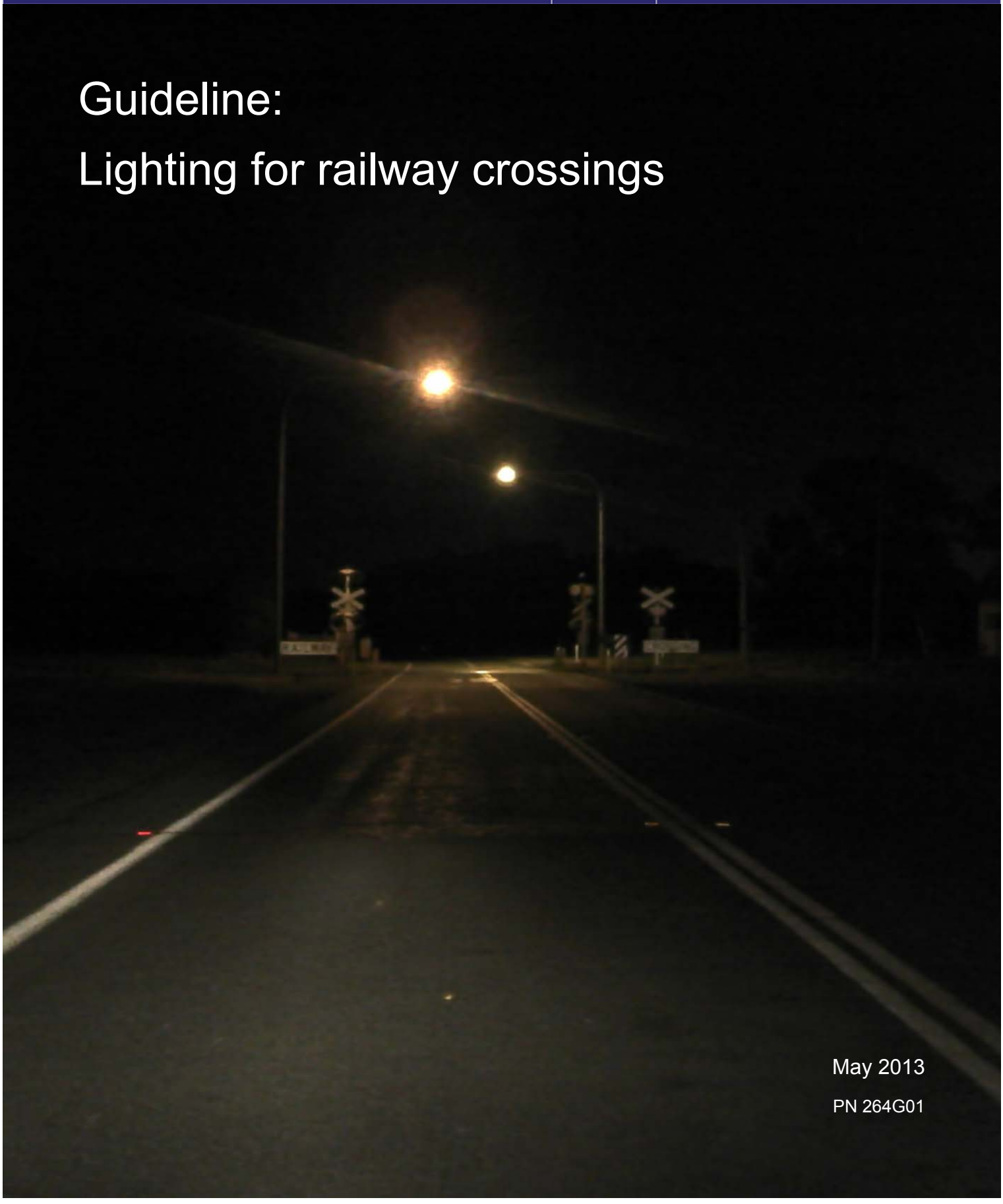
Transport Roads & Maritime Services

Guideline:
Lighting for railway crossings



May 2013

PN 264G01

[Inside front cover

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Lighting for Railway Crossings

Special Note:

As of 17 January 2011, the former Roads & Traffic Authority (RTA) now Roads and Maritime Services (RMS), adopted the Austroads Guides (Guide to Traffic Management) and Australian Standards (AS 1742, 1743 & 2890) as its primary technical references.

A supplement exists for each part of the Guide to Traffic Management and relevant Australian Standard. The supplements document any **mandatory** Roads and Maritime Services practice and any complementary guidelines which need to be considered.

The supplements **must** be referred to prior to using any reference material.

This document is a complementary guideline. Therefore if any conflict arises, the supplements, the Austroads Guides and the Australian Standards are to prevail.

The supplements are located on the Roads and Maritime Services website at www.rms.nsw.gov.au

Cover photopgraph: Alleena railway crossing. *Note that lighting was installed before introduction of this guideline.*

Roads and Maritime Services
www.rms.nsw.gov.au

VERSION: 1.0
ISSUED: May 2013
AMENDMENTS: Refer to Amendment Record

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For the latest amendments (if any) to these guidelines go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/payparkingv4i.pdf

ISBN 978-1-922245-39-7 (Electronic only)
RMS 13.274
PN 264G01

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Amendment record

Please note that the following updates have been made to this document.

Amendment No	Page	Description	Issued	Approved By

1 INTRODUCTION

Effective road lighting helps to reduce the risk of injury or death to people using roads at night.

Roads must be well lit in order for motorists to clearly see road alignment, kerbs, road furniture, pavement surfaces and other road users, such as pedestrians and cyclists.

Australian Standard 1158.1.2:2010 notes that the objective of good lighting is to provide an illuminated environment, which is conducive to the safe and comfortable movement of vehicular and pedestrian traffic at night.

> Road lighting is acknowledged to be an effective crash counter-measure. The costs involved in providing road lighting can be demonstrated to provide significant financial and community benefits in terms of reductions in road crashes at night. Studies in Australia and New Zealand, and in other countries, have led to the conclusion that traffic route lighting is likely to reduce night time casualty crashes by about 30%, taken over the road network[1].

LIGHTING RAILWAY CROSSINGS

Effective lighting for railway crossings (RC) illuminates the road alignment both *on approach* to the RC and *at* the RC. This helps motorists to identify the RC in advance, to observe the road alignment *on approach*, and to detect the presence of a train *at* the RC.

Effective lighting reduces risk by enhancing the ability of a driver to identify the existence of the RC. It helps the driver to perceive the road alignment through the site, particularly where the RC:

- Results in a constriction in road width
- Is located past a curve or crest in the road
- Is affected by another sighting restriction

Effective lighting also improves the ability of a driver to observe a train occupying a passive control RC, particularly where:

- the train stops or shunts
- long trains travel at low speed through the RC

1.1 PURPOSE OF GUIDELINE

This guideline is applicable to RCs on public roads in NSW. It provides guidance for planners considering lighting of a RC as an additional safety management measure to reduce the risk of:

- A road vehicle colliding with a train
- A road vehicle leaving the travel lane at night or during situations of extreme low natural light weather events, such as heavy fog or dust

[1] Standards Australia AS/NZS 1158.1.2:2010 Lighting for roads and public spaces – Vehicular traffic (Category V) lighting – Guide to installation, operation and maintenance, p2.

The purpose of this guideline is to help planners:

- determine if a RC will benefit from lighting as an additional safety management measure
- design effective lighting schemes for RCs

The guideline assists in identifying objectives for lighting and the corresponding design criteria, and sets out minimum design principles for the design and performance of lighting as a safety management measure for RCs.

Note:

This guideline provides a framework for planners to make decisions about the design and performance of lighting *at* RCs and *on approach* to RCs. In some locations, the particular circumstances of the road network, the site, or the traffic and rail volumes may lead the planner to modify the application of the details in this guideline.

RELATIONSHIP TO *RAILWAY CROSSING SAFETY SERIES 2011*

This guideline builds on the *Railway crossing safety series 2011* in three ways, as follows.

- It shows how lighting schemes can address objectives to reduce risks at RCs
- It includes technical specifications and references associated with designing a lighting scheme
- It highlights the measures needed to manage new risks introduced by the lighting scheme

Lighting roadmap

The lighting roadmap on p 21 provides a table view to assist in relating risk categories as provided in the *Railway crossing safety series 2011* to the concepts provided in this guideline. The roadmap assists planners to consider:

- Which cues for considering lighting (see Table 2 Prompts for selecting sites, page 9) relate to which lighting objectives (see Section 3.1 on p 11)
- The lighting design criteria applicable to the risks and objectives (see Section 3.2 on p 12)
- The design principles applicable to the design criteria (see Section 3.3 on p 14)
- Potential outcomes of the project

‘So far as is reasonably practicable’

Lighting must be considered as one of potentially many safety management measures available to a planner to reduce night time risk. As for any RC safety management measure, lighting must be designed and installed according to ‘so far as is reasonably practicable’ principles.

