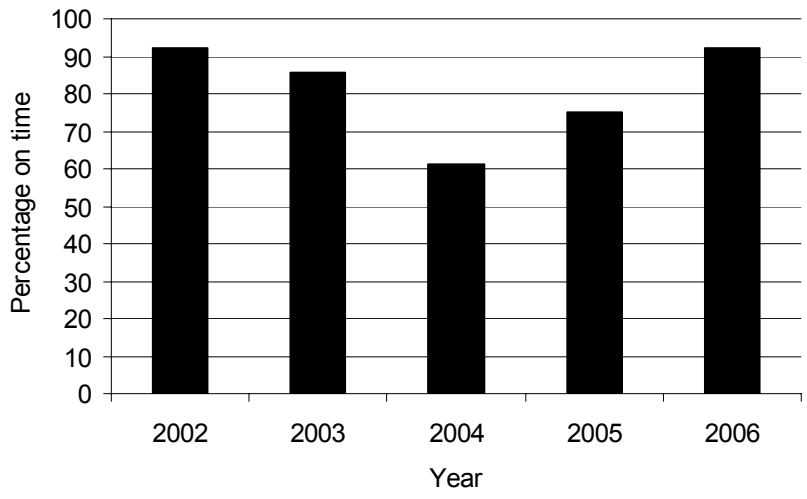
1.2 On-time running

The State Plan released in September 2006 confirmed that on-time running is a key service measure for RailCorp.

On-time running is improving

Peak on-time running measures the percentage of trains that operate during peak periods that are running on or close to schedule. On-time running has improved since 2004. RailCorp met its target of 92 per cent of peak trains on time in 2006, although it did not meet it every month.

Exhibit 1: Peak on-time running performance - monthly average



Source: RailCorp 2007

The improvement since 2004 has been helped by changes during 2005 to the:

- timetable which reduced the effect of a late service on the timeliness of other services (September 2005 and May 2006)
- definition of a late train during peak periods, which was extended from a delay of more than three minutes 59 seconds to a delay of five minutes or more (June 2005).

RailCorp is not able to say by how much the improvement in reported on-time running is due to these changes. Their impact will have been partially reflected in the 2005 results, and fully reflected in the 2006 results.

1.3 Why is signalling important?

RailCorp operates a 'fail safe' system

The signalling system exists for the safe operation of the railway. It achieves this by providing a fail safe interlocking mechanism. This sets and locks all points on a train's route locking out any movements that might bring another train into its path. Once the route is set, locked and cleared as safe to proceed, a signal is displayed to the train driver, giving details of the route to be taken, and the status of the next signal ahead.

Signalling reliability is an important contributor to on-time running. Being a fail safe system, mechanical failures cause the signalling system to revert to a safe state. Generally, this means that trains stop or run at a reduced speed until staff address the failure.

Signalling failures are responsible for about 15 per cent of all peak trains recorded as delayed on the network. When signalling fails, however, it can have a large impact on train running, passenger comfort and well-being. This is because the average delay due to signalling failure is 11 minutes, compared to eight minutes for rolling stock.

1.4 What are the features of the signalling system?

The signalling system consists of many parts and range of technologies

The signalling system on the network has many parts, including approximately 3,800 signals, 2,900 train stops, 6,800 track circuits and 2,200 sets of points.

Signalling technologies have changed over time. The oldest technologies still in use in the metropolitan area date back to the 1920s. These are predominantly mechanical systems. Electrical technologies were introduced in the 1950s and computer-based technologies were introduced in the 1990s.

Keeping the signalling system reliable therefore presents a significant challenge to RailCorp. For instance:

- the large number of parts creates a large number of failure opportunities
- staff have to be trained on a number of different signalling technologies
- there is a shortage of spare parts for some older equipment.

Exhibit 2: RailCorp signalling

Signal indicator

Points

Train stop

Source: RailCorp and Audit Office 2007

1.5 What is the future direction of RailCorp signalling?

State Plan patronage targets

The State Plan released in September 2006 included two key patronage targets:

- increase the share of trips made by public transport to and from the Sydney CBD during peak hours to 75 per cent (currently 72 per cent) by 2016
- increase the proportion of total journeys to work by public transport in the Sydney metropolitan region to 25 per cent (currently 20-22 per cent) by 2016.

The capacity of the network depends, among other things, on its signalling system. It determines how close a train can travel to the one in front.

Determining future signalling requirements

RailCorp is due to make a submission to government later this year outlining what will be required of the network, including signalling, to allow it to meet the foreshadowed patronage increase.

Move towards Automatic Train Protection

RailCorp commenced three pilots of Automatic Train Protection (ATP) in May this year. This technology has the potential to eliminate mechanical train stops and prevent speeding.

The capacity increase needed to meet the State Plan patronage targets may, however, require an even more advanced signalling system which allows trains to safely travel closer together. Some overseas networks have increased capacity through Automatic Train Control (ATC). ATC is a method for automatically controlling train movement, enforcing train safety, and directing train operations.

1.6 How does this audit relate to our earlier work on managing disruptions?

Over the last few years, the performance of our public transport system has been a key focus.

In June 2005 the then Auditor-General released his report on 'Managing Disruptions to CityRail Passenger Services'. This performance audit examined how well RailCorp, during disruptions to scheduled services:

- managed passenger journeys
- provided information to passengers.

The audit identified opportunities for RailCorp to improve in both areas, and in particular to raise the customer focus of its staff. The audit report can be accessed at *www.audit.nsw.gov.au*.

Focus of this audit

This current audit complements our 2005 audit. It examines whether RailCorp is effectively managing the risk of signal failures. It focuses on whether RailCorp is keeping the number, frequency and duration of signal failures low enough to support its on-time running target.

In undertaking this audit, we have not revisited matters covered in our 2005 audit.

1.7 What do we mean by on-time, incident, delay and peak?

Throughout this report, we refer to on-time running, incidents, delays and the peak period.

These have a specific meaning for RailCorp and this report. This is important for the reader to understand.

A train is defined as **on-time** if it arrives at its final destination within five minutes of schedule if a suburban train (four minutes prior to June 2005), and six minutes if an intercity train.

If a train is not on-time, it is deemed to be **delayed**. A signalling **incident** occurs when a signalling failure causes at least one peak train to be delayed.

Peak services are those scheduled to arrive in the Sydney CBD between the hours of 6 am and 9 am (morning peak), and departing the Sydney CBD between the hours of 4 pm and 6 pm (evening peak) from Monday to Friday.

The change in definition of on-time in July 2005 is important. It affects the definition of incident and delay. This in turn makes it difficult to determine whether the change to the number of delays and the duration of delays is due to the change in definition or a real change in performance.

2 Is the number of signal failures low enough?

At a glance

The key question we wanted to answer was:

Is the number of signal failures low enough to support its on-time running target?

Our assessment:

Between 2004 and 2006, the total number of signal failures on the network fell by nine per cent, and the number of failures which delayed at least one peak train (incidents) fell by 45 per cent. RailCorp met its monthly signal failure target nine times in 2006.

This improvement in signal reliability is consistent with our observations that Railcorp has been improving its signal asset management practices. For example, it has comprehensive information on its key signalling assets, prepares maintenance schedules for each, and produces an annual asset integrity report.

We did, however, identify some opportunities for RailCorp to further build on these improvements.

RailCorp was not able to say by how much the fall in recorded incidents resulted from a change to the timetable.

We also could not conclude whether RailCorp was keeping signalling failures low enough. It uses past performance to determine the number of signal failures the network can tolerate while still retaining service levels, but should also trial reliability modelling. This would reduce the risk that its targets were set too low leading to poor on-time running; or too high leading to over-investment in signalling.

RailCorp needs to determine as soon as possible the signalling system required to deliver the State Plan's 2016 patronage targets, and how it will implement any necessary system changes. Otherwise, it could spend money on upgrading signal assets which are soon after replaced or removed from service.

It also needs to benchmark its performance against other like rail systems in regard to signalling performance targets and the reliability of signalling equipment.

2.1 Does RailCorp determine the required signalling performance level?

Our assessment

RailCorp sets monthly targets for signalling failures and incidents arising from infrastructure failures. RailCorp could not show, however, that these represent the maximum number the network can tolerate while still retaining service levels. Its targets are based on past performance, but it should also trial reliability modelling.

Service targets established

RailCorp has established key service delivery targets for:

- on-time running during peak (92 per cent)
- skipped stops (one per cent)
- cancelled services (one per cent).

Signalling performance targets established

RailCorp has also established targets for:

- signalling failures (247 per month, regardless of whether they lead to train delays)
- infrastructure incidents, ie failures that cause at least one peak train to be delayed (26 per month).

Monitoring performance against these targets helps RailCorp focus its efforts on problem areas.

