

NEXT CHAPTER MEETING:

Thursday 3rd September

Hosted by the Institution of Railway Signal Engineers (IRSE)

**JOINT MEETING of the
Permanent Way Institution (PWI) and the
Railway Technical Society of Australasia (RTSA), SA Chapter**

National Train Communication System



**Presented by Mike van de Worp, General Manager of Train Communications and
Control Systems, ARTC**

Venue: Gil Langley Room, Adelaide Oval

Time: 5.45pm for a 6pm start

To be followed at 7pm by a FREE Cocktail Meal and Refreshments (RSVP required)

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Chapter Meetings

Thursday 3 September 2009

Joint Chapter meeting RTSA/PWI hosted by IRSE at Gil Langley Room, Adelaide Oval – National Train Communication System by Mike van de Worp, ARTC.

NOTE: Meeting to be followed by FREE Cocktail Meal and Refreshments. For catering purposes, please RSVP to Malcolm Menadue on 0418 827 126 or at mmenadue@internode.on.net to confirm your attendance.

Thursday 1 October 2009

Chapter meeting, 11 Bagot St, North Adelaide – 'Accident Investigation in the Indonesian Railways' by Lucky Soegito, Indonesian Railways.

Thursday 22 October 2009

PWI Quiz Night, details to follow shortly.

Thursday 5 November 2009

Chapter meeting – ARTC Network Enhancement investment update by Ben Leske.

Tuesday 1 December 2009

Annual dinner meeting + AGM, Hyde Park Tavern.

Publisher

This newsletter is a publication of the South Australian Chapter of the Railway Technical Society of Australasia, Engineering House, 11 Bagot Street, North Adelaide SA 5006. Opinions expressed within are not necessarily those of the Chapter, Society or Editor.

Contributions

Contributions, including news, opinions, or letters to the editor, are always welcome. Send material by e-mail to sa-editor@rtsa.com.au

Continuing Professional Development

Engineers Australia members are reminded that attendance at RTSA technical meetings contributes towards CPD requirements. Each RTSA technical meeting generally has a value of 1 CPD point.

RTSA Website

The RTSA website www.rtsa.com.au has details of RTSA activities, including future meetings and reports from past meetings, for all Chapters.

Membership

Information for potential new members and an application form may be found at www.rtsa.com.au.

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Newsletter Dispatch

Dispatch of the newsletter is undertaken by Steve Torok. Contact Steve on storok@tge.com.au if you have any problems receiving newsletter electronically or in hard copy, or change your e-mail address.

News

SA Chapter Meeting August 6th, 2009

The last Chapter meeting saw a presentation on the topic of *'The Noise Abatement Project'* by Carlyne Southern of Pacific National. A copy of this presentation is included at the end of this newsletter for those of you who were unable to attend.

New Members

The SA Chapter is pleased to welcome three new members over the past few months, namely Steve Cooper, Christian Rogers and Aidan Stanger.

Complimentary AusRAIL PLUS 2009 Attendance

The SA Chapter is pleased to announce that the successful applicants for complimentary attendance at AusRAIL PLUS 2009 in Adelaide later this year are Tiana Hume, Victor Prados-Vaero, Aidan Stanger and Ian Fox. Congratulations to you all and we hope you enjoy the event!

2010 RTSA Annual Railway Engineering Awards

In 2010, the RTSA is offering awards in five different categories: Individual, Industry, Young Railway Engineer, Railway Engineering Student Thesis and Contact Mechanics. Nominations for the 2010 Engineering Student Thesis Award and the Contact Mechanics Award will close on 27 November 2009 and for all other categories, nominations will close on 28 February 2010. For more information please see: www.rtsa.com.au

New Chapter Chair, NSW

Earlier this month, the NSW Chapter announced that Katharina Gerstmann has been appointed as new Chapter Chair. Congratulations Katharina and we wish you well in your new position!

Coming Events

AusRail Plus 2009, Adelaide

Between 17th-19th November, Adelaide will host the largest annual rail event in the Asia Pacific region, AusRail Plus, at the Adelaide Convention Centre. With trade exhibitions, networking functions and a program of international speakers, this 3-day conference will be the biggest rail event of 2009.

Full details can be obtained from www.ausrail.com/informaoz/AusRAIL/

CORE 2010 – Wellington, NZ

The RTSA's biennial Conference on Railway Engineering (CORE) is to be held next year in Wellington, NZ with the theme 'Rail – Rejuvenation & Renaissance'. Registration for Abstract Submissions is open now until November 29th 2009. For more details please see <http://www.core2010.org.nz/>

Chairman's Chatter

It would be hard to find a more challenging and complex technical investigation than the one described by Carlyne Southern at our August meeting – the "Noise Abatement Project"

The desirability of reducing wheel/rail noise emissions in the Adelaide Hills has been an ongoing issue for some time, so it is pleasing to see that real progress with mitigation is being achieved. However, few of the complainants would appreciate

the multi-faceted nature of the problem and the difficulties involved in bringing about a meaningful improvement.

Not only are there two distinct main types of noise – flanging and wheel squeal – but the wheel squeal on its own can have as many as 60 potential contributing causes. Investigating and eliminating all the possible causal factors is indeed a complex task.

When the rail industry became largely separated into above rail operators and below rail track owners, many observers were quick to point out perceived detrimental effects of a potential lack of focus on the critical interface between wheel and rail. However, the Adelaide Hills project demonstrates a commendable co-operation between all operators using the corridor, the track owner, and a second interstate track owner with similar issues. Such an integrated effort is in many respects an achievement in itself.