Part 3 (Division 1) of the *National Rail Safety Law (NSW)* sets out the concept of ensuring safety and sets out the requirement to reduce risk ‘so far as is reasonably practicable’:

(a) to eliminate risks to safety so far as is reasonably practicable, and

(b) if it is not reasonably practicable to eliminate risks to safety, to minimise those risks so far as is reasonably practicable.

The term ‘so far as is reasonably practicable’ is referred to as SFAIRP.

Planners must consider SFAIRP principles when determining if lighting is a suitable safety management measure — that is, will lighting in combination with other safety management measures eliminate the risk; or if it is not reasonably practicable to eliminate the risk, reduce the level of risk so far as is reasonably practicable?

AUDIENCE AND SCOPE

This guideline is aimed at traffic engineers, transport planners, urban designers, town planners and other planners involved in the design and management of RCs and/or the roads approaching them.

The guideline applies to the provision of lighting at the following locations:

- *On approach* to a RC
- *At* a passive control RC

Notes:

- References in this guideline to lighting *on approach* to a RC and references to *at* a RC refer to specific design considerations and are defined in the Glossary.
- Lighting *at* an active control RC is not generally considered essential from a road manager perspective. However, planners may consider providing lighting *at* an active control site based on assessment of site conditions and the potential benefits to railway and road safety.
- Specific lighting restrictions provided in land use planning instruments must also be considered in the design of lighting for RCs.

POLICY ISSUES

This guideline raises certain policy issues.

Applying this guideline

This guideline provides a framework for planners to make decisions about the design and performance of lighting *at* RCs and *on approach* to RCs. In some locations, the particular circumstances of the road network, the site, or the traffic and rail volumes may lead the planner to apply the details in this guideline in a modified way.

Context

Any proposed change to safety management or operation of a RC must consider the applicable Interface Agreement and requirements of rail safety legislation. As lighting is a change to safety management, all lighting designs on the *approach to* and *at* the RC must be designed in consultation with the relevant road and railway managers.

This guide must be read in conjunction with the Australian Standards *AS 1158 Lighting for roads and public spaces*, *AS 1742.7 Manual of uniform traffic control devices, Part 7: Railway crossings* and the Roads and Maritime Services (RMS) Supplements. If there are any differences in practice between these documents, the RMS Supplements take precedence.

Holistic approach

A holistic approach will consider:

- the combined affect of all safety management measures in eliminating or minimising a risk 'so far as is reasonably practicable', and
- what new risks may be introduced with the safety management measures.

It will be necessary for the planner to consider if the costs involved with planning and installing, maintaining and operating lighting, and mitigating any risks introduced by the installation and maintenance of the lighting outweigh the risk(s) the lighting is intended to address.

CONSULTING WITH STAKEHOLDERS

Under provisions of safety interface agreements, any proposed change to a RC must be discussed with the parties to the interface agreement and their concurrence gained for the proposed change. A change by one party may require action by another to address potential risks associated with the change.

Therefore, when identifying lighting objectives and determining whether the planned scheme meets these objectives, planners should consider the additional information and perspectives of other stakeholders. For example, the rail infrastructure manager and the local council should be consulted, as should anyone else indicated in the safety Interface Agreement or site Safety Management Plan as having responsibilities at the site.

The following protocol should be followed to ensure there is adequate collaboration between RMS and other stakeholders.

Initiation

The project must be discussed with the rail infrastructure manager and local council to gain their knowledge of site issues, and to gain concurrence to the project. Consultation and approvals must be undertaken in accordance with requirements of the site safety Interface Agreement.

Submit the design

The design proposal must be given to the rail infrastructure manager and local council for acceptance and approval, or as required by the safety Interface Agreement. The design should also be assessed with a view to how the scheme will be maintained, and consultation with the maintaining organisation should be undertaken during the design process.

Implement the lighting scheme

The lighting scheme can be implemented once approval for the scheme is provided by the responsible parties, and once funding, maintenance and running costs are agreed.

Update the safety Interface Agreement and Safety Management Plan

This should be done as is appropriate for the particular site.

Advise Transport for NSW (TfNSW)

TfNSW should be advised to update the Australian Level Crossing Assessment Model (ALCAM).

1.2 HOW TO USE THE GUIDELINE

The guideline contains the following sections.

- ***Section 2 Selecting sites for lighting*** provides information on how lighting assists to reduce night time risk at RCs, and provides prompts to guide planners considering lighting for a RC.
- ***Section 3 Designing lighting as a safety management measure*** presents the design approach to be undertaken including:
    - Identifying objectives and aligning with risks
    - Selecting design criteria
    - Applying design principles
    - Reviewing the design and mitigating any introduced risks.
- ***Section 4 Review and evaluate the lighting scheme*** considers the ongoing management of the lighting scheme.
- ***Appendix A The lighting roadmap*** illustrates how risk categories map onto the lighting objectives, design criteria, design principles and expected outcomes.
- ***Appendix B Summary of design principles*** provides a snapshot of the design principles.
- ***Appendix C Schematic layouts*** illustrates different lighting layout concepts.
- ***Additional resources***
- ***Glossary***

Figure 1 Structure of guideline, outlines the process of selecting, designing and managing lighting at RCs and indicates which parts of the guideline are relevant at each step.

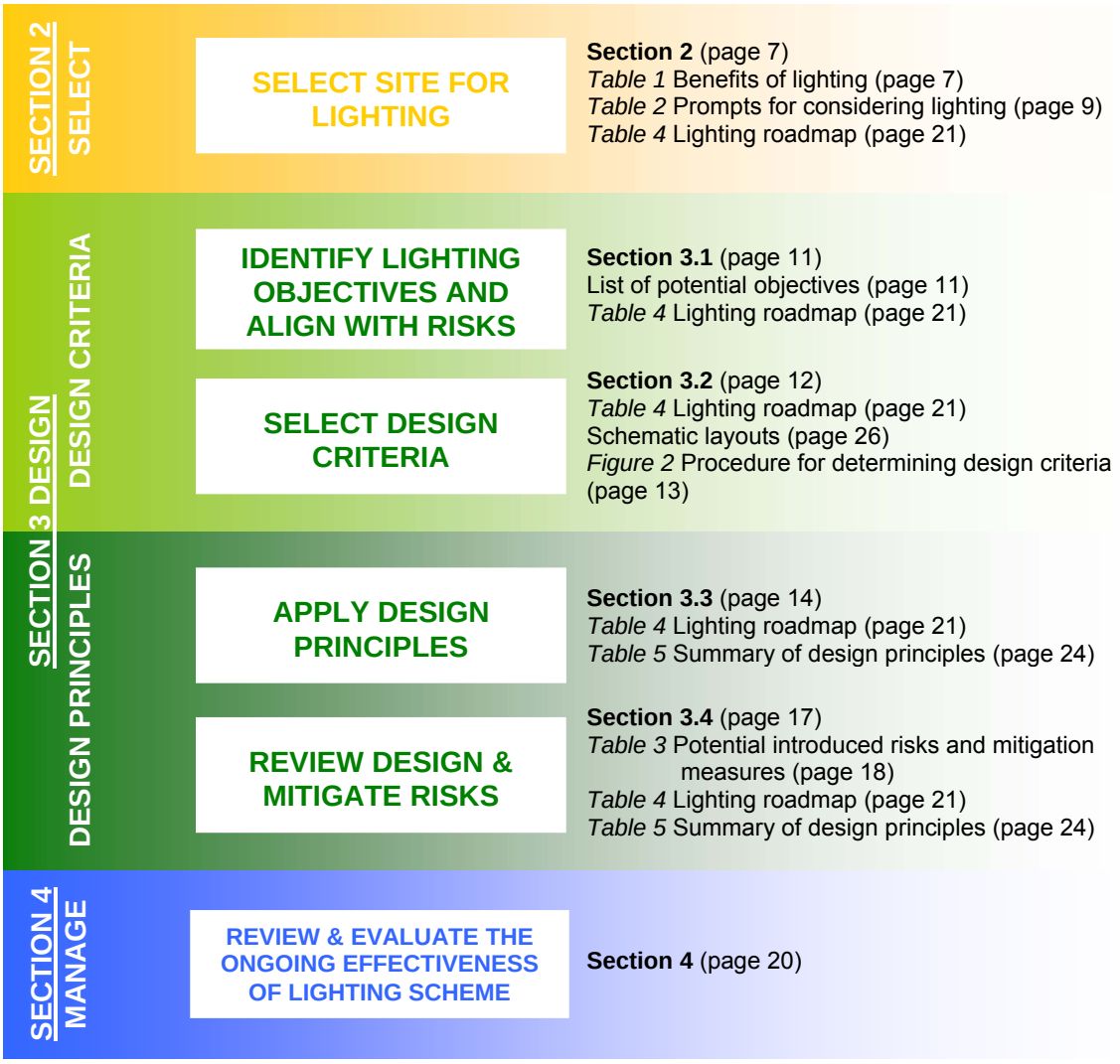

Figure 1 Structure of guideline

2 SELECTING SITES FOR LIGHTING

Lighting may be an effective safety management measure for railway crossings (RC) in rural and urban areas, and for active and passive control RCs. However, lighting may not add value at all sites or mitigate all risk types.

