MOOLARBEN COAL PROJECT

Stage 2

APPENDIX 13

Rail Traffic Impact Assessment

Moolarben Coal Mines Pty Limited

Moolarben Coal Project - Stage 2

RAIL TRAFFIC ASSESSMENT

- Final Rev 2
- 10 February 2009

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1. Introduction

This report has been prepared in response to a request from Moolarben Coal Mines Pty Limited (MCM) to assess the rail traffic impacts of the Stage 2 development of the Moolarben Coal Project (MCP).

On 1 May 2008, a Major Project application was lodged by MCM with the NSW Department of Planning for the Stage 2 development of the Moolarben Coal Project near Ulan in the Hunter Valley of NSW.

The proposal, to undertake an increase in mining operations above that approved for the Stage 1 development of the MCP, is forecast to increase the 'run-of-mine' (ROM) production by 5 Mtpa (million tonnes per annum) to 17 Mtpa, and resulting product coals by 3mtpa to 13mtpa.

As part of the Environmental Assessment Stage 2 of the MCP, MCM is required to address the impacts of its development on 'Traffic and Transport'.

Accordingly, this assessment has been undertaken to identify the impacts to rail traffic and public road level crossings resulting from the increased coal train traffic along the railway network between Moolarben and Muswellbrook.

This report has focused on determining the following issues with respect to the development of the mine and the railway corridor between Moolarben and Muswellbrook:

- Determine if an increase to rail traffic will result from the forecast coal production for the rail corridor;
- Determine if any increased delay times will be experienced by motorists at all affected public level crossings along the proposed rail haul route; and
- Assess the condition of all identified level crossings situated on public roads and maintained by a road authority.

This report has been prepared with reference to the previous Sinclair Knight Merz (SKM) railway traffic assessment undertaken for the Stage 1 development of the MCP in 2006.

A number of rail issues for this report have been addressed with consultation of the Australian Rail Track Corporation (ARTC), as the railway network directly affected by this proposal is leased by ARTC.

The level crossing assessment contained in this report has not included those sites situated on private roads or un-maintained 'Crown' public roads. These sites have been excluded on the basis

of the recommendations relating to the traffic assessment previously undertaken by SKM for the Stage 1 development of the MCP in 2006.

The coal mine output information adopted in this report has been derived from a number of sources including mining company annual report statements, NSW Department of Planning major project registers, and mining industry annual publications.

Moolarben Coal Project (MCP)

Stage 1 (21 year approval @ maximum production received 6 September 2007)

- 12 Mtpa Run of Mine;
- 10 Mtpa Product Coal; and
- Approval of up to 10 Mtpa to go to Port of Newcastle via Muswellbrook.

Total approval for Stage 1 is 10 Mtpa Product Coal.

Stage 2 (Seeking 24 year approval @ maximum production)

- 17 Mtpa Run of Mine;
- 13 Mtpa Product Coal; and
- Approval of up to 13 Mtpa to go to Port of Newcastle via Muswellbrook.

Total approval required is for 13 Mtpa Product Coal.

2. Existing Conditions and Operation

2.1 Railway Network

The MCP site is situated near the township of Ulan and is located 40km north-east of Mudgee and 25km east of Gulgong.

It is further located adjacent to the Muswellbrook to Gulgong Railway line, and is situated approximately 146km by rail from Muswellbrook to the east

The railway between Merrygoen and Muswellbrook is fully operational, and currently provides access to the grain and mineral ore producing areas in the west of NSW, coal reserves in the Hunter Valley and port facilities located at Newcastle on the eastern seaboard.

The railway network in the vicinity of the MCP is wholly managed by the ARTC. The section between Muswellbrook and Merrygoen is leased from RIC (Rail Infrastructure Corporation).

2.2 Classification of Lines

Railway lines are classified by rail authorities with respect to their operational limitations including regulated train speeds and their capacity to carry trains of certain tonne axle loads (TAL).

The classification of railway lines managed by the ARTC is undertaken in accordance with ARTC Engineering Standard TDS 11 (ARTC, 2007).

An extract from the Standard is included as Table 2-1.

- **Table 2-1 Main Line Track Standard Classification**

Track Class	Axle Load (tonnes)	Maximum Train Operating Speed (kph)	
		Passenger	Freight
1XC	25 (a)	115	80
1C	25	115	80
1	25	115	80
2	21	100	80
3	19	-	70

Note:
(a) '30' tonne axle loads where approved

2.3 Track Condition Indices

The Track Condition Indices (TCI) is a measurement of the track geometry. The TCI measures individual geometry parameters such as twist and gauge, and collates these into a track index. The higher the number (in general) the more the track is deteriorating.

The track class indices (maintenance) shown below in Table 2-2 are the allowable maintenance levels.

Table 2-2 Track Indices

Track Classification	TCI Tangent	TCI Curve
Class 1XC	35	38
Class 1	43	47
Class 2	47	52
Class 3	52	58

The latest track recording car runs were undertaken in October 2003, however, due to technology changes the latest recording indices may not be comparable with the numbers shown in Table 2-2. An investigation of the issue resolved that a recording run undertaken during April 2002 would give a good indication and the numbers are on the same basis as Table 2-2.

Table 2-3 'Track Indices 2002 Comparison' indicates the track condition. The maintenance target TCI is obtained from ARTC Engineering Standard TES 08 'Track Recording Car Track Condition Indices' (ARTC, 2005).

Care should be used in comparison as each index that goes to make up the overall TCI has to be examined for exceedence levels.