Before the detailed work commenced, who would have imagined that popularly assumed causes of wheel squeal, such as train speed, may play little part in the level of noise generated. A focus on vehicle condition monitoring, including bogie, axle and wheel alignment, has produced some useful improvement, but is by no means the whole story.

It was somewhat surprising to learn that the relative humidity of the air appears to be a significant contributing factor. In the past, this had never been seriously considered as a reason for variations in noise emissions.

But as well as the high number of potential contributing parameters, this investigation has additional layers of complexity, particularly the significant politicisation of the issue, and the involvement of external regulatory agencies.

One local council has been vocal in its opposition to train noise, and has formally established a Rail

Freight Sub-Committee to deal with the issues. It must be quite challenging to present to such interested parties the concepts involved in investigation of rail wheel noise. These concepts need to be presented in a form which can be readily understood and digested by the general community and their elected representatives, who no doubt expect a rapid and complete solution to the problem.

In addition, community action gets intertwined with the concurrent issues of locomotive noise, the increasing number of freight trains on the corridor, safety risks associated with derailments, the supposed desirability of shifting the problem onto someone else's patch by constructing an alternative freight route elsewhere, and – more recently – a proposed increase in train lengths.

It is a credit to the investigation team that local politicians appear to be convinced that action is being taken in an appropriate way. The public focus on the noise aspect seems to have diminished in recent times, even if only because of the focus on a new route.

With regard to regulatory agencies, the Environment Protection Authority monitors developments, and operators' Environmental Improvement Programmes. The authority also seems to be satisfied with the progress being made, to the extent that it claims it is itself implementing a program to reduce rail noise.

So it is to be hoped that this co-operation between operators and track owners can continue, and lead to a real breakthrough in identifying those elusive causal factors.

The issue is not confined to the Adelaide Hills, or to Australia – the current research has potential benefits for rail worldwide.

Duncan McLeod

The Noise Abatement Project – Carlyne Southern, Pacific National

The slides from this presentation can be seen on the following pages:

**Adelaide Hills
Wheel Squeal Project**
6th August 2009

Carolyn Southern
Manager – Standards and Monitoring
Pacific National

Kirsten Alexander
Manager – Network Performance
ARTC

Introduction

The main interstate rail passes through residential areas in the Adelaide Hills in South Australia operating over sections of track consisting of many sharp curves and varying grades.

The passage of some trains / wagons may cause the generation of unacceptable wheel / rail noises for those residents.

Community annoyance is high, as most trains pass through during evening to early morning

ARTC, Operators and their contractors have joined forces to create the "Noise Abatement Committee" (NAC) to find a means of reducing the frequency and occurrence of these noises.

RailSQUAD has been developed as a TOOL to identify those wagons and locomotives that are repeat offenders, as well as to gain an understanding of the operational and environmental conditions under which noise is generated.

Adelaide Hills Wheel Squeal Project – 6th August 2009

Introduction

- Rail / wheel squeal is an international problem
- It is recognised worldwide as a complex interaction between wheel and rail
- Over 65 parameters have been identified as contributing to wheel squeal
- The NAC are trying to stay informed on projects and latest technology and have formed networks in the rail industry both in Australia and overseas to share and gain knowledge to solve this issue.
- The work involved at Heathfield, SA is leading technology in solving the issue.
- The NAC is combining the data and trying to identify relationships that create noise.
- Unfortunately there is a very large amount of data and work that needs to be undertaken on where to target the efforts.

Adelaide Hills Wheel Squeal Project – 6th August 2009

Benefits of Rail over Other Transport

Less costs to Australia

- > Safer, so less accidents and deaths: 10 times less incidents per movement than road.
- > Less energy use per tonne, means less particulates per tonne of freight, which means better air quality and public health
- > Less vehicles on road means less road congestion, less accidents and lower spending required on road infrastructure
- > Lower greenhouse gases from rail freight than road freight transport, means every tonne of freight from road to rail, reduces Australia's greenhouse gas emissions

Energy Intensity in Undertaking Freight Task (MJ/FKG/Tonne Kilometre)

Light Commercial Vehicles	21.16
Rigid Trucks	3.00
Articulated Trucks	1.01
Rail	0.3

A train between Melbourne and Sydney will use 45 000 litres less fuel, replace 145 semi-trailers and saves 135 tonnes of greenhouse gases.
Source: Australian Rail Association

Adelaide Hills Wheel Squeal Project – 6th August 2009

Definitions

- Wheel disk rings at its resonance frequency. Other vibration modes damped.
- Wheel resonance heard as loud, high pitched squeal.
- Transverse "stick-slip" movement of wheel across and along rail head acts as a source of vibration.

Wheel Squeal:
Wheel squeal is where a high frequency sound is emitted from the wheel, through a phenomenon known as "stick-slip", which is essentially where the wheel slides on the rail

Flanging:
Flanging is caused by contact between flange and rail face usually from contact angle from the wheelset(s).

Repeat Offender
A repeat offender is a wagon that have passed over RailSQUAD eight or more times and have produced noise for at least 40% of those passes

Adelaide Hills Wheel Squeal Project – 6th August 2009

Wheel Squeal Project

To tackle the problem, the "Noise Abatement Committee" formed in 2003, consisting of:

- Track Owner (Australian Rail Track Corporation)
- Rail Operators
- Environmental Protection Authority (EPA)
- Vipac Engineers and Scientists / Track IQ (commissioned developer of RailSQUAD)

The primary focus of the project was to gain an understanding of the relationship between the train operation and the generation of wheel / rail noise emission.