RailCorp could not show, however, that these signalling failure and infrastructure incident targets represent the number the network can tolerate while still retaining service levels.

There have been several changes to the operating environment in recent times. For example, RailCorp changed its timetable in 2005 resulting in more time between trains. This provided maintenance staff with more time to respond to signalling failures ie it increased the network's tolerance to delays.

We would have greater confidence if RailCorp's targets were based on reliability modelling as well as past performance.

Getting targets right is important. If they are set too high or too low there is a risk that RailCorp will under or over spend on meeting them.

Recommendation

We recommend that RailCorp use both past performance and reliability modelling to estimate the number of signal failures the network can tolerate and set targets accordingly.

2.2 Is RailCorp achieving the required signalling performance level?

Our assessment

Between 2004 and 2006, RailCorp met its monthly failure targets most of the time, the number of signal failures fell by nine per cent, and the number of incidents fell by 45 per cent. The improvement in 24 hour signalling failures indicates that asset performance has improved. RailCorp was not able to show, however, the extent to which changes to the timetable in 2005 contributed to the fall in peak incidents.

Target for peak incidents achieved

RailCorp met its monthly target (ie 26) for peak incidents caused by infrastructure incidents nine times in 2006 (it did not meet it in February, March and June). RailCorp met its monthly target twice in 2004 and seven times in 2005.

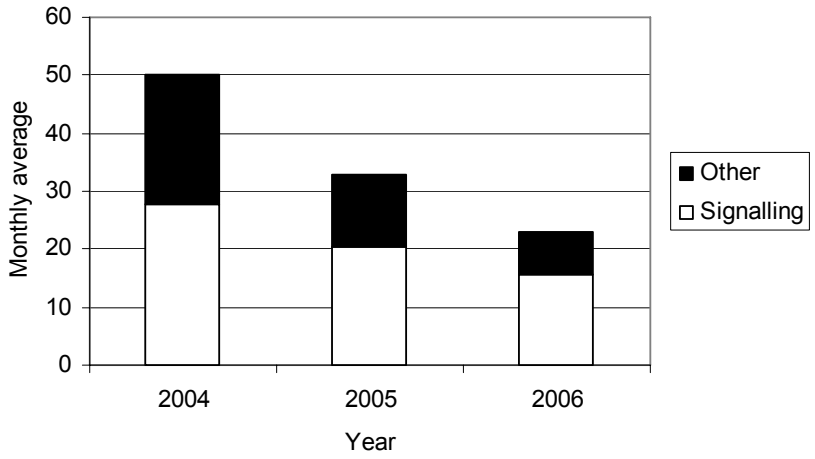
Even though it met its target most of the time in 2006, this does not necessarily mean it is keeping the number of incidents low enough. As discussed in 2.1, RailCorp could not show that this target represents the number the network can tolerate while still retaining service levels.

The target for infrastructure incidents has changed twice in the last three years increasing from 27 to 39 incidents per month in July 2004, and decreasing to 26 per month in September 2005 with the introduction of a new timetable.

The number of incidents is falling

The number of peak infrastructure incidents fell by 54 per cent between 2004 and 2006.

Exhibit 3: Peak infrastructure incidents



Source: RailCorp 2007

RailCorp does not have a target for peak incidents caused specifically by signal failures, nor could it show the number the network can tolerate while still retaining service levels.

The number of peak incidents resulting specifically from signalling failures fell from 28.3 per month in 2004 to 15.5 per month in 2006, a 45 per cent decrease.

Timetable changes helped

As discussed in 2.1, the reduction in peak incidents between 2004 and 2006 was assisted by changes in 2005 and 2006 to the timetable, which increased the time between trains, thereby increasing the time available to respond to incidents and reducing the risk of failures in the morning impacting upon trains during the afternoon peak. RailCorp was not able to quantify the contribution of this change to the recorded reduction in incidents.

RailCorp has a monthly target of 247 signalling failures. RailCorp met this target seven times in 2006, eight times in 2005 and only twice in 2004.

Exhibit 4: Common causes of signal failures

Points failure is when the points don't move as they should or don't close. This can occur if there are alignment problems due to track movement, a mechanical or electrical fault or if an object is wedged between the rails. Problems with the system that detects whether the points are operating correctly will also cause the signalling system to fail safe (ie go to red).

Track circuit failures usually result in the system showing a train on a length of track when there is none. This can occur due to defective electrical components or power supply.

Trainstop failures can result from motor faults, interference by vandals or problems with the electrical contacts that detect the stop's movement.

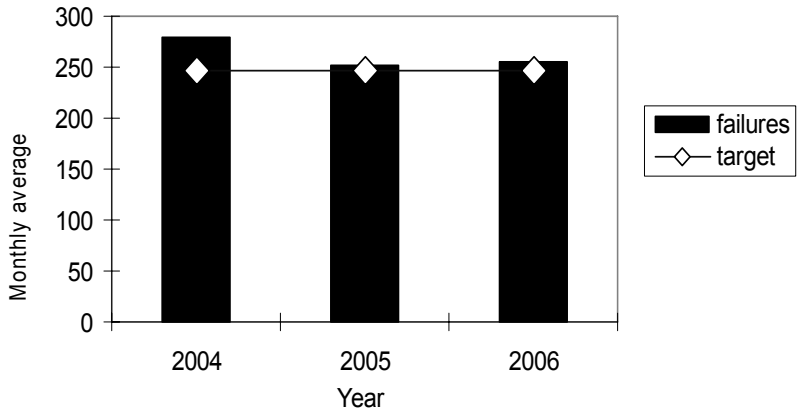
Source: RailCorp interviews

Overall decrease in signalling failures

The total number of signalling failures fell nine per cent between 2004 and 2006 from an average of 279 failures per month to 255 failures.

The number of signalling failures per month in 2006 was slightly higher than in 2005 (ie 251 in 2005 compared with 255 in 2006). This increase may be due to better detection and recording of signalling failures.

Exhibit 5: Signalling failures



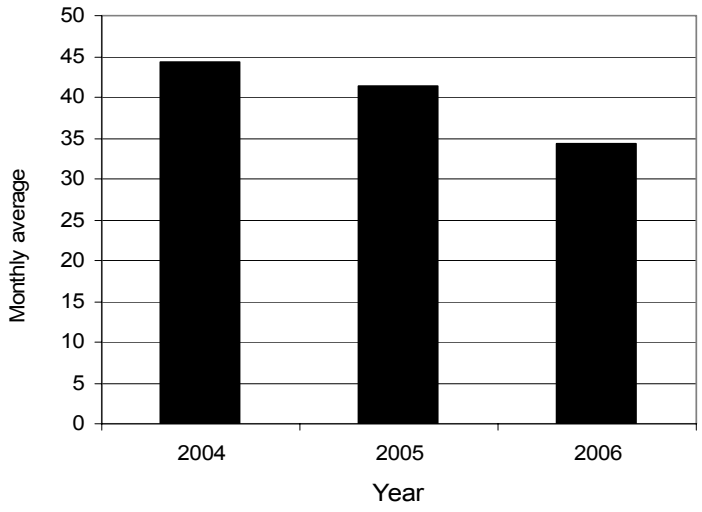
Source: RailCorp 2007

RailCorp's current performance contrasts with the situation identified in the 2001 Christie report. It found that infrastructure failures were increasing with significant impacts on service levels.

Repeat failures have decreased

The number of repeat failures in signalling equipment has decreased since 2004. Daily and weekly management meetings focus on resolving repeat failures.

Exhibit 6: Repeat failures within 28 days

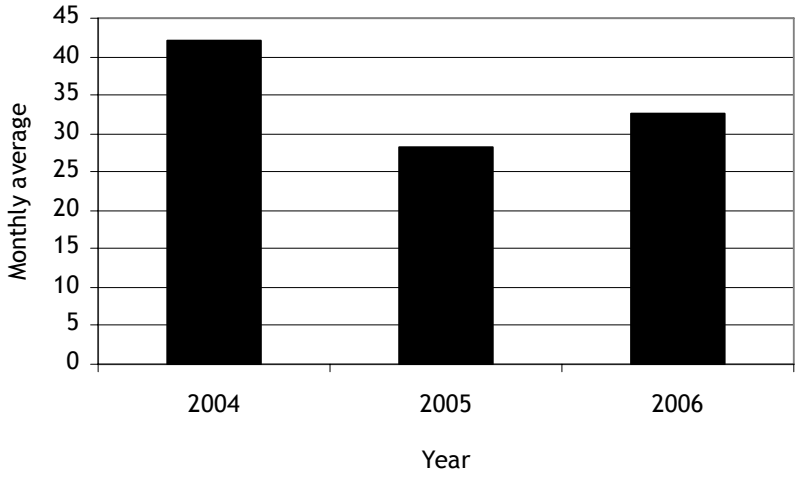


Source: RailCorp 2007

Reasons for failures are identified

RailCorp has also been working to better identify the causes of signalling failures. The number of failures in signalling equipment where no cause was found has also decreased since 2004.