Table 2-3 Track Indices 2002 Comparison

Track Section - Class	TCI Maintenance Target	TCI April 2002 All Track
Class 1XC: Muswellbrook - Ulan	38	28 (2001)

2.4 Speed Restrictions

At the time of initial report preparation, there were no permanent speed restrictions in force between Muswellbrook and Ulan.

2.5 Existing Train Operation

The Existing Train Operation restrictions are as detailed in Table 2-4 below. This is based on condition at May 2008.

Table 2-4 Existing Train Operation

From	To	Distance Km	Track Class	Axle Load	Maximum Wagon Speed
Muswellbrook	Ulan	146	1XC [(b)]	30	60 {100} [(c)]

Notes:

(b) Muswellbrook to Ulan section was upgraded to 1XC track classification in April 2005

(c) Empty '120' tonne coal wagons are permitted to travel at 100kph

The Ulan Line from Muswellbrook to Ulan was opened in about 1982. The connection with the west of the state from Ulan to Gulgong was completed in the late 1980s.

The track between these locations generally has no constraints in regard to types of locomotives and rolling stock employed, however, locomotives and rollingstock with '30' tonne axle loads are currently not permitted beyond the railway junction to the Ulan Coal Mine.

The route is predominantly used to convey coal traffic from various mines between Ulan and Muswellbrook. Between Muswellbrook and Gulgong, the railway also experiences daily mineral ore trains, seasonal grain haulage and the occasional heritage passenger train. The route is also utilised to divert trains when major track work activities are being conducted along the other more direct routes between Sydney, and the western portion of NSW and interstate.

2.6 Proposed Train Operation

Loaded working coal trains are generally restricted to a maximum of 60kph for Class G '120' tonne wagons and 80kph for Class C '100' tonne wagons unless the TOC manual indicates otherwise. These restrictions have been factored into the calculations included in this report.

The potential train operating conditions for the class of track and the type of locomotive and coal wagons on the lines in question are indicated in Table 2-5.

- **Table 2-5 Potential Train Operation (based on TOC manual)**

From	To	Track Class	Definitive Axle Load	Definitive Loco Speed	Definitive Wagon Speed Class C 100 tonne	Definitive Wagon Speed Class G 120 tonne	Definitive Wagon Speed Class F 100 tonne
Muswellbrook	Ulan	1XC	30	115	80	60	80

2.7 Level Crossing Condition

Inspection of all public level crossings situated between Muswellbrook and Ulan was undertaken on three (3) separate occasions for the purposes of current and past railway network assessment studies.

An inspection of all known public road level crossings situated between Muswellbrook and Ulan was undertaken as part of the Stage 1 Rail Traffic Assessment for the proposed MCP in February 2006 (SKM, 2006).

A final inspection of all new or re-classified public road level crossings situated between Muswellbrook and Ulan was recently undertaken in May 2008.

All public level crossings inspected were situated over single bi-directional tracks. The protection levels afforded at each level crossing comprised either 'passive' protection, i.e. static warning signs, or 'active' protection comprising automated equipment consisting of flashing signals and bells (gongs).

Appendix B gives the detailed requirements for each level of protection.

The predominant protection types for the public road level crossings inspected for each assessment conducted to date were found to be passive. The type of passive protection provided at these level crossings varied from the minimum permitted standard of Level 1A, i.e. Give Way position signs with no advance warning signs, up to Level 2 protection, with Stop Position signs and advance warning signs.

The highest level of protection encountered during the inspections of public level crossings was active protection Level 3A, which provides a visual and audible warning consisting of flashing signals and bells. This level of protection was mainly confined to bitumen-surfaced main road level crossings. It was not possible to check the operation of the activation system for these level crossings as all affected equipment was located within the non-operational portion of the network, however, it was noted that recent maintenance works had been carried on the crossings.

None of the level crossings that were encountered during each inspection phase were fitted with boom barriers.

The level crossings encountered that had unsealed approach roads had various forms of protection from Level 1A, Give Way position signs only, to Level 3A, Automatic Warning Lights and Bells.

The level crossings inspected during each stage of assessment were generally found to be in fair condition although some minor surface repairs and road marking will be required. A number of the crossings have suffered damage to warning signs and posts with a small number of cases where signs were missing completely.

The exact location and condition of the affected level crossings are detailed within the site survey sheets in **Appendix D**.

3. Increased Coal Traffic Assessment

3.1 Delays for Road Traffic

3.1.1 Current Train Operations

According to the ARTC Network Control Centre North (NCCN), the current average total number of train movements on this line is in the region of twenty-two (22) per day.

A train movement is defined as one (1) directional run. i.e. Moolarben Coal Mine to Newcastle Port only.

These train movements are comprised of the following 'regular' workings:

Ulan Coal Mines	6
Wilpinjong Coal Mine	6
Bengalla Coal Mine	8
Elura Copper Ore Mine	2
Total Train Movements	22

The ARTC has indicated that the Muswellbrook to Ulan route currently has sufficient capacity for a total of sixteen (16) return train paths, or thirty-two (32) movements, per day.

Coal trains scheduled for the Bengalla Mine are allocated approximately six (6) return paths, or twelve (12) movements, per day. However, this is subject to fluctuation as paths allocated for other coal mines in the Northern Section may be utilised by Bengalla coal traffic when those paths are under-utilised.

The current coal train consists being operated to the mines at Ulan and Wilpinjong are comprised of 3 x Pacific National '4000' horsepower '90' class locomotives and 91 x '120' tonne hopper wagons.