With the goal of reducing the severity and frequency of occurrence.

Adelaide Hills Wheel Squeal Project – 6th August 2009

Development of RailsQAD

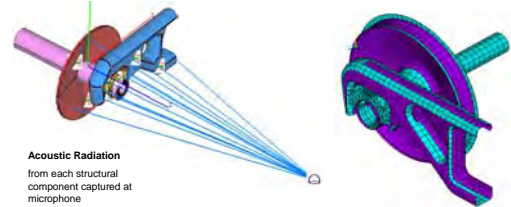
- The Committee approached Vipac Engineers & Scientists to develop a prototype system to accurately record, analyze and monitor wheel / rail noise emissions.
- In 2003 a prototype system was developed, installed and proven successful in detecting and analysing wheel/rail noise.
- The technology was based on existing technology for tracking and monitoring wheel bearing defects.
- In 2005 a permanent system was jointly funded by the ARTC and all operators.
- The site was installed on the ARTC network at Heathfield in the Adelaide Hills in Dec 2005.
- By January 2006 the system was fully operational and data was being analysed by operators.
- **RailsQAD is the only one of its kind in the world, and there is no comparable system elsewhere. The system and its use is still under development.**



Adelaide Hills Wheel Squeal Project – 6th August 2009

How does RailsQAD Work

The system has a series of complex microphones arranged so that the array can pin point the source of the noise.

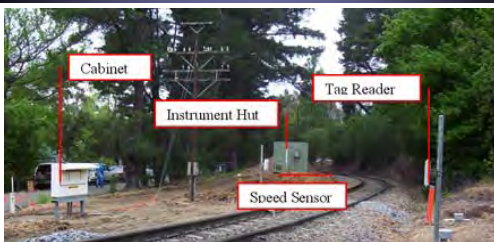


Acoustic Radiation
from each structural
component captured at
microphone



Adelaide Hills Wheel Squeal Project – 6th August 2009

RailsQAD – Adelaide Hills, SA



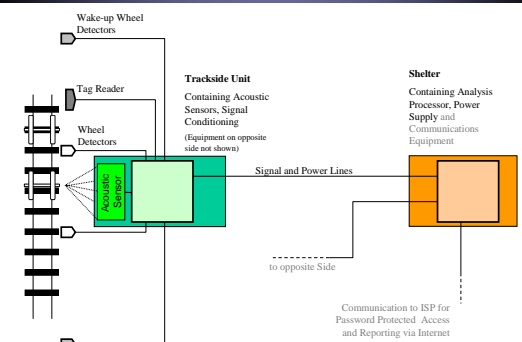
Wayside microphone array, located on a curve in the Adelaide Hills, identifies and records each noise emission for each passing wheelset.

Readings are ranked against known frequency and limits.
Records trended and mean statistics reported.



Adelaide Hills Wheel Squeal Project – 6th August 2009

RailsQAD - Overview of System



Adelaide Hills Wheel Squeal Project – 6th August 2009

Acoustic Monitoring of Wheel Squeal and Flanging

Detection & identification of major wheel/rail noises

- Identification of individual wheelsets creating noise emission through Electronic Tag Readings
- Discrimination between noise from adjacent axles

Differentiation between noise emission type:

- Wheel Squeal
- Flanging

Analyse Results

- Noise Levels and Ranking
- Train Reports
- Statistics for Tagged Wheelsets
- Trending information for each individual wagon and wheelset



Adelaide Hills Wheel Squeal Project – 6th August 2009

Why Heathfield

Heathfield was chosen due to:

- **Geography:** The location has the trains operating under stretch in both directions so no braking occurs or in-train forces due to locomotive power changes. (braking gives false indications of squeal emission).
- **Terrain:** Embankments and cuttings cause noise to be reflected causing the emitting wheel to be falsely identified.
- **Utilities:** Access to power and communications
- **Location:** Reduced vandalism
- **History:** Known area of wheel squeal and previous site of testing of methods for comparisons.



Adelaide Hills Wheel Squeal Project – 6th August 2009

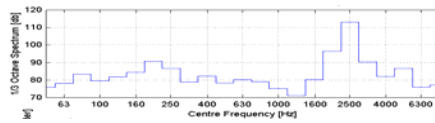
How RailSQAD is used

- Data is imported into the Database from site to a central database.
- Operators log into the database and analyse the data
- Trending allows monitoring of wheelsets over time.
- Baseline statistics are able to be obtained for monitoring improvement
- Operators have access to review their noisy wagons, down to individual bogies and wheelsets.
- Inspections are performed and records made of wagon condition.
- Statistics and trends are monitored to gauge noise levels.
- This is carried out to obtain a baseline and for comparisons over time for differing environmental conditions, trials and testing.