Discussions about the use of lighting as a safety management measure are most likely to arise when decision-makers are reviewing or amending Safety Management Plans for RCs. The Safety Management Plan will identify the risks that may be ameliorated through effective lighting; the planner's role is to determine whether lighting is an appropriate safety management measure.

HOW CAN LIGHTING REDUCE RISK?

Effective lighting can make a RC, and the approaches to the RC, more conspicuous to road users. This can help a driver to better observe and assess the road alignment *on approach* to the RC, and more readily detect the presence of a train and infrastructure *at* the RC. By taking appropriate action, the driver can safely navigate the RC and reduce the potential risk of a crash with other road vehicles, infrastructure or a train.

See Table 1 for a summary of how Category V and Category PX lighting can address risk on the approach to, through, and on departure from the RC, and how Category PX lighting can address risk at the RC.

Table 1 Benefits of lighting railway crossings

Benefits	**Category V lighting: *On approach* to the RC**	**Category PX lighting: *At* the RC**
Safer negotiation of the road alignment on approach to, through, and on departure from the RC	✓✓✓	✓
Lower approach speeds by motorists	✓✓	✓
Improved observation of the presence of a train *at* the RC	✓	✓✓✓
Improved observation of vehicles travelling across or stopped on the RC	✓	✓✓✓
Improved visibility of the RC and trains in adverse weather conditions	✓	✓✓
Improved visibility of vehicles queued on approach to the RC	✓✓	✓
Improved delineation of the RC for train drivers	✓✓	✓✓✓

The benefits of lighting may also be considered in relation to the outcomes shown in Appendix A Lighting roadmap on p 21. This helps to show how the benefits map back to the risk categories.

HOW DOES LIGHTING FIT INTO SAFETY MANAGEMENT?

When selecting safety management measures for a given site, planners use the '*Evaluate: Applying the railway crossing cause consequence bow tie models*' document of the RMS *Railway Crossing Safety Series 2011* to determine the particular risks of the site, and identify which measures are applicable. In that document, risks are grouped into five broad Risk Categories. Within each of these categories, there are specific risks for which lighting may be applicable as one of a number of safety management measures.

Below are the five Risk Categories, with a description of how lighting may reduce risk.

1. **Road user fails to stop while a train is approaching**

The existence of the RC, or a train occupying the RC, should be made more obvious – lighting may improve driver awareness of the RC, and the presence of a train.

2. **Road user fails to keep clear while a train is approaching**

Areas not lit by headlights should be illuminated – lighting may improve the ability of the road user to observe the extent of the RC and any obstructions *at* or on the departure side of the RC.

3. **Road user fails to stay within travel lane, carriageway or path**

The road alignment, controls, and any obstructions should be more obvious to the road user – lighting may improve driver awareness of the road alignment and surface conditions.

4. **Failure of traffic control signals or active controls**

The existence of the RC, or a train occupying the RC should be more obvious – lighting may improve driver awareness of the RC and the presence of a train.

5. **Road user fails to observe other road users during operation of the RC**

The existence of the RC and any queued vehicles should be more obvious – lighting may improve driver awareness of the road alignment and the actions of other road users.

The Lighting roadmap on p 21 illustrates the relationship between the risk categories and the concepts provided within this guideline.

PROMPTS TO GUIDE THE SELECTION OF SITES

When determining whether a given site will benefit from the inclusion of lighting as a safety management measure, planners should use the 'prompt' questions provided in Table 2 Prompts for selecting sites (p 9) in conjunction with consideration of the risks of the site.

Table 2 Prompts for selecting sites

Site criteria	Description
Rail and road volumes	• Do trains use the RC at night? • Would the average road user expect to meet a train at night? • Is a train likely to encounter a road user at night?
Rail and road traffic composition and operations	• What are the types of trains that use the RC at night, eg freight trains, high-speed passenger trains or commuter trains? • What are the types of road vehicles that use the RC at night, eg high proportion of heavy vehicles, buses, high-speed traffic? • Do trains stop at the RC or undergo shunting operations at night?
RC incident history[2]	• Does the RC have an incident history such as crashes or near misses between a vehicle and a train at night?
Road crash history	• Is there a night time road crash history in the vicinity of the RC?
Forward visibility and road alignment	• Is sighting to the RC restricted – does a permanent feature obstruct motorists' view of the RC? • Will lighting help to improve the delineation of the road alignment *on approach* to the RC? • Is the area prone to fog or other extreme weather events that restrict visibility?
Driver speed and train speed	• What is the speed limit on the road approach to the RC? • Is driver speed likely to exceed the limit at night? • Will the provision of lighting encourage slower approach speeds? • Is there a large speed variation between track speed and slowest train operating speed?
Access to power[3]	• Is there access to the national power grid?
Risk assessment	• Has a risk assessment been completed? • What is the assessed risk level of a crash at night? • Would lighting reduce the risk (or assist reduction) 'so far as is reasonably practicable'?
Cost effectiveness	• Has the principle of risk reduction 'so far as is reasonably practicable' been applied to the selection of lighting? Have other potential safety management measures been similarly assessed?

[2] Incidents are defined as crashes and near misses, as reported to the Independent Transport Safety Regulator (ITSR).

[3] Solar power may be used but it must meet all illumination requirements as stated in this guideline

DETERMINING WHETHER LIGHTING IS AN APPROPRIATE SAFETY MANAGEMENT MEASURE

'So far as is reasonably practicable'

When determining whether lighting is appropriate, the planner must assess whether lighting provides a reduction in risk 'so far as is reasonably practicable' (SFAIRP) and, in doing so, must consider the implementation cost and ongoing maintenance and running costs of lighting. (For explanation of 'reasonably practicable, see S47 of the *National Rail Safety Law (NSW)).*

After consulting the *Railway Crossing Safety Series 2011,* in conjunction with this guideline, planners will be better placed to undertake a risk assessment and decision-making process to determine whether lighting is an appropriate safety management measure for a given site.

Holistic management: will installing lighting introduce new risks?

When a planner is assessing whether a given site will benefit from lighting, they must consider lighting in the context of the holistic management of safety for the RC. This includes consideration of the risks associated with inadequate lighting and the risks that may be introduced as a result of the installation of a lighting scheme.

See Table 3 Potential introduced risks and mitigation measures (p 18) for a list of potential 'new' risks that may arise from the implementation of a lighting scheme.

Next steps

It is at this point that the planner should determine if lighting may be:

- appropriate for the site
- a 'SFAIRP' safety management measure

Section 3 guides planners through the process of selecting the design criteria and designing the lighting scheme. As planners move through this process, they will need to re-evaluate whether lighting is indeed a SFAIRP safety management measure for the site, and make the decision to stop or continue with implementing lighting.

3 DESIGNING LIGHTING AS A SAFETY MANAGEMENT MEASURE

Once a planner has determined that lighting is an appropriate safety management measure for a given site, they should design the lighting scheme as provided in sections 3.1 to 3.4.

There are four steps to designing effective lighting for RCs:

1. **Identify** lighting objectives and align with risks
2. **Select** the design criteria
3. **Apply** the design principles in the design
4. **Review** the design and mitigate introduced risks

3.1 IDENTIFY LIGHTING OBJECTIVES AND ALIGN WITH RISKS

It is necessary to have a clear understanding of what the lighting is to achieve. The planner therefore needs to clarify and document the specific objectives of the proposed lighting scheme, and to match these to the risks that the scheme is intended to address.

Why are lighting objectives important?

Lighting objectives inform the design criteria and provide a measure for evaluating the proposed scheme. An ineffective lighting scheme proposal may be one that fails to meet the stated objectives, or one that provides a more elaborate scheme than is necessary to meet the objectives (that is, it is not a ‘so far as is reasonably practicable’ safety management measure).