Exhibit 7: Signalling failures with no cause found



Source: RailCorp 2007

Vandalism remains a problem

The number of signalling failures caused by vandalism increased from 134 in 2004 to 219 in 2006. RailCorp was not able to provide us with data on the number of delays caused specifically by these failures.

RailCorp has undertaken a number of initiatives to address the problem of vandalism and trespass.

GOOD PRACTICE

Exhibit 8: Initiatives to address vandalism

RailCorp advises that it:

- has sponsored a joint effort with NSW Police to establish a Police Rail Vandalism Task Force. This unit commenced in May 2006 and is co-located, and works closely with, RailCorp Security Division to target rail vandals
- deploys plain-clothes and uniformed Transit Officers on an intelligence basis to locations and times where risk of vandal activity is high. RailCorp's CCTV system and wireless video cameras are being used to gather intelligence and identify offenders
- is an active member of the Attorney-General's Graffiti Action Team and is cooperating with other agencies and transport providers both in NSW and in other jurisdictions to share information about countermeasures and develop common approaches to this broad community problem
- has focussed on the problem of trespass in the rail corridor by improving fencing at a number of hotspots and conducting information campaigns targeting schools and local residents warning of the dangers.

Source: RailCorp 2007

Given the current trend in signalling failures caused by vandalism it is appropriate for RailCorp to focus on vandalism and trespass. Indeed RailCorp may need to consider further initiatives or expansion of existing measures in order to reduce signal failures caused by vandals.

A more advanced signalling system may allow the removal of some trackside equipment which is prone to vandalism.

Other factors that affect signals

Power disruptions by energy providers may be caused by bad weather, natural disasters, accidents or supply problems. RailCorp advises that major power disruptions do not occur very often but when they do they can have a significant impact on services.

For example, in November 2006, a bushfire resulted in a number of momentary power supply interruptions to RailCorp. This caused 11 signalling failures resulting in 89 train delays and three cancellations.

RailCorp is implementing a number of initiatives to reduce the impact of voltage sags, surges and spikes on the signalling system. These include implementing improved signalling power supply standards at new installations. It has also discussed its need for a more reliable power supply with its electricity supplier and the industry regulator (IPART), but the matter has not yet been resolved.

2.3 Does RailCorp know the condition of its signalling assets?

Our assessment

RailCorp has comprehensive information on its signalling assets, prepares maintenance schedules for each, and produces an annual asset integrity report.

Asset information has improved

RailCorp's current information on the condition of its signalling system is better than described in the 2002 Godfrey report which found that the asset register did not give details of all assets and their condition.

GOOD PRACTICE

RailCorp has an equipment register and associated systems in place that enable it to:

- identify each key signalling asset and its location
- schedule and record maintenance inspections and repairs
- capture the details of equipment failures for analysis.

RailCorp produces a signal asset integrity report each year which provides a detailed analysis of the condition of assets and the work required to keep them in good working order.

2.4 Is there a maintenance plan and capital investment plan covering signals?

Our assessment

RailCorp has a five year asset management plan that incorporates both maintenance and capital investment plans. It is yet to determine, however, what signalling system it needs to have in place to achieve the State Plan's 2016 patronage targets. It is currently developing a long term operating plan which will specify the functional requirements of the signalling system to 2016 and beyond.

A five-year asset plan is in place

Railcorp has an Asset Management Plan (AMP) in place covering the period 2006-07 to 2010-11. This incorporates the annual maintenance works program and a capital acquisition plan and provides an overview of asset condition and routine maintenance practices.

The asset management plan contains an annual program of closedowns and weekend possessions to enable major planned maintenance to be carried out. RailCorp advises that this creates maintenance efficiencies from: increased scope, with all possessions clear of disruptions from passing trains; use of high production maintenance equipment; reduced cost of worksite protection; reduced routine maintenance; and reduced bussing costs.

Railcorp has maintenance plans for key signalling assets which are reviewed on a regular basis. These include detailed procedures for parts to be checked and serviced and also include guidelines for when individual components should be replaced.

RailCorp needs to determine the signalling system it will need in 2016

The State Plan targets a substantial increase in public transport's share of commuter travel by 2016.

To meet the State Plan outcomes, RailCorp will need to specify the future rail system needed to meet patronage increases and the long-term freight requirements.

RailCorp is preparing an operating plan to present to government later this year which will cover the capacity requirements for each area of the network and the functional requirements for the signalling system to meet the government's 2016 targets.

Recommendation

We recommend that RailCorp determines the signalling system it needs to meet the government's 2016 patronage target as soon as possible, and documents by the end of 2008 how it intends to get there.

2.5 How well is RailCorp implementing its maintenance plans?

Our assessment

RailCorp undertakes inspections and servicing of equipment in accordance with its maintenance plans. RailCorp has a funding agreement with Treasury to address by 2011 its backlog in asset renewal (currently $53 million). A key risk to achieving this renewal and its future network expansion, however, is a worldwide shortage of skilled staff. RailCorp has recognised the need to better attract, develop and retain staff and is working to address this. It may also need to redesign work practices to make best use of scarce resources.

Inspections have improved

RailCorp staff carry out inspections and certification of equipment in accordance with technical maintenance plans. Compliance with safety critical inspections has improved from 85 per cent completed in 2001-02 to 99 per cent completed in 2005-06.

Major asset renewal wound back during the late 1990's

In 2002, the 'steady state' maintenance requirement for the network was $410 million pa (excluding stations, footbridges, yards and sidings), of which $218 million was for major renewal work. The extent of the 'maintenance backlog' was $73 million.

Previous reports had indicated the downgrading of many asset renewal programs during the 1990s resulted in a serious maintenance backlog, degraded asset quality and reliability and increased day-to-day routine maintenance costs. They predicted the backlog would lead to component failure resulting in train stoppages and delays.

RailCorp and Treasury entered a funding agreement in 2002 to address the backlog and return to steady state by 2011-12.

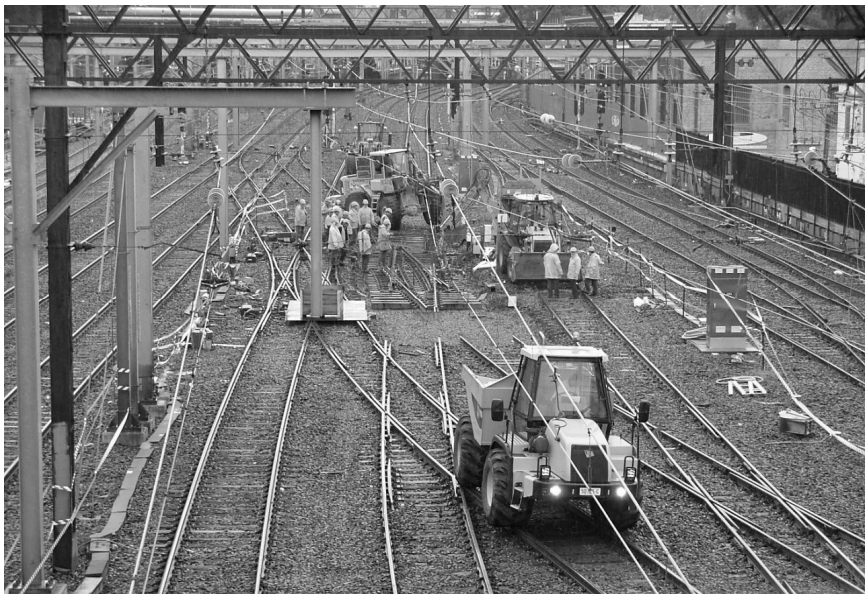
Backlog has been reduced

RailCorp now calculates that:

- $438 million pa is required for steady state (based on current productivity levels and in $2006)
- the maintenance backlog has been reduced to $55 million ($2006).

RailCorp report that as a result of this agreement the level of 'below rail' (ie sleepers, ballast, signals and points) expenditure on major periodic maintenance (MPM) increased from $267 million in 2001-02 to $425 million in 2006-07. We note, however, that expenditure in 2006-07 was below the estimated 'steady state' level.

Exhibit 9: Major planned maintenance



Source: RailCorp 2007

New work may put pressure on future resourcing

The Government has commissioned a range of infrastructure enhancement projects which are underway or planned to start soon, including the:

- Rail Clearways project
- Epping to Chatswood rail link
- North West Sydney rail line
- South West Sydney rail line.