Adelaide Hills Wheel Squeal Project – 6th August 2009

Severity Criteria



Flanging:

Level 1 – Severe	above 100dB
Level 2 – Intermediate	90dB>level<100dB
Level 3 – Minor	85dB>level<90dB

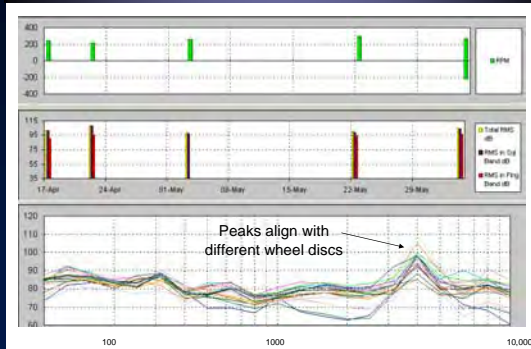
Wheel Squeal:

Level 1 – Severe	above 105dB
Level 2 – Intermediate	90dB>level<105dB
Level 3 – Minor	85dB>level<90dB



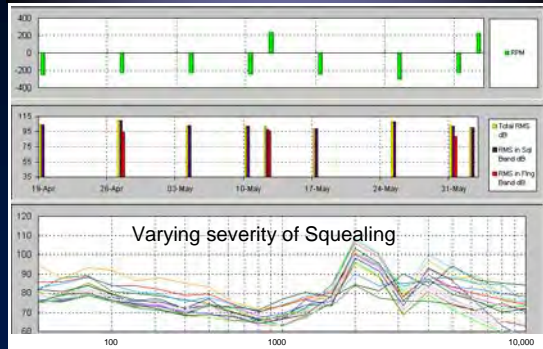
Adelaide Hills Wheel Squeal Project – 6th August 2009

Individual Loco History, Trending



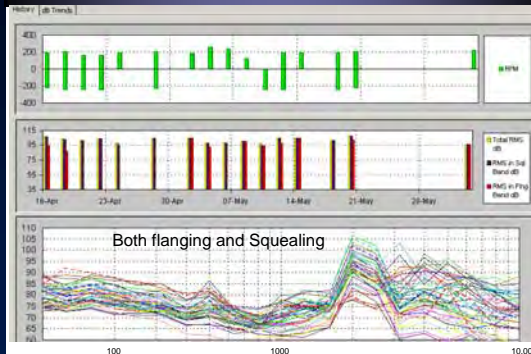
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Individual Wagon History, Trending



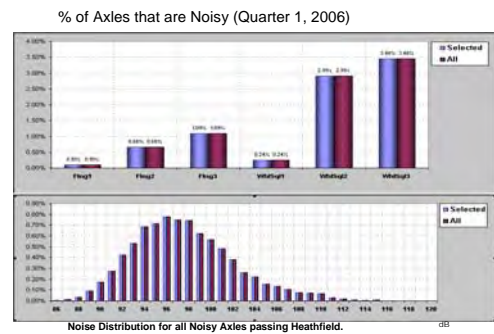
Adelaide Hills Wheel Squeal Project – 6th August 2009

Individual Wagon History, Trending



Adelaide Hills Wheel Squeal Project – 6th August 2009

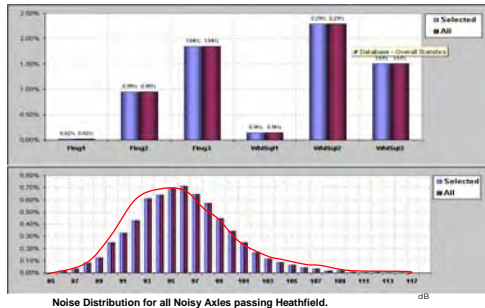
Database - Overall Statistics



Adelaide Hills Wheel Squeal Project – 6th August 2009

Database - Overall Statistics

% of Axles that are Noisy (Quarter 1, 2009)



Noise Distribution for all Noisy Axles passing Heathfield.

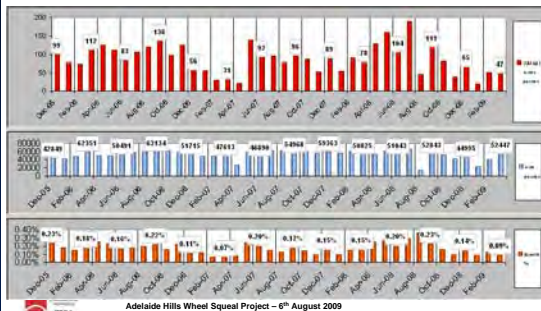
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Database - Most Seen

Detector	Y-axis	Wagon	Side	Detector	Flange Count	Wheelset Count	Flange	Wheelset	Passes	Flange %	Wheelset %
1	L				1	1	12	162	174	6.9%	9.2%
2	L				1	1	12	162	174	6.9%	9.2%
3	L				1	1	12	162	174	6.9%	9.2%
4	L				1	1	12	162	174	6.9%	9.2%
5	L				1	1	12	162	174	6.9%	9.2%
6	L				1	1	12	162	174	6.9%	9.2%
7	L				1	1	12	162	174	6.9%	9.2%
8	L				1	1	12	162	174	6.9%	9.2%
9	L				1	1	12	162	174	6.9%	9.2%
10	L				1	1	12	162	174	6.9%	9.2%
11	L				1	1	12	162	174	6.9%	9.2%
12	L				1	1	12	162	174	6.9%	9.2%
13	L				1	1	12	162	174	6.9%	9.2%
14	L				1	1	12	162	174	6.9%	9.2%
15	L				1	1	12	162	174	6.9%	9.2%
16	L				1	1	12	162	174	6.9%	9.2%
17	L				1	1	12	162	174	6.9%	9.2%
18	L				1	1	12	162	174	6.9%	9.2%
19	L				1	1	12	162	174	6.9%	9.2%
20	L				1	1	12	162	174	6.9%	9.2%
21	L				1	1	12	162	174	6.9%	9.2%
22	L				1	1	12	162	174	6.9%	9.2%
23	L				1	1	12	162	174	6.9%	9.2%
24	L				1	1	12	162	174	6.9%	9.2%
25	L				1	1	12	162	174	6.9%	9.2%
26	L				1	1	12	162	174	6.9%	9.2%
27	L				1	1	12	162	174	6.9%	9.2%
28	L				1	1	12	162	174	6.9%	9.2%
29	L				1	1	12	162	174	6.9%	9.2%
30	L				1	1	12	162	174	6.9%	9.2%