Lighting objectives will also provide a reference point for evaluating the effectiveness of the design and the final installation.

Once the lighting is implemented, lighting objectives will provide a basis for a better understanding of the risks and their mitigation. They will contribute to continuous improvement in the processes associated with the identification of sites that may benefit from lighting, and of the design criteria and principles.

Potential lighting objectives

Planners should use the lighting objectives listed below to inform their selection of the appropriate lighting criteria, and the design principles.

Potential lighting objectives for the lighting of RCs may include the following.

- Support the objectives of rail safety legislation — this applies to the government goals to ‘Improve safety for road and railway users’.
- Provide effective illumination of the RC to reduce the crash risk between trains and motorists — this applies to the risk category ‘Road user fails to stop while a train is approaching’ and to risk category ‘Failure of traffic control signals or active control’.
- Adequately illuminate the RC by improving visibility and enhancing the ability of motorists to identify the RC and the departure from the RC — this applies to the risk category ‘Road user fails to keep clear while a train is approaching’.

- Provide effective illumination of the approach to, through and departure from the RC — this applies to the risk category ‘Road user fails to stay within travel lane, carriageway or path’ and to risk category ‘Failure of traffic control signals or active control’.
- Illuminate the road *on approach* to the RC to assist drivers to observe other road users in the vicinity of the RC — this applies to the risk category: ‘Road user fails to observe other road user during operation of the RC’.
- Allow train drivers to identify a vehicle or other obstruction on the RC — this applies to the risk category ‘Road user fails to keep clear while a train is approaching’ and to risk category ‘Failure of traffic control signals or active control’.
- Support RMS objectives by not introducing safety hazards into the road environment — this applies through incorporating the safe systems approach to road safety in all road projects.

Aligning objectives with risks

Aligning lighting objectives to risks should provide the planner with the confidence that all risks that were identified are being managed ‘so far as is reasonably practicable’, or that further consideration of the lighting design, or alternative/additional safety management measures, are required. Appendix A Lighting Roadmap on p 21 will help planners align objectives with risks.

When checking that the risks will be adequately controlled by the lighting scheme, planners should consult the prompt questions in Table 2 Prompts for selecting sites (p 9), the list of benefits in Table 1 Benefits of lighting railway crossings (p 7), and the lighting objectives of the scheme.

Where a risk cannot be matched to a lighting objective, the planner should revisit the *Railway Crossing Safety Series 2011* to determine an appropriate safety management measure.

3.2 SELECT DESIGN CRITERIA

Once it is determined that lighting is an effective safety management measure and provides a reduction in risk ‘so far as is reasonably practicable’ for a given site, the planner must select the design criteria for lighting. The design criteria will be based upon the objectives of the project and the need and extent of lighting *on approach* and the need for lighting *at* the site. To do so, the planner will need to assess any existing lighting both *at* and *on approach* to the site to determine whether this lighting meets current design standards. Based on this assessment, the planner can determine where additional lighting is required, and select appropriate design criteria. Figure 2 Procedure for determining design criteria (p13) outlines this process.

Figure 3 Areas of horizontal illumination and vertical illumination (p 26) provides a representation of the two design criteria, how Category V lighting applies *on approach* to a RC and lighting of the road, its alignment and road furniture in the horizontal plane; and how Category PX lighting applies *at* the RC and lighting of a train in the vertical plane.

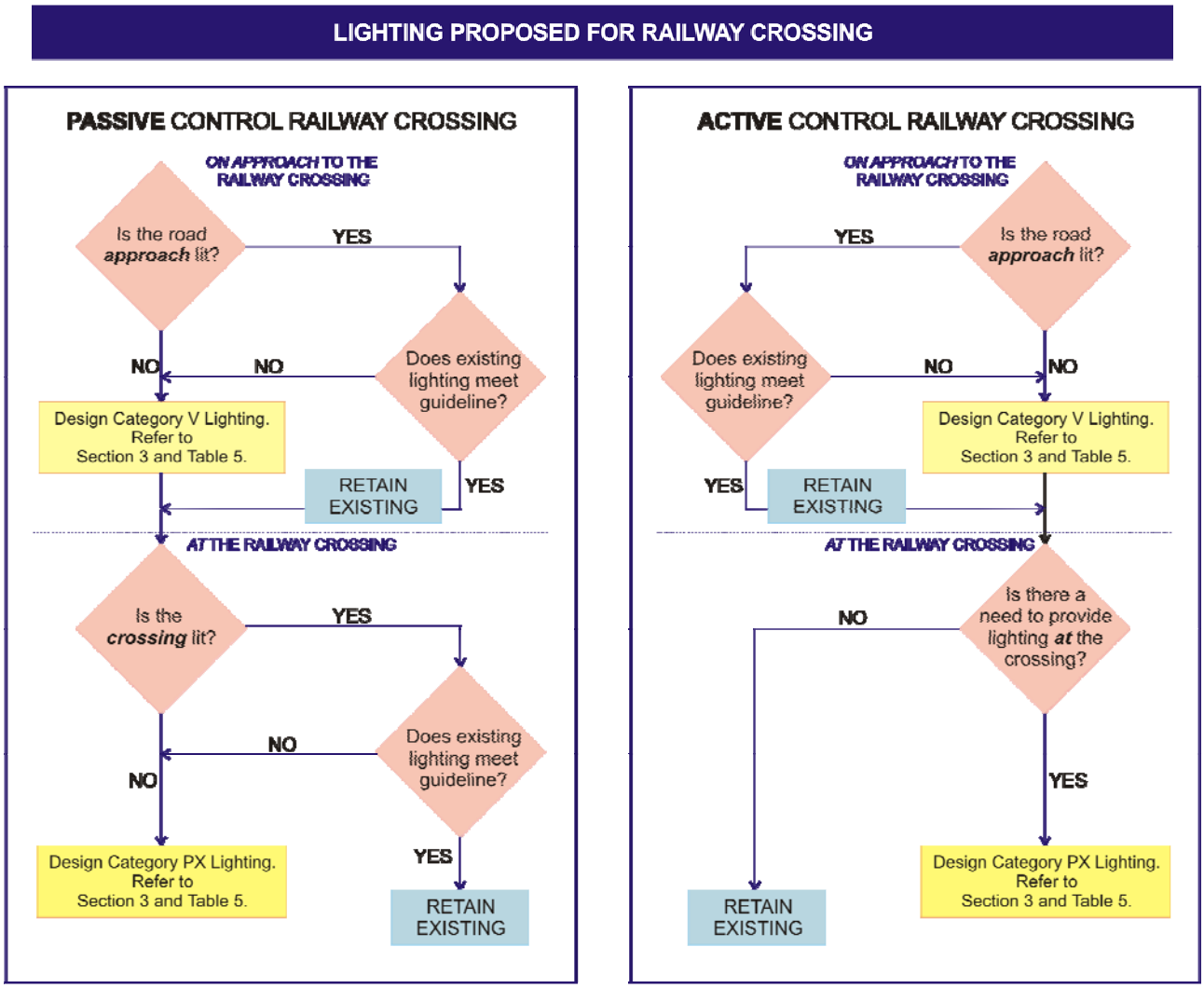

Figure 2 Procedure for determining design criteria

Please note that Figure 2 does not include the approval, cost and installation processes of the lighting designs. These processes should be completed in consultation with the responsible jurisdictions.

RE-EVALUATE WHETHER LIGHTING IS APPROPRIATE

At this point the planner has a better understanding of whether lighting will address the risks of the site, and should therefore re-evaluate whether lighting is an appropriate safety management measure. The planner must decide if lighting:

- Manages risk ‘so far as is reasonably practicable’
- Addresses all the risks as intended

Based on this re-evaluation, the planner must decide whether to continue designing the lighting scheme or return to the *Railway crossing safety series 2011* for guidance selecting alternative safety management measures.

3.3 APPLY DESIGN PRINCIPLES

When designing the lighting scheme, planners should apply the design principles for the lighting of railway crossings (RC) to ensure that new lighting schemes are safe and provide adequate illumination. When doing so, planners should take into account the lighting objectives of the scheme to ensure that these objectives are met in the design. The planner should also ensure that there is not an 'overdesign' of the project, that is, the design provides value for money.

Planners should refer to the design principles outlined below to inform their selection of design principles for a given site, and Table 5 Summary of design principles in Appendix B on p 24.

DESIGN PRINCIPLES: *ON APPROACH* TO THE RAILWAY CROSSING

All new lighting schemes *on approach* to the RC must provide lighting to AS1158 Category V standard (refer to AS 1158.1.1 and AS 1158.1.2) to:

- allow motorists to identify the RC
- allow motorists to safely negotiate the road alignment in the vicinity of the RC
- encourage lower approach speeds

Table 2.1 of AS 1158.1.1 displays the various levels of Category V lighting.