These projects are likely to place substantial pressure on RailCorp's financial and human resources. In such circumstances, there is a risk that maintenance is postponed in order to fund new work. This inevitably comes at a future cost to taxpayers. It is important that RailCorp not repeat the errors of the 1990s and does not sacrifice maintenance in order to resource network expansion.

Recommendation

We recommend that RailCorp ensures that it balances the resource demands of maintaining the existing network and eliminating the backlog against those arising from planned network expansion and improvement projects.

Finding sufficient staff is a problem

RailCorp is facing a challenge in obtaining sufficient signal engineers and electricians. There are currently 40 positions vacant out of 274. There is a skills shortage in this area, both locally and overseas.

RailCorp is doing much to manage this risk. It has increased efforts to attract staff with existing skills through overseas recruitment. RailCorp is also working to improve its workforce planning capability to better allow it to predict future skill shortages

Recommendation

We recommend that RailCorp, where possible redesign work practices to help address the emerging shortage of signal engineers and electricians.

2.6 Does RailCorp monitor and benchmark its performance in managing its signalling system?

Our assessment

RailCorp routinely monitors and reviews it performance and its asset management practices. It has participated in some benchmarking but should benchmark the performance of its signalling system and components against rail systems with similar operating environments.

Discussion of asset performance

RailCorp has a range of forums where asset performance, asset failures, remedial actions and any required changes in maintenance practices are discussed and resolved.

GOOD PRACTICE

Exhibit 10: The Clawlock problem and solution
Clawlocks were introduced in the late 1990s to lock points in place. Through its monitoring, RailCorp found these were failing repeatedly. When it investigated, RailCorp found that few staff had received formal training in maintaining and repairing clawlocks and there was no guidance material to help staff undertake clawlock maintenance. In February 2006, a training manual was developed and since then signalling staff have been taught how to adequately maintain clawlocks leading to a fall in failures attributed to clawlocks.

Source: RailCorp 2007

RailCorp advises that it has been collecting data for a number of years, but in recent times has started to make more use of the data to identify opportunities to improve maintenance practices and signal design.

RailCorp is also in the process of implementing 'six sigma' as a business improvement tool focussing on asset reliability. 'Six sigma' is about reducing variation in the business processes and making decisions through statistical evidence.

Benchmarking in information management

RailCorp participated in a benchmarking review on the management of asset information including the asset type, value, location, condition and maintenance schedule. The other organisations involved included Singapore Mass Rapid Transit Ltd, Hong Kong Mass Transit Railway Corporation and Severn Trent Water. The results were favourable, with RailCorp scoring highly for its asset register and maintenance data.

But has not benchmarked asset performance

RailCorp has not, however, benchmarked itself against other like rail systems in regard to:

- its signalling performance targets
- the reliability of its signalling equipment.

Recommendation

We recommend that RailCorp benchmark the reliability of its signalling assets against other railway operators with similar operating environments.

3 Is the duration of signal failures low enough?

At a glance

The key question we wanted to answer was:

Is the duration of signal failures low enough to support its on-time running target?

Our assessment:

RailCorp data shows that signalling failures caused fewer trains to be delayed in 2006 than 2004. Over this period, the average monthly duration of delays and signalling downtime also fell. RailCorp met its monthly target (190) for peak trains delayed by infrastructure failure (including signalling) most of the time in 2006.

RailCorp's response to signalling incidents has improved. RailCorp has developed and adopted an incident management framework (IMF). It locates key staff across the network to respond to signalling failures. In peaks, RailCorp places staff on standby where it considers the network to be most vulnerable.

We did, however, identify some opportunities for RailCorp to build on these results.

RailCorp was not able to say by how much the fall in delays resulted from change in the definition of a delayed train and changes to the timetable which occurred in 2005.

We also could not conclude whether it was keeping the number of delays and duration of signalling failures low enough. It uses past performance to determine the duration of signal failures the network can tolerate while still retaining service levels, but should also trial reliability modelling.

RailCorp is yet to review how well its incident management framework has been applied and the impact this has had on its response to signalling failures.

RailCorp's signal response deployment strategies were not based on a systematic risk assessment, and it needs to do more to ensure staff possess the skills to respond well to signal failures.

It is yet to benchmark its response performance and practice against other networks and to report on-time running and delays on a 24 hour basis.

3.1 Does RailCorp know the duration of signal failures it can tolerate?

Our assessment

RailCorp data shows that signalling failures caused fewer trains to be delayed in 2006 than 2004. Signalling downtime also fell. RailCorp met its monthly target (190) for peak trains delayed by infrastructure failure (including signalling) most of the time in 2006.

RailCorp could not show, however, that these targets represent the maximum number the network can tolerate while still retaining service levels. RailCorp was not able to say by how much the fall in delays resulted from change in the definition of a delayed train and to the timetable. We also could not conclude whether it was keeping the number of delays and duration of signalling failures low enough. It uses past performance to set targets, but should also trial reliability modelling.

Changes to delay definition and timetable

The definition of a 'delayed' train changed in June 2005, from more than three minutes 59 seconds to five minutes or more late. If all other factors remained unchanged, we would expect the *recorded* number of trains delayed to have fallen and the average length of *recorded* delay to have risen.

RailCorp also implemented two timetable changes (September 2005 and May 2006) to reduce the snowballing effect of disruptions. This too should have reduced the number of *recorded* delays.

Getting better at meeting delay targets

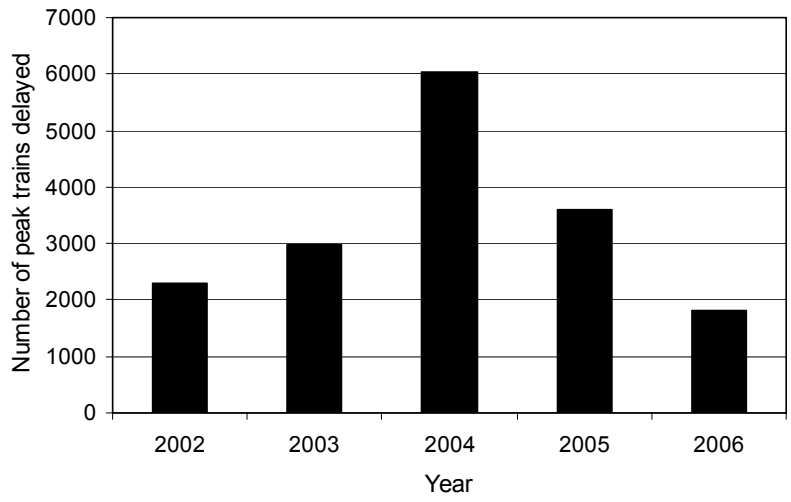
RailCorp has a target of no more than 190 peak trains delayed each month due to infrastructure failures. RailCorp met this monthly target eight times in 2006, twice in 2005 and never in 2004.

RailCorp's target for infrastructure delays remained the same between 2004 and 2006. We would have expected some changes given the changes to delay definition, the timetable and changes to the incident target. RailCorp also could not show that the targets represent the maximum number the network can tolerate while still retaining service levels.

Trains delayed through infrastructure failure falling

The number of peak trains delayed due to infrastructure failures fell by more than two thirds from an average of 6,028 in 2004 to 1,804 in 2006. In 2006, it was lower than in 2002.

Exhibit 11: Number of peak trains delayed by infrastructure failures



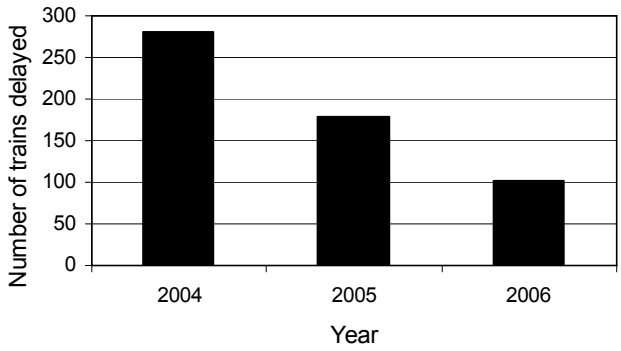
Source: RailCorp 2007

In 2006, infrastructure incidents contributed to 20 percent of total peak delays on the network. Of this, 73 percent of peak trains were delayed were due to signal failures.

Delays due to signalling declining

Within this, the average number of peak trains delayed due to signalling failures each month fell by almost two thirds from an average of 294 per month in 2004 to 102 in 2006.

Exhibit 12: Number of peak trains delayed by signal failures – monthly average



Source: RailCorp 2007

Note: Reliable data only available from 2004.

On average, each signal incident delayed ten trains in 2004 compared to nine trains in 2005 and seven trains in 2006.

The total duration of train delays caused by signalling incidents have also fallen in line with the decline in the number of incidents and delays.