Database - Repeat Vehicle Alerts

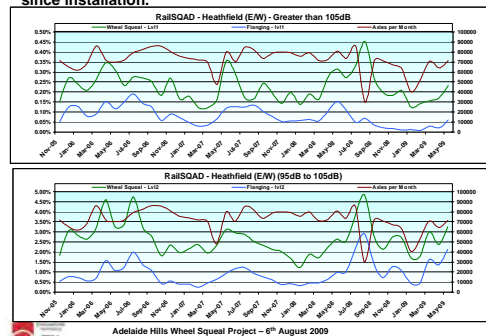
Repeat Vehicle Alerts - Number of Vehicles with 40% or more of the passes of a vehicle, with a minimum of 8 passes, for each month of monitoring in Quarter 1, 2009.



Adelaide Hills Wheel Squeal Project - 6th August 2009

Database Noise Statistics

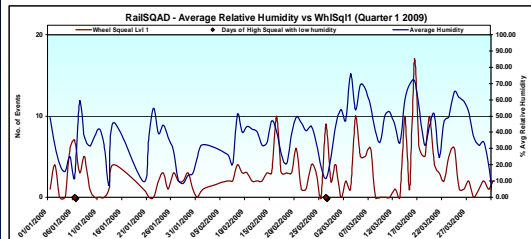
Percentage of Axle Passes with Noise Issues - Monthly Average since installation.



Adelaide Hills Wheel Squeal Project - 6th August 2009

Database Noise Statistics

RailSQAD - Average Relative Humidity vs WhISq1 (Quarter 1 2009)

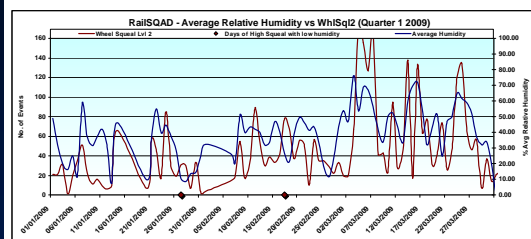


Note: This graph shows the level of correlation between average Relative Humidity (the average of 9am and 3pm readings) and Noise Events (Wheel Squeal level 1 and Flange level 1).

Adelaide Hills Wheel Squeal Project - 6th August 2009

Database Noise Statistics

RailSQAD - Average Relative Humidity vs WhISq2 (Quarter 1 2009)



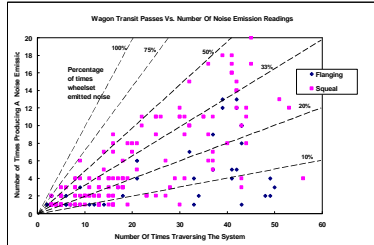
Note: This graph shows the level of correlation between average Relative Humidity (the average of 9am and 3pm readings) and Noise Events (Wheel Squeal level 2, Flange level 2).

Adelaide Hills Wheel Squeal Project - 6th August 2009

Preliminary Topics Investigated

Consistency/Repeatability

- Only a small number of events generated high noise levels
- There are a few 'repeat offenders' creating high noise levels
- However, some wagons generated high levels only once



Adelaide Hills Wheel Squeal Project – 6th August 2009

Preliminary Topics Investigated

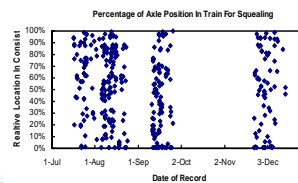
Dependence of Squeal and Flanging Noise on

Direction of travel:

- Downhill produced significantly more squeal

Position in Train, e.g. towards front, middle, end:

- No significant correlation for wagons



Adelaide Hills Wheel Squeal Project – 6th August 2009

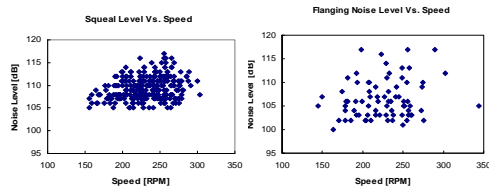
Preliminary Topics Investigated

Speed:

Data suggests no significant correlation with squeal

Loading:

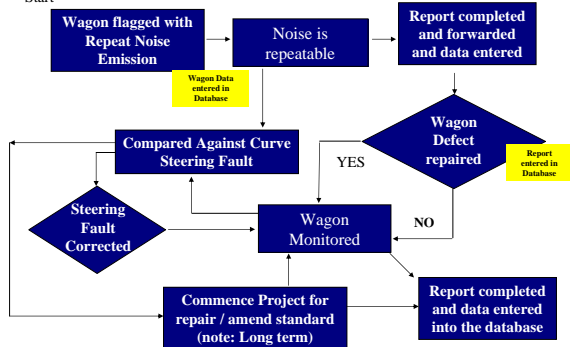
A review of loading has been undertaken: Neither tare and gross load, nor variation in load position has proven to be a factor in noise generation.