The design must provide adequate illuminance for the extent of the area of need without dull or excessively bright patches. To determine the level of illumination, planners must take into account the minimum requirements of this guideline, as well as competing lighting in the driver's field of view *on approach* to the RC.

To determine the extent of the area of need, planners should take into account road alignment. At a minimum, the area of need is to include two spans of lighting on the approach and two spans on the departure sides of the RC, as well as providing lighting through the RC.

Illuminance

The technical parameters of Category V lighting *on approach* to the RC must be in accordance with Table 2.2 of AS 1158.1.1.

Category V lighting must be provided for a minimum distance equivalent to at least two spans of lighting before and after the RC. Category V lighting must be provided on approach, through, and on departure from the RC. For a one-way carriageway, at least two spans of Category V lighting must be provided after the RC. The lighting provided before and after the RC must be of the same standard and should provide contiguous lighting through the RC.

Horizontal illumination

The lighting *on approach* to the RC must have adequate horizontal illumination. This provides sufficient illumination of the road surface and the RC allowing approaching motorists to identify the road alignment and the presence of the RC. Figure 6 and Figure 7 (p 28) conceptualise horizontal illumination *on approach* to a RC.

The various lighting technical parameters for Category V lighting are presented in Table 2.2 of AS 1158.1.1. New lighting schemes on approach to the RC must have a maintained horizontal illuminance level of at least 7.5 lux which means that the luminaire maintenance factor and the lamp lumen maintenance factor must be taken into consideration in the design.

Lamp requirements

On approach to the RC, in accordance with Clause 2.8 of AS 1158.1.1, high pressure sodium (HPS) lamps must be used for all Category V lighting in the first instance and metal halide (MH) lamps may be used if HPS is deemed to be inadequate.

Table 5.1 of AS 1158.1.2 displays the various characteristics of HPS and MH. Based on this table the planner may choose the suitable lamp type for the lighting scheme. Should lighting also be required at the RC, the requirements of section 2.1.2 must also be taken into account when selecting the lamp type.

New lighting types such as Light Emitting Diode (LED) lamps may be used to illuminate the approach to the RC. If these new types of lighting are preferred to the standard lamps, then they must be installed in accordance with Clause A6.4 of AS 1158.6 and must satisfy all the lighting technical parameters.

Glare

Glare from the lights must be minimised to avoid discomfort to motorists, train drivers and rail workers. The illumination levels must not exceed the maximum Threshold Increment (TI) values as shown in Table 2.2 of AS 1158.1.1. Flat glass luminaires mounted with the luminaire lens parallel to the roadway, or other appropriate type of luminaires, must be used to minimise glare to both motorists and train operators. Where necessary, luminaires with shields must be installed to minimise glare from the lighting.

Table 2.10 of AS 1158.3.1 presents the classification of luminaires and associated criteria for the control of glare and upward waste light.

The potential for the lighting to wash out adjacent road or railway signals must also be considered and appropriate mitigation measures implemented.

DESIGN PRINCIPLES: *AT* THE RAILWAY CROSSING

The purpose of illuminating *at* the RC is to help approaching motorists to identify the RC and to observe the presence of a train at the RC. Effective vertical illumination of the RC will sufficiently illuminate the sides of a train, consequently reducing the risk of a vehicle colliding with the train.

All new lighting schemes *at* RCs must provide lighting to AS1158 Category PX standard (Refer to *AS 1158.4 – Lighting for pedestrian crossings*).

The design principles for lighting *at* RCs are similar to the design principles for the lighting of pedestrian crossings, where adequate vertical illumination is critical to safety. Category PX lighting is able to satisfy this requirement and is therefore a suitable lighting type for RCs.

Lighting *at* RCs (Category PX) should only be provided for passive control RCs. Lighting *at* active control RCs is generally not required as control devices such as flashing lights and boom gates are used to warn drivers of the presence of a train *at* the RC.

The design must provide adequate illuminance *at* the RC without providing an excessively bright patch of light. The level of illumination will be determined on the minimum requirements of this guideline, and of competing lighting in the driver's field of view *at* the RC.

Illuminance

One span of Category PX lighting is required on both approaches to the RC. This ensures that the RC is well illuminated and both sides of a train *at* the RC are illuminated. Category PX lighting is only required on the approach side of a RC on one way carriageways.

Vertical illumination

The RC must have adequate vertical illumination. This allows the sides of a train to be well illuminated allowing approaching motorists to observe the presence of a train *at* the RC. Figure 4 and Figure 5 (page 27) conceptualise horizontal illumination *on approach* to, and vertical illumination *at* the RC.

The vertical illumination must be measured to a height of at least 1.5 m above the road level. For new lighting schemes, a minimum vertical illumination level of 32 lux must be maintained at the RC. The luminaire maintenance factor and the lamp lumen maintenance factor must be taken into consideration in the lighting design. The illumination levels *at* the RC must comply with the minimum lighting technical parameters indicated in Table 3.2 of AS 1158.4.

Lamp requirements

Illumination provided *at* the RC must be of a different colour from the general lighting in the area. White light through the provision of metal halide (MH) lamps or other suitable alternatives must be provided. If CCTV is used, the lighting should not interfere or distort the images.

New lighting types such as Light Emitting Diode (LED) lamps may be used to illuminate the RC. If these new types of lighting are preferred to the standard lamps, then they must be installed in accordance with Clause A6.4 of AS 1158.6 and must satisfy all the lighting technical parameters.

Glare

Glare from the lights must be minimised to avoid discomfort to motorists and train operators. Care needs to be taken to ensure that glare does not obscure the train signals. Flat glass luminaires mounted with the luminaire lens parallel to the roadway or other appropriate type of luminaires must be used to minimise glare to both motorists and train operators. Appropriate shields should also be used, where necessary, to minimise the glare.

Table 2.10 of AS 1158.3.1 presents the classification of luminaires and associated criteria for the control of glare and upward waste light.

The potential for the lighting to wash out adjacent road or railway signals must also be considered and appropriate mitigation measures implemented.

GENERAL CONSIDERATIONS

Other principles for consideration in designing the lighting scheme relate to road safety, designing safety into all road projects, and to environmental affects of the scheme.

Pole set-back and pole types

The RMS requirement to build safety into all road projects is to be considered in a holistic assessment of safety at the RC. The use of an appropriate pole type and adequate set-back distance will provide a safer lighting installation. Frangible impact absorbing poles at the RC are recommended to prevent the pole falling onto the railway tracks (refer to Clause B4.2.3 of AS 1158.1.2). A clear zone distance of at least 5 m from the nearest railway track must be maintained, or such distance specified by the rail infrastructure manager.

On the approach to the RC either frangible impact absorbing or slip base poles can be used. If frangible poles cannot be used due to site conditions, rigid poles may be installed with appropriate safety barrier protection. Adequate clear zone distances must be maintained.

Clause B6 of AS 1158.1.2 presents guidelines for pole set-back distances for different road layouts. The pole set-back distance is dependent on site conditions, which must be taken into consideration. Some of these site conditions may include:

- clearance from overhead power lines
- speed zones
- traffic volumes
- traversable and non-traversable verges
- available clear zone distance
- presence of safety barrier
- drainage conditions
- access for lighting maintenance personnel

The pole must not obstruct sight distances, traffic signs, signals and other traffic control devices. The pole locations and set-back distances at the RC must be designed in consultation with the rail infrastructure manager and road managers.

Maintenance vehicle parking area

Allowance of safe access for maintenance personnel must be considered in the design, allowing personnel to locate vehicles clear of the railway ‘danger zone’, road carriageway, and reduce the risk of maintenance vehicles impeding driver observation of RC controls or an approaching train.

Ongoing access arrangements for maintenance of the lighting should be negotiated at this stage.

Environmental planning

Local environmental planning instruments may require certain controls be placed on lighting, such as control of light spillage and general lighting levels. For example, near observatories inappropriate lighting may adversely impact astronomical observations.

Power supply

Connection to the national grid is preferred. However, solar panels may be used if the solar powered lights meet all the lighting technical parameters as described in AS 1158 and in this guideline. It will be necessary to have a regularly scheduled maintenance and inspection regimen to ensure adequate operation and output of power, especially during winter.

3.4 REVIEW THE DESIGN AND MITIGATE INTRODUCED RISKS

Once the design of the proposed scheme has been finalised, the planner should consider three questions, as follows.