Exhibit 13: Length of delays caused by signalling incidents

	2004	2005	2006
Total duration of delays (minutes)	38271	14939	14340
Average duration per train (minutes)	11	11	11

Source RailCorp peak on-time running performance data

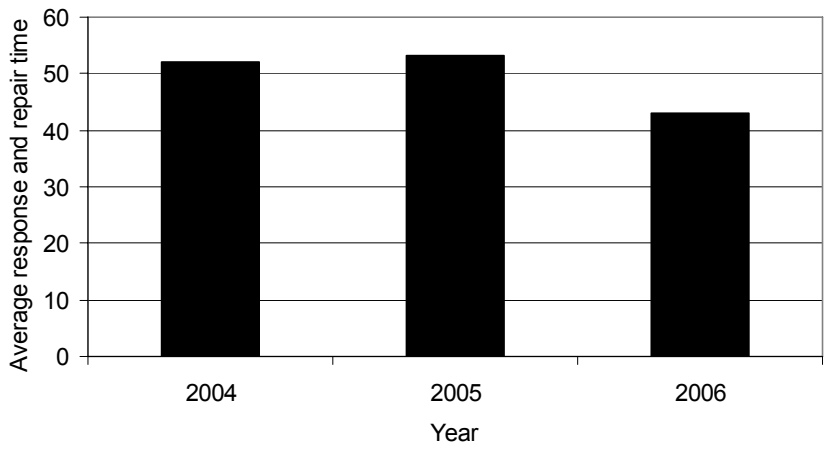
However, the average duration of each train delayed has stayed constant at 11 minutes over the three years from 2004 to 2006.

RailCorp was not able to say by how much the fall in trains delayed and the overall duration of delays resulted from change in the definition of a delayed train and to the timetable.

Quicker at responding and repairing failures

The average time taken to respond to and rectify each signal failure during peak remained relatively stable at 52 minutes in 2004 and 53 minutes in 2005, but fell to 43 minutes in 2006. This represents a 17 per cent improvement between 2004 and 2006 which is indicative of improved response practices as discussed later in the chapter.

Exhibit 14: Average time taken to repair and respond to failures



Source: RailCorp 2007

Note: Reliable data only available from 2004.

The level of delay the network can tolerate not clear

While its results for downtime and delays have been improving, RailCorp could not show it was keeping the number of delays and the duration of delays resulting from signalling failures low enough.

It also does not have targets for the:

- number of trains delayed due to signalling incidents
- duration of delays due to infrastructure or signalling incidents.

It uses past performance to estimate the delays due to infrastructure incidents the network can tolerate while still retaining service levels. Although this is a good starting point as discussed in chapter 2, it should also trial reliability modelling.

Recommendation

We recommend that RailCorp use both past performance and reliability modelling to estimate the duration of signalling delays the network can tolerate and set targets accordingly.

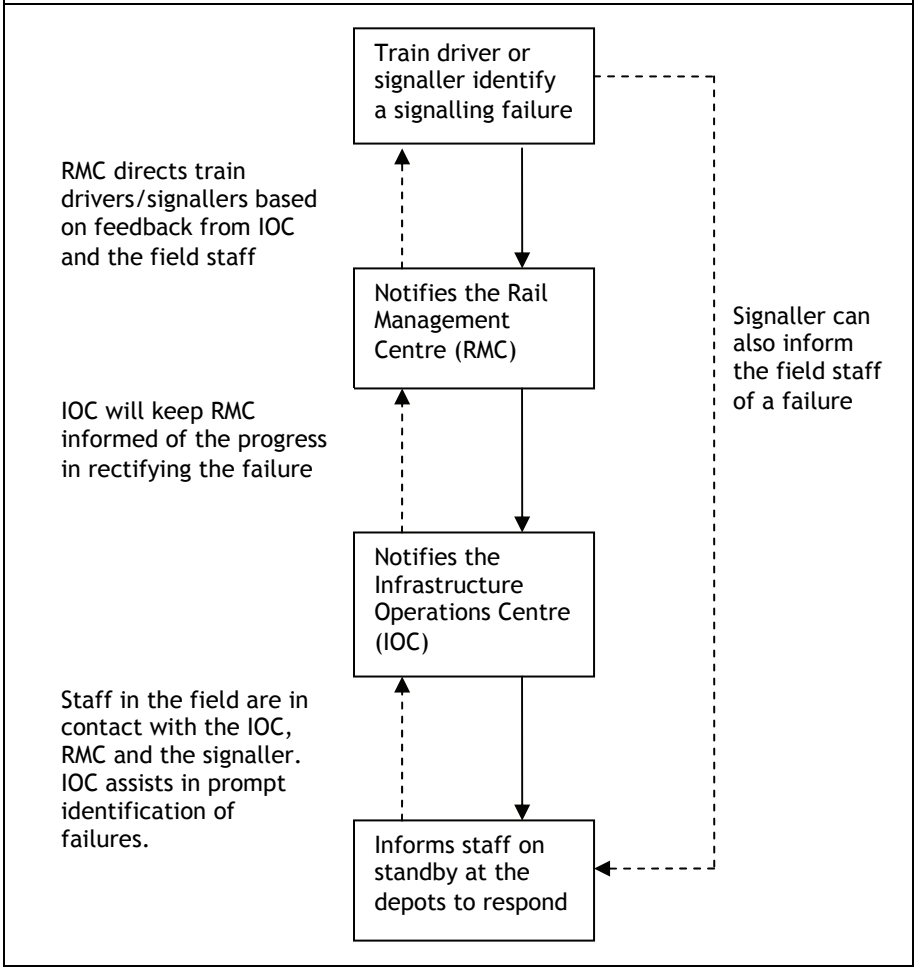
3.2 Does RailCorp have plans to guide incident response?

Our assessment

RailCorp has developed and adopted an incident management framework which specifies how incidents should be managed at organisational, divisional and regional levels. It should, however, review how well this framework is implemented, the extent to which it meets its objectives, and how well it captures lessons for continuous improvement.

Response is coordinated

Exhibit 15: Response to signalling incidents

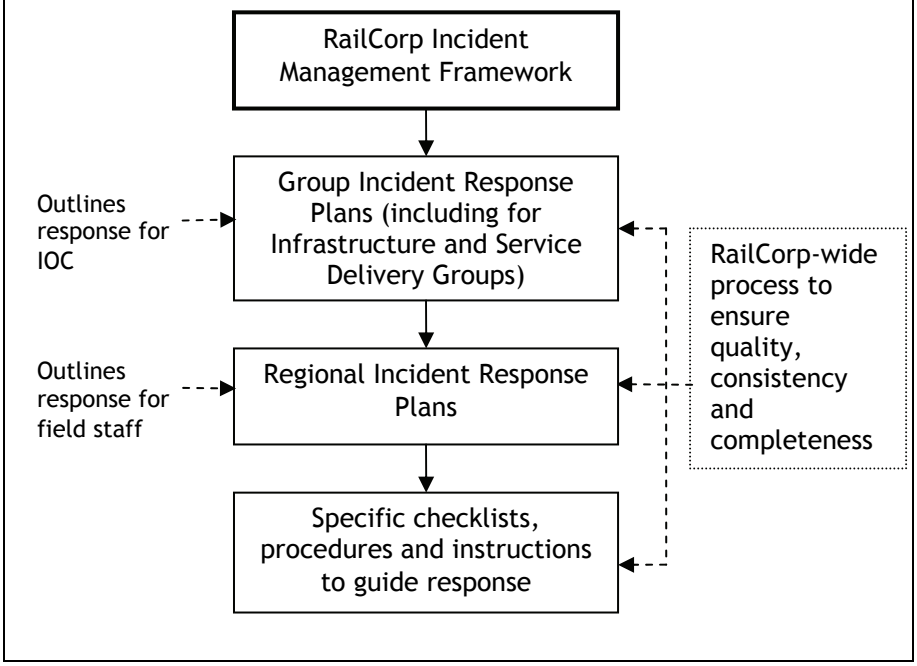


Source: Railcorp documents and interviews.

A framework guides incident response

In 2005 RailCorp developed and implemented an Incident Management Framework (IMF) to guide incident response. The IMF sets out the business rules, roles and responsibilities for responding to rail incidents.

Exhibit 16: Incident management



Source: RailCorp documents and interviews

Most signal failures are minor incidents

All rail incidents are categorised as minor, major or emergency and the IMF outlines how each category of incidents should be managed. RailCorp advises that about 99 percent of signalling incidents are categorised as minor incidents, that is, they can be appropriately managed without significant disruptions to the network.

RailCorp advised that:

- the IMF was informed by good practice
- plans are reviewed regularly to ensure they are consistent with the framework and comprehensive.

Need assurance that framework works

Although we acknowledge that developing a framework is an important step to improving performance, RailCorp could not show how well it has been applied and the impact this has had on effectively managing signalling failures.