3.1.2 Forecast Changes to Train Operations

Train operations over the Muswellbrook to Gulgong line will be affected in the short-to-medium term by a number of factors, comprising the following:

- The commencement of new 'approved' coal mining operations at Mt Pleasant and Anvil Hill near the existing Bengalla Coal Mine;

- The commissioning by ARTC of new capacity-improving works along the Muswellbrook to Ulan rail corridor including a number of new crossing loops and the implementation of Centralised Traffic Control (CTC) safeworking; and
- The implementation of a new Standard Working Timetable (SWTT) by ARTC to optimise train operations in line with the capital works programs for the corridor.

3.1.3 Proposed Moolarben Train Operations

Based on the current operation of coal trains to the mines in the Ulan area, it is expected that the operation of 3 x '90' class locomotives, or similar, and 91 x '120' tonne hopper wagons will prevail for the operation of the MCP. This configuration of locomotives may be subject to change due to locomotive availability and may be substituted with 4 x Pacific National '3000' horsepower '82' class locomotives.

A coal train matching the above configuration will deliver up to 8827 tonnes of product and will measure 1542 metres in length; extended to 1564 metres if '82' class locomotives are utilised in-lieu of '90' class locomotives.

Stage 2 of the MCP will result in up to a further 3 Mtpa of product coal that will require transport by rail to the Port of Newcastle. The resulting change to coal train movements travelling between Muswellbrook and Ulan is estimated to comprise one (1) additional laden train per day, i.e. two (2) additional movements per day.

Table 3-1 below indicates the number of loaded coal trains currently running on the Ulan to Muswellbrook line.

- **Table 3-1 Coal train operations (Ulan – Muswellbrook)**

Mine	Train consist	Pay load / train (t)	ROM (Mtpa)	Product (Mtpa)	Train cycles / day	Overall Length	Notes
Ulan	3 x 90 + 91 x 120	8827*	10	6	3 (6)	1542	Based on current Department of Planning approval for ROM (NSW Department of Planning, 2005) and production capacity for Product Coal (Australia's Mining Series, 2007)
Bengalla	3 x 90 + 91 x 120	8827*	10.7	6	4 (8)	1542	Based on current Department of Planning approvals for ROM (NSW Department of Planning, 2006) and production capacity for Product Coal (Australia's Mining Series, 2007)
Wilpinjong	3 x 90 + 91 x 120	8827*	13	8.5	3 (6)	1542	Based on current Department of Planning approvals for ROM and Product Coals (NSW Department of Planning, 2006)
Mt Pleasant	3 x 90 + 91 x 120	8827*	10.5	6	2 (4)	1542	Based on current Department of Planning approvals for ROM and Product Coals (NSW Dept of Planning, 1999)
Anvil Hill	3 x 90 + 91 x 120	8827*	10.5	8	2 (4)	1542	Based on current Department of Planning approvals for ROM and Product Coals (NSW Department of Planning, 2007)
Moolarben	3 x 90 + 91 x 120	8827*	12	10	4 (8)	1542	Based on current Department of Planning approvals for ROM and Product Coals (NSW Department of Planning, 2007)
The total number of train movements for each mine to allow for returning empties is shown bracketed ().							

* Denotes 97% efficiency of coal loaded.

Assumptions:

- Train operations would be conducted over an average of 359 days per year due to two (2) Public Holidays and various booked Possession of the line close downs;
- Tonnages are maximum consented tonnages; and
- Train consist are assumed and may vary due to availability and handling capacities.

3.1.4 Traffic delays

The delay caused at a level crossing by a train is calculated by consideration of a number of factors.

The first is the warning time required by road users prior to the arrival of a train at the level crossing. The ARTC standard for single line railway lines using flashing lights and warning bells is 25 seconds advance warning time (ARTC, 2005).

The second delay factor is the time taken for the train to traverse the level crossing. This time is based on train length and speed.

Table 3-2 gives figures for various scenarios.

The third factor is a small allowance once the train clears the level crossing for the de-activation of the warning systems. For this exercise, a nominal time of 3 seconds has been adopted.

For the assessment of level crossing waiting time, consideration of the train configuration and performance characteristics that will result in the longest waiting time should be adopted, i.e. the longest train travelling at the slowest speed.

On the basis that working laden coal trains, restricted to 60kph for Class G '120' tonne wagons are likely to be used with an estimated train length of 1542 metres, the average delay at each level crossing will be approx 121 seconds (2 minutes).

Although there are no definitive rules as regards acceptable delay times it is generally felt that delays up to 180 seconds are acceptable. This calculation is based on the section line speed and does not include for local permanent or temporary speed restrictions. It should be noted that empty coal trains are permitted to run at higher speeds and will thus cause less delays.

- **Table 3-2 Typical Level Crossing Waiting Times**

Typical Level Crossing Waiting Times					
(Single Track - flashing signals and bells type)					
Warning time (secs)	Consist length (m)	Train Speed (kph)	Train Passing Time (secs)	Time out (secs)	Total Delay (secs)
25	1000	60	60	3	88
	1250		75		103
	1500		90		118
	1600		96		124
	1000	80	45		73
	1250		56		84
	1500		67		95
	1600		72		100

3.2 Level Crossing Protection Arrangements

The basic standards for the operation of level crossings are dictated by a number of level crossing standards.

The following are extracts from the ARTC Engineering Standards for Level Crossings contained within XDS 01 Configuration Standards (RIC Standard: TS 27 000 1 01 SP) Issue 1 Rev 2 dated March 05 (ARTC, 2005), XDS 02 Design and Installation (RIC Standard: TS 27 000 3 01 SP) Issue 1 Rev 2 dated March 05 (ARTC, 2005) and XDS 03 Pedestrian Level Crossings – Design and Installation (RIC Standard: TS 27 000 3 02 SP) Issue 1 Rev 1 dated March 05 (ARTC, 2005).