- Does the design meet the lighting objectives?
- Does the design introduce new risks and if so, does it provide mitigating measures for each of them?
- Does it provide a safety management measure that minimises risk 'so far as is reasonably practicable'?

Based on this re-evaluation, the planner must decide whether to continue designing the lighting scheme or return to the *Railway crossing safety series 2011* for assistance with selecting alternative safety management measures.

Table 3 below presents a list of 'new' risks that may arise from the implementation of a lighting scheme and proposes mitigation measures.

Table 3 Potential introduced risks and mitigation measures

Potential introduced risk	Mitigation measure
Vehicle loses control and collides with a lighting pole *on approach* to or *at* the RC	• Use frangible lighting poles OR • Protect rigid poles with appropriate safety barriers AND • Ensure that a clear zone distance is provided
Lighting pole falls onto the tracks affecting safe railway operations	• Ensure a minimum clear distance of five metres from the nearest railway track, or as specified by the rail infrastructure manager AND • Use impact-absorbing poles
Glare from the light causes discomfort to motorists and train drivers	• Install flat glass panels AND • Install glare shields where appropriate AND • Use appropriate illuminance levels
Glare from the light obscures railway signals	• Align the luminaires so as to prevent glare and light spill from obscuring railway signals AND • Install glare shields where appropriate AND • Establish programmed monitoring to ensure maintenance of alignment and shields
Glare from the light obscures traffic controls *on approach* to the RC	• Align the luminaires so as to prevent glare and light spill from obscuring the traffic controls AND • Install glare shields where appropriate AND • Establish programmed monitoring to ensure maintenance of alignment and shields

Potential introduced risk	Mitigation measure
High lighting level *at* RC reduces driver vision of road hazard on departure side of RC	• Provide Category V lighting on the departure side of the RC to ensure that there is suitable transition to darkness
Absence of lighting through a loss in power supply or other mechanical failures	• Maintenance protocols are implemented AND • Include an information sign providing an emergency contact number for road users to report incidents and infrastructure failure AND • Provide adequate delineation, (eg traffic signs, guideposts, road markings and RRPMs) to highlight the road layout *on approach* to the RC and to warn motorists of the presence of the RC
Lighting causes distraction to road user on another road	• Align the luminaires so as to prevent light spill and glare on surrounding roads and private property AND • Install glare shields where appropriate AND • Establish programmed monitoring to ensure maintenance of alignment and shields

CONSULTING WITH STAKEHOLDERS

Under provisions of safety interface agreements, any proposed change to a RC must be discussed with the parties to the interface agreement and their concurrence gained for the proposed change. A change by one party may require action by another to address potential risks associated with the change.

Therefore, when reviewing the design, planners should consider the additional information and perspectives of other stakeholders. For example, the rail infrastructure manager and the local council should be consulted, and anyone else indicated in the safety Interface Agreement or Safety Management Plan as having responsibilities at the site.

4 REVIEW AND EVALUATE THE LIGHTING SCHEME

During the project

As for any road project, a road safety review may be undertaken during any of the various phases of the project. The timing and frequency of road safety reviews during the project is a matter for planners to determine, and should be based on the risks associated with the project and guidance provided in RMS and Austroads publications.

A review of the project process may also be undertaken to inform future projects and inclusion in a 'lessons learned' register.

Once in operation

Once the design has been built and is in operation, the lighting scheme should be reviewed against the lighting objectives to ensure that the risks proposed to be managed by the lighting scheme are effectively managed; any ineffectively managed risks must be reassessed and additional or alternative safety management measures determined.

Ongoing effectiveness

An evaluation of the effectiveness of the lighting scheme should be undertaken approximately 12 months after commissioning. This allows the effect of operation through seasonal variations to be considered. The evaluation should consider the following.

- Change in incidents *on approach* to and *at* the site — this may include:
  - crashes within the area of influence of the railway crossing (RC); See *Railway crossing safety series 2011* for discussion on the area of influence
  - new (and unreported) damage to road furniture or other infrastructure.
- Change in driver behaviour *on approach* to and *at* the site — this may be measured by comparing traffic classifier data collected before installation and 12 months after commissioning
- Effectiveness of lighting through climatic and seasonal variations — the effect of weather on the installation, such as high winds misaligning luminaires or shields

A note on maintenance of lighting schemes

Lighting requires maintenance, particularly given that luminaires may move under certain conditions and become misaligned producing glare for rail or road users, or reducing the effectiveness of the lighting. When developing and implementing a lighting scheme, planners should therefore consider the ease with which the scheme can be accessed for maintenance purposes. There must be adequate access to the rail corridor to allow maintenance work on the luminaires without entering the railway 'danger zone'. Similarly, night inspection of the lighting to assess alignment and effectiveness of the scheme must be scheduled.

APPENDIX A: LIGHTING ROADMAP

Table 4 Relationship of risks to outcomes, examples

Risk category	Prompt	Objectives	Criteria	Principles	Outcomes
1. Road user **fails to STOP**	Do trains occupy the railway crossing (RC) at night? Would the average road user expect to meet a train at night? Is there a night time crash / incident history? Is sighting to the RC restricted? Is driver speed likely to exceed the speed limit at night? Is the road alignment obvious at night?	Increase driver awareness of the RC Increase driver awareness of a train	Provide contiguous lighting *on approach* to the RC Provide contrasting lighting *at* the RC Control glare and light spillage Mitigate risks introduced by the lighting	Illuminance (horizontal and vertical) Lamp requirements Glare control Power supply Number of spans Pole location	Increased conspicuity *of approach* to RC Increased conspicuity of a train *at* the RC Reduced vehicle approach speed Fewer incidents / crashes
2. Road user **fails to KEEP CLEAR**	Do trains occupy the RC at night? Would the average road user expect to meet a train at night? Is there a night time crash / incident history? Is sighting of the RC and departure restricted? Is queuing or short staking a noted issue at the RC?	Increase driver awareness of the RC Increase driver awareness of a train Increase conspicuity of departure side	Provide contiguous lighting *on approach* to the RC Provide contrasting lighting *at* the RC Control glare and light spillage Mitigate risks introduced by the lighting	Illuminance (horizontal and vertical) Lamp requirements Glare control Power supply Number of spans Pole location	Increased conspicuity *of approach* to RC Increased conspicuity *at* and departure side Increased conspicuity of a train *at* the RC Reduced vehicle approach speed Fewer incidents / crashes

Risk Category	Prompt	Objectives	Criteria	Principles	Outcomes
3. Road user **fails to STAY IN TRAVEL LANE**	Is there a night-time crash / incident history? Is sighting to the RC restricted? Is driver speed likely to exceed the speed limit at night? Is the road alignment obvious at night? Are the actions of other road users obvious? Are constrictions and hazards obvious at night?	Increase driver awareness of the RC Increase conspicuity of road alignment	Provide contiguous lighting *on approach* to the RC Control glare and light spillage Mitigate risks introduced by the lighting	Illuminance (horizontal) Lamp requirements Glare control Power supply Number of spans Pole location	Increased conspicuity *of approach* to RC Increased conspicuity *at* and departure side road environment Reduced vehicle approach speed Fewer incidents / crashes
4. Failure of **ACTIVE CONTROL**	Is there a night time crash / incident history? Is sighting to the RC restricted? Is driver speed likely to exceed the speed limit at night?	Increase driver awareness of the RC Increase driver awareness of a train Increase conspicuity of road vehicle for train driver	Provide contiguous lighting *on approach* to the RC Provide contrasting lighting *at* the RC Control glare and light spillage Mitigate risks introduced by the lighting	Illuminance (horizontal and vertical) Lamp requirements Glare control Power supply Number of spans Pole location	Increased conspicuity of a train *at* the RC Reduced vehicle approach speed Fewer incidents / crashes

5. Road user **fails to OBSERVE** other road users	Is there a night time crash / incident history? Is sighting to the RC restricted? Is driver speed likely to exceed the speed limit at night? Is the road alignment obvious at night? Is the actions of other road users obvious?	Increase driver awareness of the RC Increase driver awareness of other road user actions	Provide contiguous lighting *on approach* to the RC Control glare and light spillage Mitigate risks introduced by the lighting	Illuminance (horizontal) Lamp requirements Glare control Power supply Number of spans Pole location	Increased conspicuity *of approach* to RC Increased conspicuity of other road user actions Reduced vehicle approach speed Fewer incidents / crashes