Adelaide Hills Wheel Squeal Project – 6th August 2009

General Wagon Actions Undertaken

Start

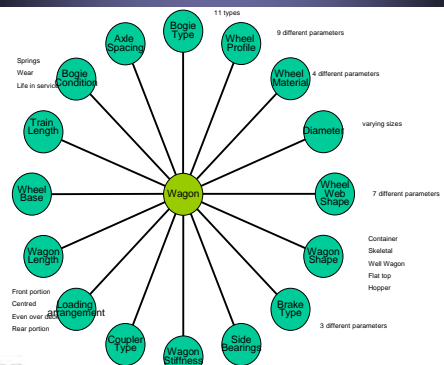


Wagon Statistics

- There are currently a number of wagons that are causing squeal emissions on a regular basis. There are more than **7500 wagons and 250 locomotives** passing the site. All are being monitored for repetitive readings.
- Some squealing one in every 10 passes, others 3 or 4 out of every 10 passes.
- There are an even larger number of wagons causing random readings only squealing one in every 60 passes or never making a noise emission. These need to be addressed through other means.
- There are some that are squealing at other sites but not at this location.

Adelaide Hills Wheel Squeal Project – 6th August 2009

Wagon Parameters



Adelaide Hills Wheel Squeal Project – 6th August 2009

Track Statistics

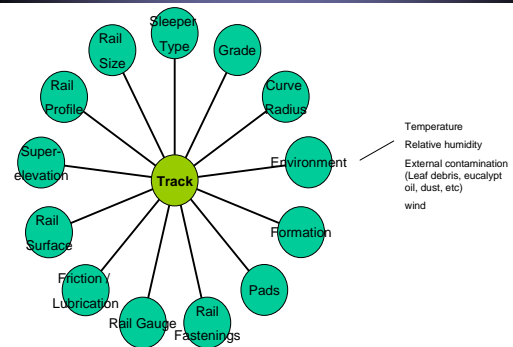
Between Goodwood (5.3km) and Balhannah (45km) there are ;

- 17 lubrication sites with many being both rails
- 17 curves (13 low radius) :
 - 8 curves under 300m radius (shortest 201m)
 - 5 between 300m and 600m radius
 - 4 between 600m and 900m
 - Varying Grades with maximum of 1 in 40
- Concrete sleepers with resilient fastenings
- Various rail sizes (generally 53-60kg rail)



Adelaide Hills Wheel Squeal Project – 6th August 2009

Track & Environmental Parameters



Adelaide Hills Wheel Squeal Project – 6th August 2009

Infrastructure Projects

Track options Short Term

- Rail Face Lubrication Strategies
- Lubricant dosage &/or type
- Field review of track gauge

Track options Long Term

- Top of Rail Friction Modifiers
- Track super elevation vs train speed
- Rail – pad and fastening systems



Adelaide Hills Wheel Squeal Project – 6th August 2009

Infrastructure Discussion

Change from Broad Gauge Timber Sleepers to Standard Concrete: Issues

- Concrete sleeper gauge is generally a few mm tight on ARTC track (due to production tolerances). Excessive tight gauge may contribute to poor wagon steering and thus wheel squeal noise generation.
- Compared to timber, concrete obviously does not flex and widen the gauge as the train wheels pass over, this extra stiffness makes noise production more prevalent on concrete.
- The overall stiffness of concrete track leads to vibrations in the wheels being less damped, and hence also more prone to noise generation.
- Gauge for concrete sleeper track is much more consistent and prevents derailments due to spread track. Concrete sleepers are now the rail industry standard for modern track, their benefits in life cycle cost and safety are considerable over timber sleepers.



Adelaide Hills Wheel Squeal Project – 6th August 2009

Infrastructure Discussion

Grinding Issues

- Grinding of the rail head surface is performed annually in the Adelaide Hills on tight curves. The rail is ground to achieve many beneficial outcomes, all of which help to extend the life of the rail (remove fatigued metal, optimum rail profile shape, remove defects etc).
- Grinding a rail profile shape onto curves gives improved wagon steering characteristics (hence potentially less squeal noise). Recent RailSQAD results confirm this relationship.
- When grinding occurs there is an initial increase in noise generation as the rail surface is rougher, this quickly smooths out under the passage of trains, therefore reducing noise generation in the long term.



Adelaide Hills Wheel Squeal Project – 6th August 2009

Infrastructure Discussion

Lubrication Issues

- Grease is applied to the gauge face of curve rails to help reduce wear of the rail metal. Rail wear on the gauge face of the high (outer) rails severely shortens the useable life of the rail, and re-railing is a high cost maintenance activity.
- If incorrectly applied (on top of rail head) there is a potential for grease to have a negative influence on wheel squeal due to different friction levels between high and low rails.
- If correctly applied lubrication can help reduce flanging noise by minimising the metal-to-metal sliding friction between the wheels and the rail gauge face.
- Grease is applied by automatic pumps at selected curve locations. There are 17 locations in the hills section due to high number of tight curves on this track.



Adelaide Hills Wheel Squeal Project – 6th August 2009

Infrastructure Discussion

Lubrication Issues (cont)

- ARTC has an ongoing program to improve and optimise the hills lubrication for both noise and wear benefits. This has involved many field trials and ongoing research into new options and best practise. The ideal goal being to minimise the number of lubricators used, and to improve the efficiency of those remaining (using better equipment and calculating the optimum locations will improve the travel of grease and reduce the maintenance issues)
- Using a tribometer to measure the rail friction levels at different curve locations, ARTC have gathered critical data which can help decide where lubrication is inefficient, leading to rail wear and potential noise.
- Further work is planned for 2009 with the goal of permanently implementing the successful elements of the trials so far.