The contents of the Draft RTA Traffic Engineering Manual Section 6 Railway Level Crossings (RTA, 1994) and Australian Standard 1742.7 - 2007 'Manual of uniform traffic control devices, Part 7: Railway crossings' (Standards Australia, 2007) were also considered.

- The principal considerations when identifying type and level of protection relevant to a particular level crossing are sighting, type and frequency of user, approach speed and surfacing. The type or weight of the rail traffic passing through the level crossing is not considered;
- Due to the high percentage of trucks on public roads, these vehicles are used to set the minimum acceptable sight distance requirements when assessing passive control measures. The standard categorises sight distances for passive control as either 'standard' or 'base' condition;
- The minimum requirement for passive control of Public and Private Level Crossings is a 'Give Way' sign;
- Where there is a risk of stock entering the rail corridor at public level crossings, cattle stops (grids) are to be provided;
- Sighting distance assessment of public level crossings requires the collection of data such as road traffic mix, road vehicle approach speed, rail vehicle approach speed. The crossings should be assessed for the maximum permissible line speed;
- A copy of the sighting distance assessment flow chart is included in **Appendix C** for information; and
- Sighting distance assessment for public road crossings are based on level, sealed surfaces.

The protection arrangements currently in place for the level crossings encountered during each stage of investigation generally appear to be in accordance with accepted industry standards and require no additional works.

However, a small number of new and re-classified 'public' level crossings investigated for this report have been assessed to require further investigation to determine if they provide satisfactory levels of protection for road users. These level crossings have been assessed to either have sighting

distance issues and/or not comply with the current industry standards for level crossing maintenance. The work recommended to be undertaken at these level crossings ranges from basic level crossing maintenance tasks, such as sign repair and pavement marking, up to road re-alignment and/or the provision of active level crossing protection.

Historically, the need to increase the level of protection provided at a railway crossing has been determined using the product of the daily road vehicle traffic (V) and the weekly train traffic (t). The resulting calculated figure has then been compared with 'warrants' provided by the relevant road authorities which has then been used for guidance in the selection of appropriate treatment options; such as level crossing upgrades to active protection, grade separation, etc.

Whilst this assessment of public level crossings between Muswellbrook and Ulan has determined potential rail traffic volumes, further study would be required to determine the respective annual average daily traffic (AADT) volumes for the roads affected at these level crossings.

3.3 Level Crossing Condition and Maintenance

Various forms of bitumen, concrete, steel plate and gravel road surfaces were encountered throughout each stage of investigation and all were found to be within reasonable maintenance standards.

The surfaces of the approaching roads up to the level crossings were also found to be generally within acceptable limits. However, the provision of unsealed approaches to a level crossing may affect the ability of a motor vehicle to stop, accelerate and clear a passive level crossing safely prior to the arrival of a train in locations where minimum sighting distances prevail.

The application of a minimum of 7 metre of seal at level crossings on unsealed roads in accordance with ARTC Engineering Standard XDS 02 will improve vehicle performance when using a passive level crossing and may reduce the warrant for other more costly solutions to improve sighting distances.

A number of level crossings fitted with steel road panels have also been found to have pavement failures in the vicinity of the interface of these units with the adjoining road surface. This occurrence has most likely to have resulted from the removal of the units during track maintenance activities by the railway authority or its contractors.

Each of these level crossings should be inspected following panel replacement with appropriate and effective measures taken to limit the degradation of the road pavement in this vicinity.

It should be noted that continuance of maintenance will be required to prevent degradation of the crossing conditions.

Regarding other elements of the level crossings inspected, each were also found to be in fair condition although some minor surfacing repairs and white lining will be required. A number of the crossings have suffered damage to warning signs and posts with some missing completely.

The exact location of public level crossings situated between Muswellbrook and Ulan, together with any outstanding maintenance issues that require addressing, are detailed within the site survey sheets in **Appendix D**.

4. Conclusions

4.1 Additional Coal Train Traffic

The assessment of public level crossings contained in this report has determined that Stage 2 of the MCP will generate in the order of one (1) additional laden coal train per day with reference to the number of coal trains currently operating, and approved to operate, between Muswellbrook and Ulan.

The total train movements that will operate along the Muswellbrook to Ulan route will be limited by the capacity of the prevailing railway infrastructure. Progressive future capital works programs for this route will ultimately provide higher track capacities and permit the working of a higher number of trains closer to that indicated above.

4.2 Delays to Road Traffic

Whilst it has been assessed that a further two (2) coal train movements per day along the Ulan to Muswellbrook line will not result in an increase in the incidental average waiting time for motorists at level crossings, the overall waiting time at public level crossings, however, will increase by 4 minutes per day.

4.3 Level Crossing Protection Suitability

With regards to the protection arrangements for level crossings this is dictated by the volume and speed, of both road and rail traffic, combined with sighting distances.

The protection arrangements currently in place for the public level crossings encountered during each stage of investigation ‘generally’ appear to be in accordance with accepted industry standards and require no additional works. However, a small number of new and re-classified level crossings investigated for this report have been assessed to require further investigation to determine if they provide satisfactory levels of protection for road users. These level crossings have been assessed to either have potential sighting distance issues and/or not comply with the current industry standards for level crossing operation.

Although outside the scope of this assessment, the overall forecast increase in rail traffic along the Ulan to Muswellbrook line resulting from additional coal production from new, approved and yet to be approved mines, will impact upon the protection levels required at public level crossings.

Historically, the need to increase the level of protection provided at a railway crossing has been determined using the product of the daily road vehicle traffic (V) and the weekly train traffic (t). The resulting calculated figure has then been compared with ‘warrants’ provided by the relevant road authorities which has then been used for guidance in the selection of appropriate treatment options; such as level crossing upgrades to active protection, grade separation, etc.