Recommendation

We recommend that RailCorp review by the end of 2008 how well its incident response framework impacts on signal incidents.

3.3 Are response resources effectively allocated?

Our assessment

RailCorp locates key staff across the network to respond to signalling failures. In peaks, RailCorp places staff on standby where it considers the network to be most vulnerable. RailCorp's deployment strategies are not, however, based on a systematic risk assessment.

Specialist staff on standby during peaks

RailCorp advises that during peaks, it puts around 200 regional signal engineering and electrical staff on stand-by at 30 locations around the network to respond to signal failures. An additional eight depots are staffed 24 hours seven days a week.

Incident coordination centre

In 2002 RailCorp set up an Infrastructure Operations Centre (IOC) to coordinate responses to infrastructure incidents. The IOC is equipped with detailed maps of the network and information on signalling assets, their type, and locations. It uses this to support field staff.

GOOD PRACTICE

Exhibit 17: Initiatives to improve incident response

In addition to the IOC, RailCorp is implementing initiatives such as:

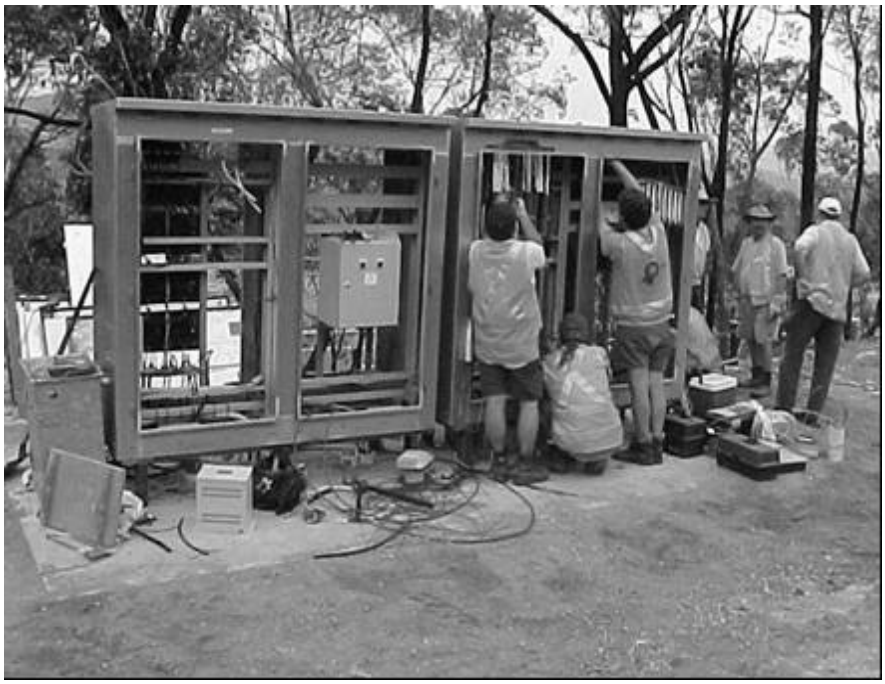
- gradually increasing computer visibility and control of signalling assets on the network through the Advanced Train Running Information and Communication System (ATRICS). In an event of a failure this helps staff to accurately identify what signalling component has failed
- weather systems to assist in forecasting the possible impact of weather patterns on signal infrastructure e.g. lightning strikes. Power surges and sags due to the weather related incidents are not frequent but they can have a high impact.

Source: RailCorp document and interviews

To complement the response teams, other staff located across the network are also trained in responding to signal incidents. These include:

- Network Operations Superintendents – located at critical junctions and in charge of managing incidents on site to ensure their effective resolution
- Station Operations Superintendents and station staff –some staff are also trained in rectifying basic failures near their stations e.g. if a set of points is not functioning they can manually set these points.

Exhibit 18: Response teams at work



Source: RailCorp

Deployment should be based on risk

Although we recognise that staff are located around the network, and are put on standby during peaks, RailCorp was not able to demonstrate that staff deployment is based on a systematic risk analysis. It was unable to demonstrate that it has the right number, with the right skills at the right place and at the right time to respond to failures.

Recommendation

We recommend that RailCorp base incident response strategies on a systematic risk assessment.

3.4 Are response staff adequately trained?

Our assessment

Signal electricians and engineers develop their skills through training and are accredited by RailCorp every three years. RailCorp needs, however, to do more to ensure staff possess the skills to respond well to signal failures.

Signalling staff are qualified

Signal electricians and engineers involved in responding to signalling incidents are qualified and also trained and accredited to work on RailCorp's rail signalling system.

GOOD PRACTICE

Exhibit 19: Continuously improving the response to failures

We noted several RailCorp initiatives to develop the skills of staff responsible for responding to signal failures, including:

- accreditation of signal engineers and electricians qualifications every three years
- routine performance assessments of staff to test knowledge of response protocols. For example, signallers are assessed on effective communication during an incident
- signal electricians and engineers from all regions attend quarterly forums to share problems/ideas in improving response capabilities
- a 'just culture' approach to reporting and investigating incidents involving human error. This has helped identify training needs and reduced the number of failures due to maintenance error
- circulation of 'special instructions' on repair techniques, and one-to-one training in the field. Where there are system-wide problems' specific instructions are released to all regions.

Source: Audit interviews

Need to do more to ensure staff possess skills

RailCorp has identified that it needs to do more to be sure that all staff who respond to signal failures have the necessary skills. In addition to the above, it is implementing a new system which focuses on identifying critical technical and non-technical skills and targeting training to address skill gaps. This process has started with train drivers and is expected to be rolled out to signal engineers and electricians later in 2007.

The worldwide shortage of signalling engineers and electricians is likely to make it hard for RailCorp to train staff. The competencies RailCorp would need for a more advanced signalling system (such as ATP or ATC) may also be different to those needed for the current signalling system. RailCorp is yet to demonstrate how it intends to address these risks, but it needs to do this soon.

Recommendation

We recommend that RailCorp review competencies of staff involved in signal asset management or incident response by the end of 2008 and address skills gaps.

3.5 Does RailCorp monitor response performance?

Our assessment

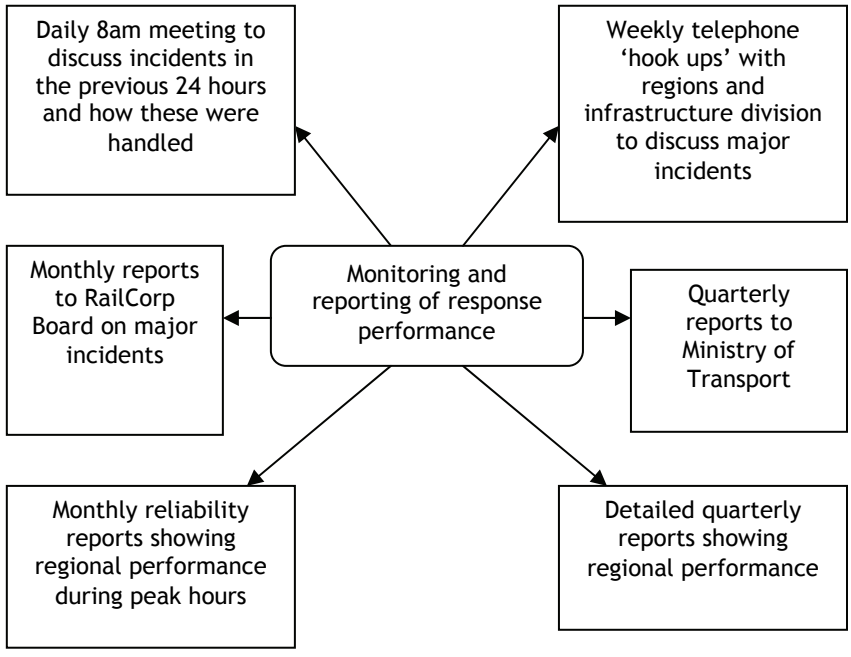
RailCorp has several forums to monitor response performance, and regularly distributes performance reports to regions. These provide opportunities for internal comparisons and to share learning. It needs, however, to benchmark its response performance and practice against other networks and report on-time running and delays on a 24 hour basis.

Several reports and forums

RailCorp produces several reports which include response performance and has several forums where incident response is discussed.

GOOD PRACTICE

Exhibit 20: Forums and reports on response performance



Source: RailCorp documents and interviews

These reports and forums cover a range of issues such as:

- number of peak incidents and delays
- time taken to respond to and repair failures
- internal benchmarking of performance across regions
- major incidents and areas for improvement
- trends and results of local initiatives.

Lack of external benchmarking

RailCorp has not, however, undertaken any external benchmarking to measure and improve its signalling incident response capabilities. Such external comparison would allow a more informed judgement of how good its performance is, and help identify opportunities for improvement.