Adelaide Hills Wheel Squeal Project – 6th August 2009

Future Topics To Be Investigated

Dependence of Squeal and Flanging Noise on

- Rollingstock type and configuration, e.g. wagon length, bogie set-up
- Individual Axle Load
- Wheel & rail profiles, e.g. wear, wheel rail interfacing
- Train handling (driving techniques)
- Environmental Factors

Maintenance options

- Rolling stock maintenance regimes
- Wheel and Rail profiling
- Lubrication
- General track condition

Operation

- Most suitable rollingstock configuration
- Train Length



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SA and NSW Comparisons and Data Sharing

- The committee has been working with RailCorp in NSW who are tackling the same problem with in-track bogie monitoring equipment.
- Both track owners and operators are members of the CRC Noise project working with UoW. RailSQAD data is being provided to the UoW for analysis.
- The RailCorp bogie monitoring equipment has been linked to microphones, however it is difficult to align the noise data with individual wagons. Further work is planned in this area to compare RailCorp noise monitoring equipment with RailSQAD results.
- 40-50% of intermodal traffic passes over both Heathfield and the NSW equipment.
- Data and experiences are being shared between the operators and both track owners.



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Site Comparison



Apart from the fact that trains are under full stretch or compression when passing Heathfield, there is little difference in the two locations in terms of track geometry.



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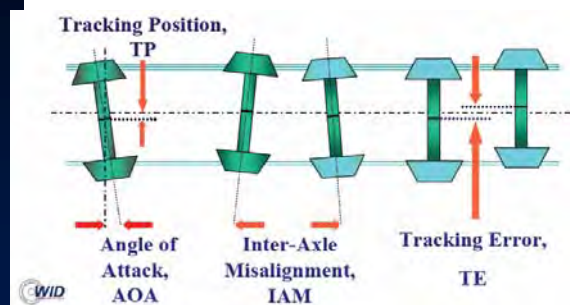
NSW Angle of Attack System

- A TBOGI – (Truck Bogie Optical Geometry Inspection) bogie angle of attack performance monitor was installed on a curve at Beecroft, NSW – another known location of wheel squeal complaints.
- The equipment measures the angles of the axles in relation to the rail.
- The equipment is occasionally linked to microphones, but these are not directional.
- Additional complexities exist in the fact the equipment is not designed to be placed on a curve, and this is the only installation in the world located on a curve.
- 40-50% of intermodal traffic passes over both Heathfield and the NSW equipment.
- Comparisons between the two sets of data are compared. And inspections organised and results analysed.



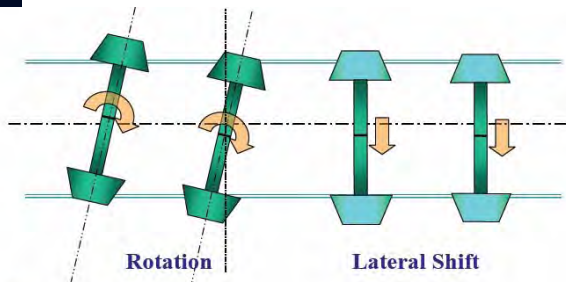
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Angle of Attack System (Definitions)



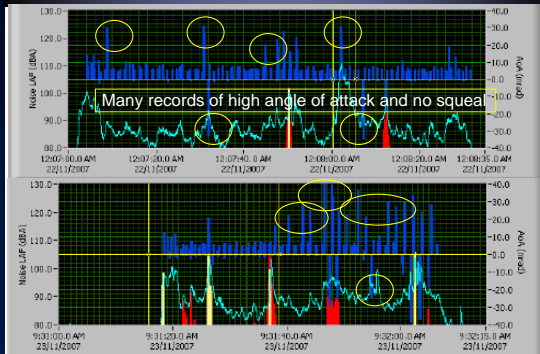
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Angle of Attack System (definitions)



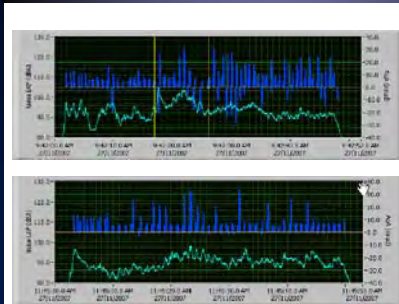
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Noise and AoA Relationships



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Noise and AoA Relationships

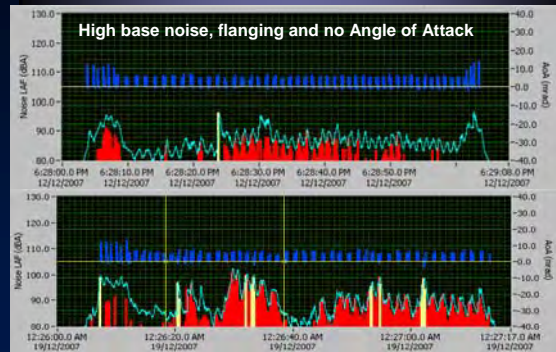


The majority of the train's axles here have high AoA and or rotation, yet no squeal