Whilst this assessment of public level crossings between Ulan and Muswellbrook has determined potential rail traffic volumes, further study would be required to determine the respective annual average daily traffic (AADT) volumes for the roads affected at these level crossings.

4.4 Level Crossing Condition

The condition of public level crossing encountered during the various stages of the rail traffic assessment process have been determined to be generally in a fair state of repair with most level crossings well signposted in accordance with accepted industry standards.

A number of level crossings were identified as requiring remedial maintenance work to correct damaged, missing or incorrectly mounted signs.

The surfaces of the approaching roads leading up to level crossings were also found to be generally within acceptable limits. However, the provision of unsealed approaches to a level crossing may affect the ability of a motor vehicle to stop, accelerate and clear a passive level crossing safely prior to the arrival of a train in locations where minimum sighting distances prevail. The application of a minimum of 7 metre of seal at level crossings on unsealed roads in accordance with ARTC Engineering Standard XDS02 will improve vehicle performance when using a passive level crossing and may reduce the warrant for other more costly solutions to improve sighting distances.

A number of level crossings fitted with steel road panels have also been found to have pavement failures in the vicinity of the interface of these units with the adjoining road surface. This occurrence has most likely to have resulted from the removal of the units during track maintenance activities by the railway authority or its contractors. Each of these level crossings should be inspected following panel replacement with appropriate and effective measures taken to limit the degradation of the road pavement in this vicinity.

The work required to address these issues is the responsibility of the relevant local government authority and the Australian Rail Track Corporation (ARTC), and does not form part of the recommendations to the proponent of this report.

Appendix A References

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Appendix B Protection Levels for Level Crossings

Protection Levels in accordance with ARTC XDS 01 (RIC TS 27 000 1 01 SP) Issue 1 Revision 2 (Mar 05)

Public and Private Vehicle Crossings

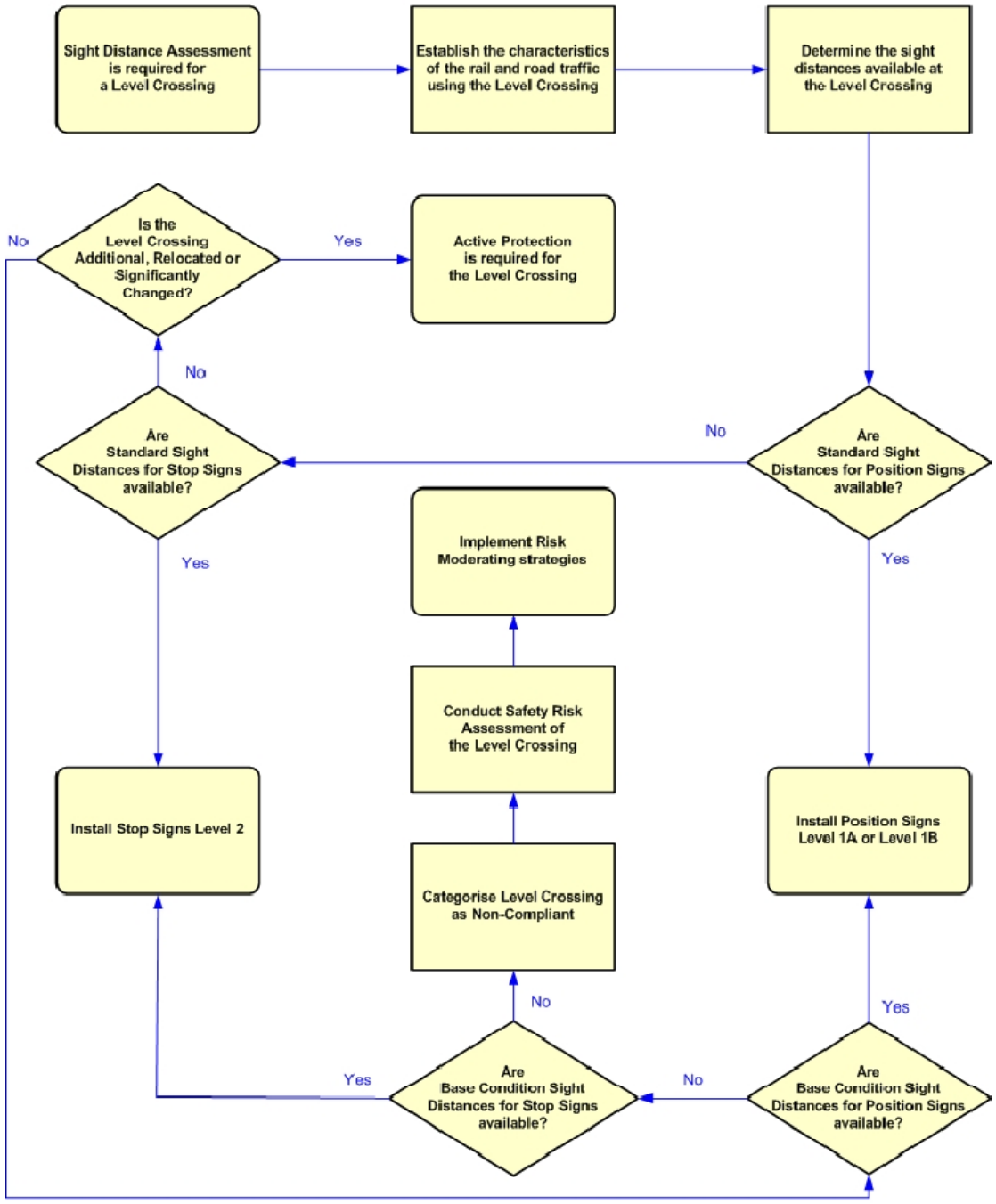
Level 1A
Control: Passive
Protection: Give Way Signs
Category: Minimum Treatment
This is the minimum treatment to be adopted at road Level Crossings.
Level 1 B
Control: Passive
Protection: Give Way Signs + Approach Warning Signs
Category: Standard Treatment
This is the treatment to be adopted at road Level Crossings when Level 1A is inadequate and a higher level of protection is not warranted.
Level 2
Control: Passive
Protection: Stop Signs
This is the treatment to be adopted at road Level Crossings when there are inadequate sight distances for Level 1 control and active control Level 3 or 4 is not warranted. Vehicles are required to stop. This is the minimum treatment to be adopted at Service Level Crossings, where it is to be used in conjunction with an "Authorised Vehicles Only" sign.
Level 3A
Control: Active
Protection: Flashing Lights + Bells
This is the minimum treatment to be adopted at road Public Level Crossings when passive protection is inadequate.
Level 3B
Control: Active
Protection: Flashing Lights + Bells + Boom Barriers
This is the treatment to be adopted at road Public Level Crossings when Level 3A protection is inadequate. Installation of half-boom barriers in conjunction with flashing lights and bells should particularly be considered at Level Crossings that pass over more than one track.
Level 3C
Control: Active
Protection: Special Warning Lights
This configuration is not approved for Public Level Crossings. It only applies to Private Level Crossings and each installation is subject to approval by ARTC's General Manager ISP or nominated representative.
Level 4
Control: Active
Protection: Level Crossing Gates
These are gates across the railway line that are manually opened for the passage of each train.
Level 5A
Control: Active
Protection: Manual Control
The Level Crossing is manually controlled by a handsignaller with a hand held STOP banner (R6-7 or R6-8) or red flag (e.g. at a Level Crossing with inoperative flashing lights or gates).
Level 5B
Control: Active
Protection: Special Control