Reporting is focused on the peak

Most current performance reporting is focused only on peak hours. Although these are crucial times, it is only a snapshot of RailCorp's overall performance. RailCorp has advised that plans are underway to move to 24 hour reporting of on-time running and delays to provide a more comprehensive view of its performance.

Recommendation We recommend that RailCorp:

- benchmark incident response against other railway operators with similar operating environments
- implement in 2007-08 its plans to move to 24 hour on-time running reporting
- monitor and report on asset performance and its impact on on-time running on a regular basis.

Appendices

Appendix 1 About the audit

Audit Objective

This performance audit assessed whether RailCorp is effectively managing the risk of signal failures.

Lines of Inquiry

In reaching our opinion against the audit objective, we sought to answer the following questions:

1. is RailCorp keeping the number of signal failures low enough to support its on-time running target?
2. is RailCorp keeping the duration of signal failures low enough to support its on-time running target?

Audit scope

We focussed on the Sydney metropolitan rail network. Based on advice from RailCorp, we focussed on three main causes of signalling system failure:

- track circuitry
- points
- train stops.

Audit Criteria

In answering the lines of inquiry, we used the following audit criteria (the 'what should be') to judge performance. We based these standards on our research of current thinking and guidance on better practice. They were been discussed and agreed with RailCorp.

For line of inquiry 1, we assessed the extent to which RailCorp:

- could demonstrate that it determines the required signalling assets and performance level
- could demonstrate that it defines its signalling infrastructure and determines its condition
- had developed and implemented a maintenance plan
- monitored and evaluated implementation and results and benchmarks its performance so as to identify opportunities to improve
- was achieving the required signalling asset performance level and reporting its performance.

For line of inquiry 2, we assessed the extent to which RailCorp:

- determined the duration of signalling failures it can tolerate and achieves this level
- had adopted an appropriate signalling incident management framework and has plans to respond to and rectify signal and point incidents
- effectively allocated its signalling incident response resources on the basis of risk
- trained its signalling incident response teams
- monitored, evaluated and reported implementation and results so as to identify opportunities to improve and benchmarks its signalling incident response.

Audit approach

We collected evidence by:

- interviewing program managers and staff in RailCorp who manage signalling infrastructure
- interviewing program managers and staff in RailCorp who respond to incidents of signalling failure
- reviewing RailCorp documentation and asset management systems for signalling
- reviewing RailCorp documentation and response systems for signalling failures
- reviewing good practices used by RailCorp to manage the risk of signalling failures and identify opportunities for improvement
- reviewing documentation on evaluation and reporting of performance to identify opportunities for improvement.

The onus was, however, for RailCorp to demonstrate that it is preventing and responding to signalling failures adequately.

Audit selection

We use a strategic approach to selecting performance audits which balances our performance audit program to reflect issues of interest to Parliament and the community. Details of our approach to selecting topics and our forward program are available on our website.

Audit methodology

Our performance audit methodology is designed to satisfy Australian Audit Standards AUS 806 and 808 on performance auditing, and to reflect current thinking on performance auditing practices. We produce our audits under a quality management system certified to International Standard ISO 9001. Our processes have also been designed to comply with the auditing requirements specified in the *Public Finance and Audit Act 1983*.

Acknowledgements

We gratefully acknowledge the co-operation and assistance provided by RailCorp. In particular we wish to thank our liaison officer Ronnie Azzi, and staff of RailCorp who participated in interviews, assisted with research or provided other material relevant to the audit.

We also acknowledge the assistance provided by the Independent Transport Safety Reliability Regulator.

Audit team

Our team leader for the performance audit was Rodney Longford, who assisted by Angelina Pillay and Neil Avery. Jane Tebbatt provided direction and quality assurance.

Audit cost

Including staff costs, printing costs and overheads, the estimated cost of the audit is $350,000.

Appendix 2 Glossary

Automatic Train Protection	A system which provide security against inappropriate movements of a train if the driver is not managing the train appropriately. It prevents a train from proceeding at greater than the authorised speed.
Automatic Train Control	A system in which the complete operation of the train is controlled automatically, that is, without driver involvement.
Delay	When a train is not on time.
Downtime	Time taken to respond to and repair a failure.
On-time	A train that arrives at its final destination within five minutes of schedule if a suburban train (four minutes prior to June 2005) and six minutes if an intercity train.
Peak services	Trains services scheduled to arrive in the Sydney CBD between the hours of 6.00 am and 9.00 am (morning peak), and departing the Sydney CBD between the hours of 4.00 pm and 6.00 pm (evening peak) from Monday to Friday.
Points	A set of switches installed to allow a train to move from one track to another parallel track.
Reliability modelling	Model used to flow down the top level performance requirements to sublevels. The outputs of reliability modelling can be used to establish performance targets for networks, assets and support functions.
Renewal	The replacement of assets like for like or with a modern engineering equivalent to retain asset function. The objective of renewals is to optimise the long run cost effectiveness of an asset (minimal life cycle cost).
Signal	A mechanical or electrical device beside a railway line to pass information relating to the state of the line ahead to a train driver. The driver interprets the signal's indication and acts accordingly. Typically, a signal might inform the driver that the train may safely proceed (green light), or it may instruct the driver to stop (red light).
Signalling failure	Signalling equipment not performing its required function
Incident	A signalling failure which causes at least one peak train to be delayed.
Skipped stop	When a train service does not stop at a station designated in the timetable.
Technical Maintenance Plan	Documents schedule inspection, condition monitoring and servicing tasks performed on infrastructure assets as part of preventative maintenance.
Track circuit	An electrical circuit where current is carried through the rails and is used to detect the presence of a train. Track circuits are used in the operation and control of signals and points.
Train stop	A device located on the track and fitted with an arm which is raised when the signal is displayed as red (stop sign). This is a safety device which automatically applies the train's brake if it passes the train stop with a raised arm.

Performance audits by the Audit Office of New South Wales

Performance Auditing

What are performance audits?

Performance audits determine whether an agency is carrying out its activities effectively, and doing so economically and efficiently and in compliance with all relevant laws.

Performance audits may review a government program, all or part of a government agency or consider particular issues which affect the whole public sector.

Where appropriate, performance audits make recommendations for improvements.

If you wish to find out what performance audits are currently in progress, visit our website at www.audit.nsw.gov.au.

Why do we conduct performance audits?

Performance audits provide independent assurance to Parliament and the public that government funds are being spent efficiently and effectively, and in accordance with the law.

Performance audits seek to improve the efficiency and effectiveness of government agencies so that the community receives value for money from government services.

Performance audits also assist the accountability process by holding managers to account for agency performance.

What are the phases in performance auditing?

Performance audits have three key phases: planning, fieldwork and report writing.

During the planning phase, the audit team will develop audit criteria and define the audit field work.

At the completion of field work we will meet with agency management to discuss all significant matters arising out of the audit. Following this, we will prepare a draft performance audit report.

We meet with agency management to check that facts presented in the report are accurate and that recommendations are practical and appropriate. Following this, a formal draft report is provided to the CEO for comment. The relevant Minister is also provided with a copy of the final report. The final report, which is tabled in Parliament, includes any comment made by the CEO on the conclusion and the recommendations of the audit.

Depending on the scope, performance audits can take several months to complete.

Copies of our performance audit reports can be obtained from our website or by contacting our Office.

How do we measure an agency's performance?

During the planning phase, the team develops the audit criteria. These are standards of performance against which the agency or program is assessed. Criteria may be based on best practice, government targets, benchmarks, or published guidelines.

Do we check to see if recommendations have been implemented?

Every few years we conduct a follow-up audit. These follow-up audits look at the extent to which action has been taken to address issues or recommendations agreed to in an earlier performance audit.

The Public Accounts Committee (PAC) may also conduct reviews or hold inquiries into matters raised in performance audit reports. Agencies are also requested to report actions taken against each recommendation in their annual report.

Who audits the auditors?

Our performance audits are subject to internal and external quality reviews against relevant Australian and international standards. This includes ongoing independent certification of our ISO 9001 quality management system.

The PAC is also responsible for overseeing the activities of the Audit Office and conducts a review of our operations every three years.

Who pays for performance audits?

No fee is charged for performance audits. Our performance audit services are funded by the NSW Parliament and from internal sources.

Further information

Further information can be obtained from our website www.audit.nsw.gov.au or by contacting us on 9275 7277.