APPENDIX B: SUMMARY OF DESIGN PRINCIPLES

Table 5 Summary of design principles

Design principles	Lighting requirements	
	Approach to the railway crossing	**At the railway crossing (RC)**
Type of lighting	Category V lighting	Category PX
Australian Standards (AS) reference	• AS 1158.1.1 and AS 1158.1.2	• AS 1158.4
Number of spans of lighting	• Minimum two spans of lighting are required on approach and departure sides of the RCs • At one way carriageways, a minimum of two spans of lighting must be provided after the RC	• Minimum one span of lighting is required on approach and departure sides of the RC • At one way carriageways, lighting is only required on the approach side
Illumination levels	• Category V lighting design parameters must be in accordance with Table 2.2 of AS 1158.1.1 • Horizontal illuminance level must be measured at ground level • Minimum point horizontal illuminance level = 7.5 lux • Lighting must be contiguous on approach, through and departure from the RC	• Category PX lighting design parameters must be in accordance with Table 3.2 of AS 1158.4 • Vertical illuminance level must be measured at a minimum height of 1.5 m above ground level • Minimum point vertical illuminance level = 32 lux
Lamp requirements	• High pressure sodium (HPS) • Metal halide (MH) can be used if HPS is inadequate for the scheme • Refer to Table 5.1 of AS 1158.1.2 for the various operational characteristics of HPS and MH	• Metal halide (MH) or similar alternative • Colour of the lighting at the RC must provide a clear colour difference from the general lighting in the area • LEDs can be used in accordance with Clause A6.4 of AS 1158.6 and must meet all lighting technical parameters

Design principles	Lighting requirements	
	Approach to the railway crossing	**At the railway crossing (RC)**
Glare	• Flat glass luminaires must be used (and glare shields where appropriate) to minimise glare to motorists and train drivers • Threshold increment (TI) value ≤ 20 % as shown in Table 2.2 of AS 1158.1.1	• Flat glass luminaires must be used (and glare shields where appropriate) to minimise glare to motorists and train drivers • Glare control at 90^{o} = 0 as shown in Table 3.2 AS 1158 • Glare control at 70^{o} ≤ 6000 cd as shown in Table 3.2 AS 1158.4
Power supply	• Solar powered lighting may be used in areas where there is no access to the national grid • The illumination level of the solar powered lighting must meet the lighting technical parameters as shown in Table 2.2 of AS 1158.1.1	• Solar powered lighting may be used in areas where there is no access to the national grid • The illumination level of the solar powered lighting must meet the lighting technical parameters as shown in Table 3.2 of AS 1158.4
Pole type	• Either slip base poles or impact absorbing poles can be used • Rigid poles may be used due to site conditions but must be protected by safety barriers and clear zone distances must be maintained	• Impact absorbing poles only must be used to prevent the pole from falling onto the tracks
Pole set-back distance	• Refer to Clause B6 of AS1158.1.2 for guidelines on pole set-back distances	• Consultation with respective railway authorities must be conducted to discuss proposed locations of the lighting • Clear zone distance of at least 5 m from the nearest railway track must be maintained

APPENDIX C: SCHEMATIC LAYOUTS

Two different lighting layouts are proposed for passive control and active control railway crossings (RC) that include a straight approach and a reverse curve approach to the RC. The areas where Category V lighting and Category PX should be considered are indicated on the layouts.

Key points in the lighting layouts as shown in Figure 4 to Figure 7 (pp 27 to 28) are as follows.

- A minimum of two spans of Category V lighting are required *on approach* to the RC. More spans may be required to illuminate curves *on approach* or road furniture and devices
- A minimum of one span of Category PX lighting on each side of the RC is required
- A minimum 7.5 lux horizontal illuminance for the Category V lighting and minimum 32 lux vertical illuminance Category PX lighting must be maintained
- Appropriate lamp types for Category V and Category PX lighting should be used, such as high pressure sodium (HPS), metal halide (MH) or other suitable alternatives such as light emitting diode (LED). There must be a clear colour contrast difference between the type of lamps used for Category V and Category PX lighting
- Glare must be minimised for motorists and train drivers and must not obscure train signals or traffic control devices. Suitable luminaires with glare shield should be used, as appropriate
- Existing traffic signs and road markings must also be adequately illuminated by the lighting

The lighting layouts shown are schematic layouts only. Detailed designs should be prepared and checked by qualified lighting consultants

THE TWO DESIGN CRITERIA

Figure 3 provides a representation of the two design criteria: how Category V lighting applies to the approach to a RC and lighting of the road, its alignment and road furniture in the horizontal plane; and how Category PX lighting applies at the RC and lighting of a train in the vertical plane.

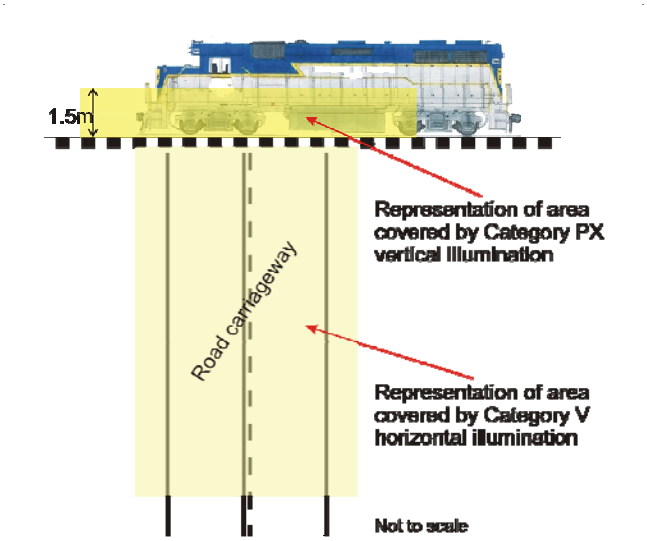

Figure 3 Areas of horizontal illumination and vertical illumination

PASSIVE CONTROL RAILWAY CROSSING

Figure 4 illustrates the lighting requirements for a straight *approach* to a passive control RC. All new Category V lighting schemes must satisfy the minimum lighting technical parameters as stated in Table 2.2 of AS 1158.1.1.

Figure 5 illustrates the lighting requirements for a reverse curve *approach* to a passive control RC. Additional spans of lighting may be required to safely illuminate the road alignment *on approach* to the RC. This will assist drivers to negotiate the curve safely and to identify the RC. All new Category V lighting schemes must satisfy the minimum light technical parameters as stated in Table 2.2 of AS 1158.1.1 and must be designed using the methods described in Clause 3.3 of AS 1158.1.1:2005.

The layout of the Category PX lighting at the passive control RC must meet the minimum lighting technical parameters as stated in Table 3.2 of AS 1158.4.

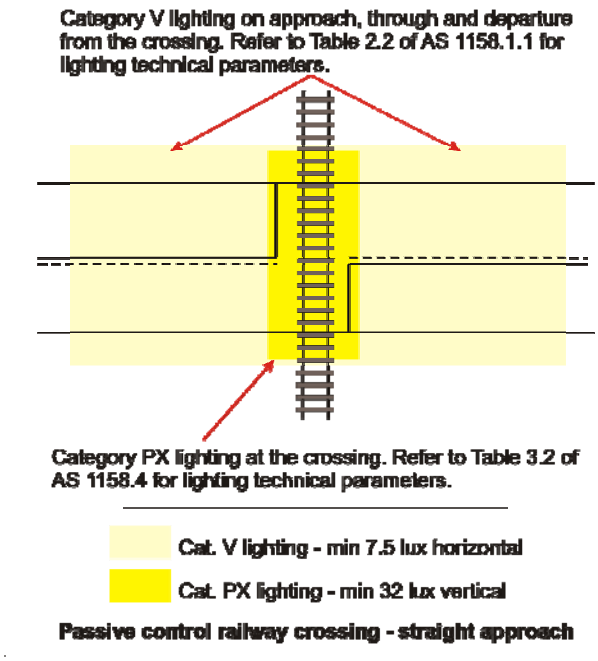

Figure 4 Lighting layout – straight approach, passive control

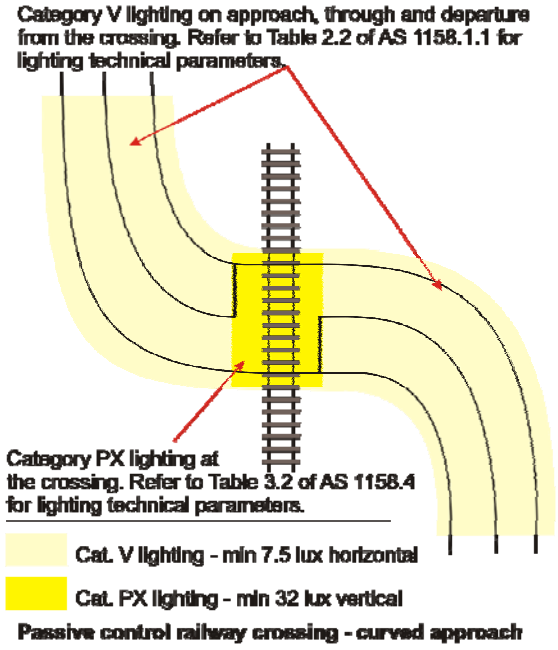

Figure 5 Lighting layout – curved approach, passive control

ACTIVE CONTROL RAILWAY CROSSING

Figure 6 illustrates the lighting requirements for a straight *approach* to an active control RC. All new Category V lighting schemes must satisfy the minimum light technical parameters as stated in Table 2.2 of AS 1158.1.1.