This configuration is not approved for Public or Private Level Crossings. This is a generic level that is applied to Service Level Crossings when Level 2 protection is inadequate. It can include, but is not limited to:

- Temporary speed restrictions
- Signals
- Access to train running information at the crossing
- Direct communication with trains
- Worksite protection

Appendix C Sighting Distance Assessment Flow Chart

Sight Distance Assessment Flow Chart For Public and Private Road Crossings



Appendix D Survey Reports

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Mangoola**	**Km's from Sydney**	**306.491**
Road Name		**Location**	

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Steel Plate**
Protection Type	**Passive**
Signage	**Stop – Look For Trains**
Type of Road Traffic	**Cars / Vans / Trucks/ Farm Vehicles**
Usage	**Low – Medium**
Road Speed	**50 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down End

Down Side Approach

Up End

Up Side Approach

Notes:
Fairly low use crossing with excellent sighting in all directions; "Look For Trains' sign missing on Denman side; New crossing loop being installed nearby with Down turnout 'toe-of-points' situated at 306.379km

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Bell's Lane Crossing**	**Km's from Sydney**	**308.744**
Road Name		**Location**	

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Steel Plate**
Protection Type	**Passive**
Signage	**Stop – Look For Trains**
Type of Road Traffic	**Cars / Vans / Trucks/ Farm Vehicles**
Usage	**Medium**
Road Speed	**80 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Road runs parallel to railway and turns 90º to cross. Sighting of trains on Downside approach over right hand shoulder is restricted. Other approaches have excellent sighting

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Denman Road Crossing**	**Km's from Sydney**	**310.639**
Road Name		**Location**	

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Steel Plate**
Protection Type	**Passive**
Signage	**Stop – Look For Trains**
Type of Road Traffic	**Cars / Vans / Trucks/ Farm Vehicles**
Usage	**Low – Medium**
Road Speed	**50 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down End

Down Side Approach

Up End

Up Side Approach

Notes:
Light use village road with excellent sighting on all approaches

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Merriwa Road Crossing**	**Km's from Sydney**	**312.258**
Road Name		**Location**	**Marrapana (Denman)**

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Pre Cast Concrete Units in 4 foot**
Protection Type	**Active – Lights and Bells**
Signage	**Stop on Red**
Type of Road Traffic	**Cars / Vans / Trucks/ Farm Vehicles – Main Road**
Usage	**High**
Road Speed	**80 - 100 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Well maintained crossing with excellent sighting; Predictor track circuits have been installed at this level crossing to provide a uniform advance warning time

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Kenilworth Street Crossing**	**Km's from Sydney**	**313.461**
Road Name		**Location**	**Denman**

Approach Surfacing	**Gravel**
Crossing Surfacing	**Steel Plate**
Protection Type	**Passive**
Signage	**Stop – Look For Trains**
Type of Road Traffic	**Cars / Vans**
Usage	**Low**
Road Speed	**20 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good/Poor**
Rail Sighting Up End	**Medium**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Access to private properties off village road

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Ogilvie Street Crossing**	**Km's from Sydney**	**314.446**
Road Name		**Location**	**Denman**

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Steel Plate**
Protection Type	**Active**
Signage	**Stop on Red**
Type of Road Traffic	**Cars / Vans**
Usage	**Medium - High**
Road Speed	**50 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Medium/Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Access to community recreational area inc tennis courts etc; Separate footpath crossing adjacent inc maze with precast concrete surface

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Rosemount Rd Crossing**	**Km's from Sydney**	**315.240**
Road Name		**Location**	**Denman**