Performance Audit Reports

No	Agency or Issues Examined	Title of Performance Audit Report or Publication	Date Tabled in Parliament or Published
86	Follow-up of Performance Audits	*The School Accountability and Improvement Model (May 1999)* *The Management of Court Waiting Times (September 1999)*	14 September 2001
87	E-government	*Use of the Internet and Related Technologies to Improve Public Sector Performance*	19 September 2001
88*	E-government	*e-ready, e-steady, e-government: e-government readiness assessment guide*	19 September 2001
89	Intellectual Property	*Management of Intellectual Property*	17 October 2001
90*	Intellectual Property	*Better Practice Guide* *Management of Intellectual Property*	17 October 2001
91	University of New South Wales	*Educational Testing Centre*	21 November 2001
92	Department of Urban Affairs and Planning	*Environmental Impact Assessment of Major Projects*	28 November 2001
93	Department of Information Technology and Management	*Government Property Register*	31 January 2002
94	State Debt Recovery Office	*Collecting Outstanding Fines and Penalties*	17 April 2002
95	Roads and Traffic Authority	*Managing Environmental Issues*	29 April 2002
96	NSW Agriculture	*Managing Animal Disease Emergencies*	8 May 2002
97	State Transit Authority Department of Transport	*Bus Maintenance and Bus Contracts*	29 May 2002
98	Risk Management	*Managing Risk in the NSW Public Sector*	19 June 2002
99	E-Government	*User-friendliness of Websites*	26 June 2002
100	NSW Police Department of Corrective Services	*Managing Sick Leave*	23 July 2002
101	Department of Land and Water Conservation	*Regulating the Clearing of Native Vegetation*	20 August 2002
102	E-government	*Electronic Procurement of Hospital Supplies*	25 September 2002
103	NSW Public Sector	*Outsourcing Information Technology*	23 October 2002
104	Ministry for the Arts Department of Community Services Department of Sport and Recreation	*Managing Grants*	4 December 2002
105	Department of Health Including Area Health Services and Hospitals	*Managing Hospital Waste*	10 December 2002

No	Agency or Issues Examined	Title of Performance Audit Report or Publication	Date Tabled in Parliament or Published
106	State Rail Authority	*CityRail Passenger Security*	12 February 2003
107	NSW Agriculture	*Implementing the Ovine Johne's Disease Program*	26 February 2003
108	Department of Sustainable Natural Resources Environment Protection Authority	*Protecting Our Rivers*	7 May 2003
109	Department of Education and Training	*Managing Teacher Performance*	14 May 2003
110	NSW Police	*The Police Assistance Line*	5 June 2003
111	E-Government	*Roads and Traffic Authority Delivering Services Online*	11 June 2003
112	State Rail Authority	*The Millennium Train Project*	17 June 2003
113	Sydney Water Corporation	*Northside Storage Tunnel Project*	24 July 2003
114	Ministry of Transport Premier's Department Department of Education and Training	*Freedom of Information*	28 August 2003
115	NSW Police NSW Roads and Traffic Authority	*Dealing with Unlicensed and Unregistered Driving*	4 September 2003
116	NSW Department of Health	*Waiting Times for Elective Surgery in Public Hospitals*	18 September 2003
117	Follow-up of Performance Audits	*Complaints and Review Processes (September 1999)* *Provision of Industry Assistance (December 1998)*	24 September 2003
118	Judging Performance from Annual Reports	*Review of Eight Agencies' Annual Reports*	1 October 2003
119	Asset Disposal	*Disposal of Sydney Harbour Foreshore Land*	26 November 2003
120	Follow-up of Performance Audits NSW Police	*Enforcement of Street Parking (1999)* *Staff Rostering, Tasking and Allocation (2000)*	10 December 2003
121	Department of Health NSW Ambulance Service	*Code Red:* *Hospital Emergency Departments*	15 December 2003
122	Follow-up of Performance Audit	*Controlling and Reducing Pollution from Industry (April 2001)*	12 May 2004
123	National Parks and Wildlife Service	*Managing Natural and Cultural Heritage in Parks and Reserves*	16 June 2004
124	Fleet Management	*Meeting Business Needs*	30 June 2004
125	Department of Health NSW Ambulance Service	*Transporting and Treating Emergency Patients*	28 July 2004
126	Department of Education and Training	*School Annual Reports*	15 September 2004

No	Agency or Issues Examined	Title of Performance Audit Report or Publication	Date Tabled in Parliament or Published
127	Department of Ageing, Disability and Home Care	*Home Care Service*	13 October 2004
128*	Department of Commerce	*Shared Corporate Services: Realising the Benefit including guidance on better practice*	3 November 2004
129	Follow-up of Performance Audit	*Environmental Impact Assessment of Major Projects (2001)*	1 February 2005
130*	Fraud Control	*Current Progress and Future Directions including guidance on better practice*	9 February 2005
131	Follow-up of Performance Audit Department of Housing	*Maintenance of Public Housing (2001)*	2 March 2005
132	Follow-up of Performance Audit State Debt Recovery Office	*Collecting Outstanding Fines and Penalties (2002)*	17 March 2005
133	Follow-up of Performance Audit Premier's Department	*Management of Intellectual Property (2001)*	30 March 2005
134	Department of Environment and Conservation	*Managing Air Quality*	6 April 2005
135	Department of Infrastructure, Planning and Natural Resources Sydney Water Corporation Sydney Catchment Authority	*Planning for Sydney's Water Needs*	4 May 2005
136	Department of Health	*Emergency Mental Health Services*	26 May 2005
137	Department of Community Services	*Helpline*	1 June 2005
138	Follow-up of Performance Audit State Transit Authority Ministry of Transport	*Bus Maintenance and Bus Contracts (2002)*	14 June 2005
139	RailCorp NSW	*Coping with Disruptions to CityRail Passenger Services*	22 June 2005
140	State Rescue Board of New South Wales	*Coordination of Rescue Services*	20 July 2005
141	State Budget	*In-year Monitoring of the State Budget*	28 July 2005
142	Department of Juvenile Justice	*Managing and Measuring Success*	14 September 2005
143	Asset Management	*Implementing Asset Management Reforms*	12 October 2005
144	NSW Treasury	*Oversight of State Owned Electricity Corporations*	19 October 2005
145	Follow-up of 2002 Performance Audit	*Purchasing Hospital Supplies*	23 November 2005
146	Bus Transitways	*Liverpool to Parramatta Bus Transitway*	5 December 2005
147	Premier's Department	*Relocating Agencies to Regional Areas*	14 December 2005
148	Department of Education and Training	*The New Schools Privately Financed Project*	8 March 2006

No	Agency or Issues Examined	Title of Performance Audit Report or Publication	Date Tabled in Parliament or Published
149	Agency Collaboration	*Agencies Working Together to Improve Services*	22 March 2006
150	Follow-up of 2000 Performance Audit	*Fare Evasion on Public Transport*	26 April 2006
151	Department of Corrective Services	*Prisoner Rehabilitation*	24 May 2006
152	Roads and Traffic Authority	*The Cross City Tunnel Project*	31 May 2006
153	Performance Information	*Agency Use of Performance Information to Manage Services*	21 June 2006
154	Follow-up of 2002 Performance Audit	*Managing Sick Leave in NSW Police and the Department of Corrective Services*	29 June 2006
155	Follow-up of 2002 Performance Audit	*Regulating the Clearing of Native Vegetation*	19 July 2006
156*	Fraud Control	*Fraud Control Improvement Kit: Meeting Your Fraud Control Obligations*	20 July 2006
157	Roads and Traffic Authority	*Condition of State Roads*	16 August 2006
158	Department of Education and Training	*Educating Primary School Students with Disabilities*	6 September 2006
159	NSW Health	*Major Infectious Disease Outbreaks: Readiness to Respond*	22 November 2006
160	NSW Health	*Helping Older People Access a Residential Aged Care Facility*	5 December 2006
161	Follow-up of 2003 Performance Audit	*The Police Assistance Line*	6 December 2006
162	NSW Health	*Attracting, Retaining and Managing Nurses in Hospitals*	12 December 2006
163	Legal Aid Commission of NSW	*Distributing Legal Aid in New South Wales*	13 December 2006
164	Department of Juvenile Justice NSW Police Force	*Addressing the Needs of Young Offenders*	28 March 2007
165	Homelessness	*Responding to Homelessness*	2 May 2007
166	Follow-up of Performance Audit Department of Education and Training	*Using Computers in Schools for Teaching and Learning*	9 May 2007
167	Follow-up of 2001 Performance Audit: Ambulance Service of New South Wales	*Readiness to Respond*	6 June 2007
168	Ministry of Transport	*Connecting with Public Transport*	6 June 2007
169	NSW Police Force	*Dealing with Household Burglaries*	27 June 2007
170	RailCorp	*Signal Failures on the Metropolitan Rail Network*	15 August 2007

* Better Practice Guides

A list of performance audits tabled or published since March 1997, as well as those currently in progress, can be found on our website www.audit.nsw.gov.au.