Figure 7 illustrates the lighting requirements for a reverse curve *approach* to an active control RC. Additional spans of lighting may be required to safely illuminate the road alignment *on approach* to the RC. This will allow motorists to negotiate the curve safely and to identify the RC. All new Category V lighting schemes must satisfy the minimum light technical parameters as stated in Table 2.2 of AS 1158.1.1 and must be designed using the methods described in Clause 3.3 of AS 1158.1.1:2005.

Category PX lighting is not essential *at* the active control RC but planners should ensure that adequate category V lighting is provided on approach, through, and on departure from the RC in order to eliminate any dark spots. Category PX lighting may be considered at the RC for other reasons.

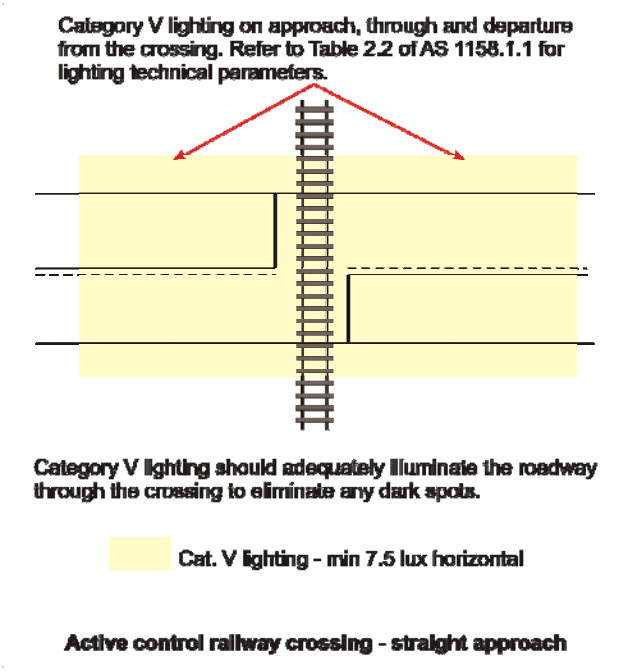

Figure 6 Lighting layout – straight approach, active control

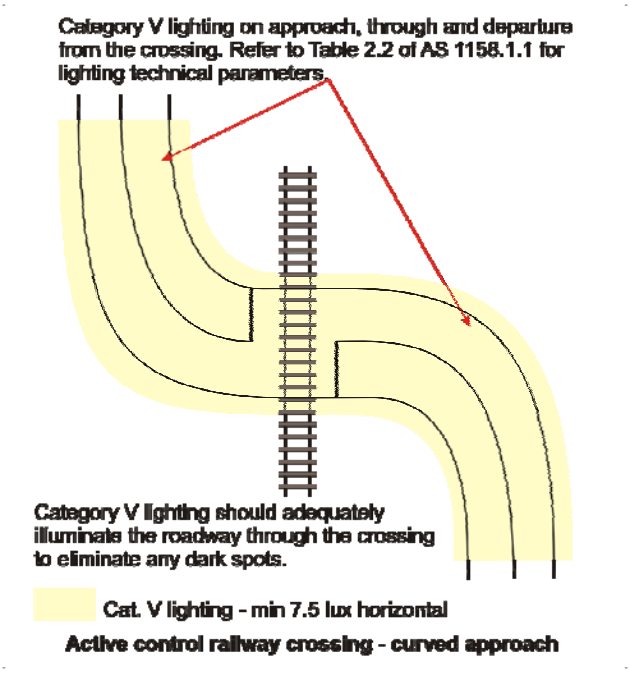

Figure 7 Lighting layout – curved approach, active control

ADDITIONAL RESOURCES

AS 1742.7:2007, *Manual of uniform traffic control devices, Part 7: Railway crossings.*

AS 1158.0:2005, *Lighting for roads and public spaces, Part 0: Introduction*.

AS 1158.1.1:2005, *Lighting for roads and public spaces, Part 1.1: Vehicular traffic (Category V) lighting – Performance and design requirements*.

AS 1158.1.2:2010, *Lighting for roads and public spaces, Part 1.2: Vehicular traffic (Category V) lighting – Guide to design, installation, operation and maintenance*.

AS 1158.3.1:2005, *Lighting for roads and public spaces, Part 3.1: Pedestrian area (Category P) lighting – Performance and design requirements*.

AS 1158.4:2009, *Lighting for roads and public spaces, Part 4: Lighting for pedestrian crossings*.

AS 1158.5:2007, *Lighting for roads and public spaces, Part 5: Tunnels and underpasses*.

AS 1158.6:2010, *Lighting for roads and public spaces, Part 6: Luminaires*.

Austroads *Guide to Road Design*

National Rail Safety Law (NSW)

RMS Project management system

RMS Guideline PN 261G: *Planning road infrastructure upgrades at railway crossings*

RMS Guidelines PN 238G, PN 239G, PN 240G, PN 241G which together comprise the *Railway crossing safety series 2011*

RMS Policy PN 264: Lighting for railway crossings

GLOSSARY

Active control — control of the movement of vehicular or pedestrian traffic across a RC using devices such as flashing signals, gates or barriers (or a combination of these), where the device is activated prior to and during the passage of a train through the RC.

At — references in this guideline to *at* the RC refer to specific additional lighting designed to illuminate a train occupying the RC.

Category PX lighting — lighting that is applicable to pedestrian crossings and provides a vertical illumination requirement to ensure that the side of a pedestrian is lit to aid driver awareness of the pedestrian. The object of lighting *at* a RC parallels that of a pedestrian crossing, but lights the side of a train to enhance driver awareness of a train occupying the RC (AS 1158.4:2009).

Category V lighting — lighting that is applicable to roads on which the visual requirements of motorists are dominant, eg traffic routes (AS 1158.1.1:2005).

Glare — condition of vision in which there is discomfort or a reduction in ability to see, or both, caused by an unsuitable distribution or range of luminaires or to extreme contrasts in the field of vision (As 1158.0:2005).

Horizontal illuminance — the value of illuminance on a designated horizontal place at ground level (AS 1158.0:2005).

Illuminance — the physical measure of illumination. It is the luminous flux arriving at a surface divided by the area of the illuminated surface. Units used: lux (lx) where 1 lux = 1 lm/m^2(AS 1158.0:2005).

Illumination — a general expression for the process of light arriving at a surface (AS 1158.0:2005).

Interface Agreement — an agreement in writing between the rail infrastructure manager(s) and road manager(s) responsible for managing risks to safety at the interface, made under the obligations of the *National Rail Safety Law (NSW)*.

Lamp — the generic term for the light source in a luminaire (AS 1158.0:2005).

Luminaire — apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except for the lamps themselves all the parts necessary for fixing and protecting the lamps and where necessary circuit auxiliaries together with the means for connecting them to the electrical supply (AS 1158.0:2005).

Luminance — the physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaire or reflecting material such as the road surface) when viewed from a specified direction. Units used: candela per square metre (cd/m^2) (AS 1158.0:2005).

On approach — references in this guideline to lighting *on approach* to a RC include lighting through and on the departure from the RC, the primary purpose being to illuminate the road alignment and any constrictions or hazards that arise from the existence of the RC.

Passive control — control of the movement of vehicular or pedestrian traffic across a RC by signs and devices, none of which are activated during the approach or passage of a train and which rely on road users, including pedestrians, detecting the approach or presence of a train by direct observation (AS 1742.7:2007).

Railway crossing — any crossing of a railway at grade providing for both vehicular traffic and other road users such as pedestrians and cyclists (AS 1742.7:2007).

Road manager — an authority, person or body responsible for the care, control or management of the road. For a State road, RMS and the local council may both be road managers for that road in accordance with the safety Interface Agreement.

Vertical illuminance — the value of illuminance on a designated vertical place at a height of 1.5 m above the ground level (AS 1158.0:2005).

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For further enquiries

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Roads and Maritime Services

May 2013
RMS 13.274
PN 264G01