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Steel Plate**
Protection Type	**Active**
Signage	**Stop on Red**
Type of Road Traffic	**Cars / Vans / Trucks/ Farm Vehicles / Coaches**
Usage	**Medium – High (seasonal)**
Road Speed	**80 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good/Medium**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Rosemount Estate road. Would be fairly well used at weekends and during holiday periods; Predictor track circuits have been installed at this level crossing to provide a uniform advance warning time

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Public**	**Km's from Sydney**	**321.857**
Road Name		**Location**	**Rosemount**

Approach Surfacing	**Gravel and Loose Tarmac**
Crossing Surfacing	**Steel Plate**
Protection Type	**Passive**
Signage	**Stop – Look For Trains**
Type of Road Traffic	**Cars / Vans**
Usage	**Low**
Road Speed	**20 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Medium**
Road Sighting Downside	**Poor**
Rail Sighting Up End	**Poor**
Road Sighting Upside	**Medium**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Access to private properties and a small a small vineyard

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Public**	**Km's from Sydney**	**325.000**
Road Name		**Location**	**Rosemount**

Approach Surfacing	**Gravel over concrete**
Crossing Surfacing	**Gravel over concrete**
Protection Type	**Passive**
Signage	**Stop – Look For Trains**
Type of Road Traffic	**Cars / Vans**
Usage	**Low – Medium**
Road Speed	**20 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
This might be a private crossing used by the public; Gates on both sides but not used.

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Rylstone Road Crossing**	**Km's from Sydney**	**331.252**
Road Name		**Location**	**Sandy Hollow**

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Pre Cast Concrete Units**
Protection Type	**Active**
Signage	**Stop on Red**
Type of Road Traffic	**Cars / Vans / Coaches**
Usage	**Medium**
Road Speed	**80 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Fairly well used level crossing on the road from Sandy Hollow to Bylong. Access to vineyards and popular picnic area.

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Sandy Hollow (Sth End)**	**Km's from Sydney**	**331.927**
Road Name		**Location**	**Sandy Hollow**

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Steel Plate**
Protection Type	**Passive**
Signage	**Stop – Look For Trains**
Type of Road Traffic	**Cars / Vans**
Usage	**Low**
Road Speed	**60 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Stop signs missing on Sandy Hollow side

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Sandy Hollow (Nth End)**	**Km's from Sydney**	**332.654**
Road Name		**Location**	**Sandy Hollow**

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Pre Cast Concrete Units**
Protection Type	**Passive**
Signage	**Stop – Look For Trains**
Type of Road Traffic	**Cars / Vans / Farm Vehicles**
Usage	**Low**
Road Speed	**50 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good**
Road Sighting Downside	**Good**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Low use crossing providing access to private homes and a few small farms

Line	**Muswellbrook to Gulgong**		
Crossing Name	**Main Road No 208**	**Km's from Sydney**	**388.050**
Road Name		**Location**	**Bylong**

Approach Surfacing	**Tarmac**
Crossing Surfacing	**Tarmac**
Protection Type	**Passive Active**
Signage	**Stop on Red**
Type of Road Traffic	**Cars / Vans / Trucks/ Farm Vehicles**
Usage	**Medium**
Road Speed	**80 kph**
Rail Speed	**0 kph**
Rail Sighting Down End	**Good/Poor**
Road Sighting Downside	**Poor/Medium**
Rail Sighting Up End	**Good**
Road Sighting Upside	**Good/Medium**

Down

Down Side Approach

Up

Up Side Approach

Notes:
Stop lines need repainting; Fairly well used crossing on road over mountains; Tarmac surfacing to crossing with dirt roads either side; Predictor track circuits have been installed at this level crossing to provide a uniform advance warning time

Line	**Muswellbrook - Gulgong**		
Crossing Name	**Coggan Creek**	**Km's from Sydney**	**401.033**
Road Name	**Wollara (Ringwood) Road**	**Location**	**Coggan Creek**

Approach Surfacing	**Unsealed**
Crossing Surfacing	**Sealed (Steel)**
Protection Type	**Passive**
Signage	**Stop Signs + Advance Warning Signs**
Type of Road Traffic	**Cars + Heavy Vehicles**
Usage	**Medium (Local Traffic and National Park Access)**
Road Speed	**80 kph (Assumed)**
Rail Speed	**75 kph (TOC Manual)**
Road Sighting Upside	**Medium (Humped)**
Road Sighting Downside	**Medium (Humped)**
Rail Sighting Up End	**Good (Straight)**
Rail Sighting Down End	**Good (Curve)**

Down Road Approach

Down Rail Approach

Up Road Approach

Up Rail Approach

Notes:
Interface angle of 70°; no level crossing width markers installed on road approaches

Recommendations:
Apply a minimum of 7m seal on each road approach with Stop Line pavement marking; install level crossing width markers installed on road approaches

Line	**Muswellbrook - Gulgong**		
Crossing Name	**Coggan Creek**	**Km's from Sydney**	**415.115**
Road Name	**Mogo Road**	**Location**	**Wollar**

Approach Surfacing	**Sealed**
Crossing Surfacing	**Sealed (Steel)**
Protection Type	**Passive**
Signage	**Stop Signs + Advance Warning Signs**
Type of Road Traffic	**Cars + Heavy Vehicles**
Usage	**Medium (Local Traffic and National Park Access)**
Road Speed	**60 kph (Assumed)**
Rail Speed	**85 kph (TOC Manual)**
Road Sighting Upside	**Medium (Curve + Intersection)**
Road Sighting Downside	**Good (Intersection nearby)**
Rail Sighting Up End	**Poor (150m approx.)**
Rail Sighting Down End	**Good (Straight)**