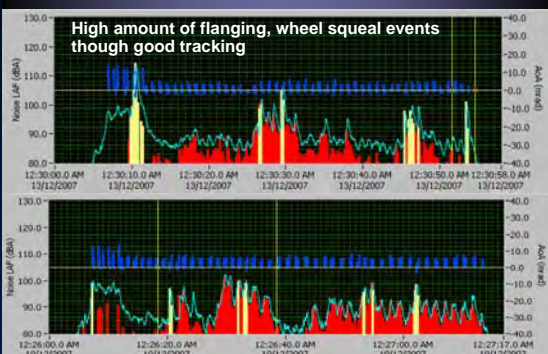
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Noise and AoA Relationships



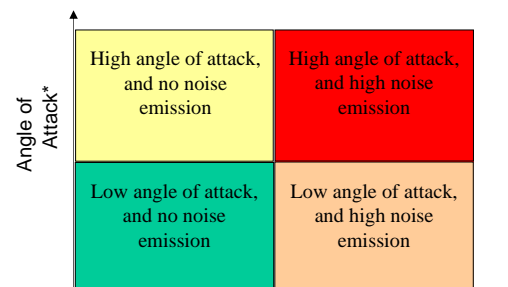
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Noise and AoA Relationships



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Comparing AoA and Squeal



*Angle of attack is also noting "rotation" and other irregular tracking readings



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Tracking Fault Vs. Noise analysis

	Wagons	Noise > 105	105< noise >95	95< Noise >85	Passes	Percentage Pass By
IAM	3	0	12	9	224	9.38%
Rotation	22	23	100	122	1868	13.12%
Tracking	17	5	25	38	940	7.23%

The above table took data from the top 42 worst wagons passing the TBOGI system (past 30 days) and reviewed the RailSQAD data (past 6 months).

Not all of the wagons in the list made noise emissions for the noted tracking fault.

Of the feature tracking characteristic, **rotation** showed to have the higher noise emission statistic. 10 Bogies of 44 produced the main noise emissions also noted as having rotation noted. Many of these are new to this month and are now planned in for inspection.

Therefore concentrating on those bogies with rotation and noise emission will be the focus.



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Actions Taken

- Improved wagon inspection sheets
- Aligning RailSQAD database with the inspection sheets for future analysis.
- Development of databases to improve reporting and analysis and facilitate the interface with operator maintenance data.
- Assistance from UoW to the NAC through the CRC on review of data to find similarities.
- Trials of differing wagon/ lubricator components and comparing against a baseline.
- Adjustments in wagon components to see if this has effects on tracking and noise generation.
- Trialled new lubrication strategies to improve friction levels on rail surfaces.
- Further investigations on the relationship between noise emissions and bogie tracking errors.



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Environmental Implementation Plan (EIP)

Both ARTC and Operators have an EIP with the South Australian EPA: Actions include:

ARTC:	Operators:
<ul style="list-style-type: none"> > Rail Noise monitoring system : Maintain the existing RailSQAD, and allow operators to access the database of results gathered. > Reporting : Provide the EPA with 3 monthly graphs, in the specified format, of critical noise event trends. > Operator Liaison : Co-ordinate 12 monthly operator user group meetings to discuss RailSQAD improvement issues. Provide operator training on RailSQAD system. > Rail Lubrication review : Review & optimise the effectiveness of gauge face lubricators. Evaluate options for improving rail head friction management. > Community Feedback :In conjunction with operators provide regular (6 monthly minimum) feedback to the community and Mitcham Council Rail Noise Taskforce. Giving updates on noise abatement actions and their progress. 	<ul style="list-style-type: none"> > Provide the EPA with a six-monthly report indicating inspections and activities undertaken in the reporting period. > Inspection of rolling stock that has been identified as producing noise emissions on a regular basis, usually 40% of passes based on a minimum of 8 passes past the RailSQAD system. > To enter the results of the inspection of vehicles identified as repeat offending vehicle's into the RailSQAD Data Base, and > To enter the action taken to repair the vehicle identified as a repeat offending vehicle into the RailSQAD data base > Attend the workshops with other operators and ARTC on a regular basis.



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Findings to Date

- RailSQAD analysis has identified some vehicles and vehicle classes that are more susceptible to wheel squeal than others.
- RailSQAD results have shown a gradual downwards trend in wheel squeal and flanging noise.
- However, the inspection and feedback process requires a lot of resources and access to wagons is limited due to traffic patterns and maintenance locations; hence there is a long lead time to confirm whether actions taken in relation to squealing wagons are successful.
- Many repeat reading wagons that are inspected to date have found any obvious defects.
- However some signs of improvement are evident in wagons that have undergone maintenance/minor modifications to trial new technologies (eg Pennsy pads?)



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Summary Of Noise Emission Trends

The following general and specific trends have been isolated from the trials analysis:

- For a number of the "repeat offender" wagons, the readings were found to be emitting noise in one train direction more than the other.
- Squealing events are three to four times as numerous as flanging events. However, a number of noise emissions contained wheel squeal and flanging simultaneously when traversing the curve.
- The majority of the high noise emissions occur in the cooler periods of the day, normally between dusk and dawn. (Probably associated with periods of increased relative humidity).
- The position of the wagon in the train consist does not appear to be a factor in the high noise emission readings.
- There is no significant relationship detected between train speed and measured noise levels, both for squealing and flanging.
- Analysis of RailSQAD data against environmental factors has shown a strong correlation between wheel squeal and relative humidity.



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How can you help us / We help You

Feedback to the NAC:

- Improvement of the survey on the web
 - Liaise with operators for assistance
 - Better definition of the locations where squealing occurs – list the curve positions
 - Better information on the train / wagons

What information would the Council like?:

- Statistics,
- Flyers and updates through the council



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