Down Road Approach

Down Rail Approach

Up Road Approach

Up Rail Approach

Notes:
'Level crossing on side road' advance warning signs on Wollar Road; restricted sighting on Up side of level crossing due to low-lying vegetation and cutting in railway corridor; no 'Stop Line' pavement markings; road vehicles required to close up on Up side approach to obtain good sighting in Up direction; level crossing may not meet base

sighting distance requirements; no level crossing width markers installed on road approaches

Recommendations
Remove vegetation and re-shape cutting OR install active level crossing protection equipment; apply Stop Line and barrier line pavement markings on each road approach; install level crossing width markers installed on road approaches

Line	**Muswellbrook - Gulgong**		
Crossing Name	**Ulan**	**Km's from Sydney**	**420.062**
Road Name	**Ulan - Wollar Road**	**Location**	**Wilpinjong**

Approach Surfacing	**Unsealed**
Crossing Surfacing	**Sealed (Steel)**
Protection Type	**Passive**
Signage	**Stop Signs + Advance Warning Signs**
Type of Road Traffic	**Cars + Heavy Vehicles**
Usage	**Medium (Main access road for mine)**
Road Speed	**100 kph (Posted; 'Reduce Speed' signs installed on approaches)**
Rail Speed	**100 kph (TOC Manual)**
Road Sighting Upside	**Good (Straight Approach)**
Road Sighting Downside	**Medium (Curved Approach)**
Rail Sighting Up End	**Medium (Limited RHS sighting due to angle on interface)**
Rail Sighting Down End	**"As Above"**

Down Road Approach

Down Rail Approach

Up Road Approach

Up Rail Approach

Notes:
No 'passive level crossing' advance warning sign on Down side approach; Stop Signs are overlapped; Up side Stop Sign damaged; no alignment chevrons on curved road approaches; 45° interface angle may exceed standard requirements; no level crossing width markers installed on road approaches

Recommendations:
Install new ‘passive level crossing’ advance warning sign face to existing post on Down side road approach; repair damaged and overlapped Stop signs; re-align level crossing interface to a maximum of 70° crossing angle OR install active level crossing protection; install alignment chevrons on each curved road approach; install level crossing width markers installed on road approaches; apply a minimum of 7m seal on each road approach with Stop Line pavement marking

Line	**Muswellbrook - Gulgong**		
Crossing Name	**Ulan**	**Km's from Sydney**	**423.744**
Road Name	**Ulan - Wollar Road**	**Location**	**Wilpinjong**

Approach Surfacing	**Unsealed**
Crossing Surfacing	**Sealed (Steel)**
Protection Type	**Passive**
Signage	**Stop Signs + Advance Warning Signs**
Type of Road Traffic	**Cars + Heavy Vehicles**
Usage	**Medium (Main access road for mine)**
Road Speed	**100 kph (Posted; 'Reduce Speed' signs installed on approaches)**
Rail Speed	**100 kph (TOC Manual)**
Road Sighting Upside	**Medium (Curved Approach)**
Road Sighting Downside	**Medium (Curved Approach)**
Rail Sighting Up End	**Medium (Limited LHS sighting due to angle on interface)**
Rail Sighting Down End	**"As Above"**

Down Road Approach

Down Rail Approach

Up Road Approach

Up Rail Approach

Notes:
45° interface angle of level crossing may exceed standard requirements; damaged and overlapped Stop Signs; fading of 'Stop Sign ahead' advance warning signs; vegetation along Down side of railway in the Down direction may affect sighting distance in future; no chevron alignment markers on curved road approaches; no level crossing width markers installed on road approaches

Recommendations:
Repair damaged and overlapped Stop signs; relocate Stop Sign on Up side approach 600mm from edge of road; re-align level crossing interface to a maximum of 70° crossing angle OR install active level crossing protection; install alignment chevrons on each curved road approach; install level crossing width markers installed on road approaches; maintain trackside vegetation situated in the Down direction from the level crossing; replace any faded sign faces on approach to the level crossing; apply a minimum of 7m seal on each road approach with Stop Line pavement marking

Line	**Muswellbrook - Gulgong**		
Crossing Name	**Ulan**	**Km's from Sydney**	**425.213**
Road Name		**Location**	**Wilpinjong**

Approach Surfacing	**Unsealed**
Crossing Surfacing	**Sealed (Steel)**
Protection Type	**Passive**
Signage	**Stop Signs + Advance Warning Signs**
Type of Road Traffic	**Cars**
Usage	**Low (Property Access)**
Road Speed	**60 kph (Assumed)**
Rail Speed	**100 kph (TOC Manual)**
Road Sighting Upside	**Poor (Humped)**
Road Sighting Downside	**Poor (Humped)**
Rail Sighting Up End	**Good (At Stop Sign)**
Rail Sighting Down End	**Good (At Stop Sign)**

Down Road Approach

Down Rail Approach

Up Road Approach

Up Rail Approach

Notes:
Damaged Stop Sign on Down side; steep road approach from Up side; 80° interface angle of level crossing; 'Stop sign ahead' advance warning signs mounted very high on posts; no level crossing width markers installed on road approaches; trees located in Up direction limit sighting to at Stop Sign from Down side approach; trees situated on RHS of road approach to level crossing; level crossing on side road signs on Ulan – Wollar Road obscured by trees

Recommendations:
Repair Stop Sign on Down side of level crossing; install level crossing width markers installed on road approaches; reduce gradient on each road approach to minimum requirement for access and mobility standards; apply a minimum of 7m seal on each road approach with Stop Line pavement marking; undertake hazard reduction in Up direction from level crossing, on Down side road approach to level crossing, and along Ulan – Wollar Road in the vicinity of level crossing advance warning signs