

Roads

Master Specification

RD-EL-D1 Road Lighting Design

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RD-EL-D1 Road Lighting Design

1 Introduction

- 1.1 This Design Standard specifies the requirements for undertaking the design and documentation of road lighting systems and associated electrical infrastructure on Department roads. It does not cover the design of the lighting of public transport interchanges, railway stations and railway infrastructure.

2 Design Development – General Information

- 2.1 The design shall comply with:
- a) Electricity Act 1996 (SA).
 - b) Electricity (General) Regulations 2012 (SA).
 - c) SA Power Networks: Service Rules and Regulations.
 - d) AS/NZS 1158 Lighting - Roads and Public Spaces.
 - e) AS/NZS 3000 Electrical Installations.
 - f) AS/NZS 3008.1 Electrical Installation - Cable Selection.
 - g) AS/NZS 3845.2 Road Safety Barrier Systems and Devices Part 2 Road Safety Devices.
 - h) Austroads Publication: Guide to Road Design Part 6B: Roadside Environment.
 - i) CASA (Civil Aviation Safety Authority) Airport Lighting Exclusion Zones.
 - j) Department Operational Instruction 20.25 “Energy Management for Electrical Assets”, available from <https://www.dpti.sa.gov.au/standards/tass>.
 - k) RD-EL-D3 “A Guide to Conduit Design for Road Lighting, Traffic Signals and ITS”.
 - l) Clearances specified by the Office of the Technical Regulator (OTR): Building Safely Near Powerlines and Working Safely Near Powerline, available from:
 - i) https://www.sa.gov.au/_data/assets/pdf_file/0003/18606/150513-Building-safely-near-powerlines-web.pdf; and
 - ii) http://www.sa.gov.au/_data/assets/pdf_file/0003/6969/160708-Working-safely-near-overhead-powerlines.pdf.
 - m) Department Technical Standards and Guidelines including above drawings, which are available from the following web site: <https://www.dpti.sa.gov.au/standards>.
- 2.2 Where this Part specifies a higher standard than that required by the above Australian Standards, the requirements of this Part will take precedence.
- 2.3 For unmetered supplies refer to Australian Energy Market Operator (AEMO) approved load tables.
- 2.4 All lighting design shall be approved by the Department before the commencement of construction.

3 Responsibilities

Designer’s Responsibilities

- 3.1 The person / organisation undertaking the design (“Designer”) shall:

- a) liaise with relevant Department staff;
- b) source asset numbers from the Department;
- c) arrange Bracket Checks and Swing and Sag calculation with SAPN where required;
- d) determine suitable Service Point location in accordance with SAPN rules where required; and
- e) complete the checklist "Design Report Electrical Services", available from <https://www.dpti.sa.gov.au/standards/roads-all> under the heading "Road Design Outputs".

Department Responsibilities

3.2 Technical Services is responsible for:

- a) providing lighting design advice and direction to Project Managers and external Designers that have been engaged to perform Lighting Designs;
- b) reviewing and signing off for the compliance of the design with AS/NZS1158 and Department Standards and Guidelines; and
- c) management of Standards and Specifications.

3.3 Road and Marine Electrical Assets Management is responsible for:

- a) providing lighting asset management advice;
- b) liaising with SAPN for tariff amendments and requests;
- c) supplying asset number allocations for poles, luminaires and switchboards;
- d) nominating the road category, e.g. V or P; and
- e) reviewing Standards and Specifications.

3.4 Electrical Assets Maintenance is responsible for:

- a) providing Lighting and Electrical advice regarding compliance, constructability and maintainability of the installation;
- b) assisting contractors and designers with site investigations when required;
- c) site acceptance inspection at completion; and
- d) reviewing Standards and Specifications.

4 Drawings

- 4.1 Drawings and other documentation shall comply with the requirements specified in <https://www.dpti.sa.gov.au/standards/roads-all>, specifically DP001, DP002, and DP013.
- 4.2 This Design Standard references Instructional Drawing which are in Appendix 1: Road Lighting Instructional Drawing.
- 4.3 For example, Refer Sh101:1a refers to Sheet 101, instructional note 1a.
- 4.4 Lighting drawings shall substantially follow the layout shown in the Instructional Drawing in Appendix 1: Road Lighting Instructional Drawing.
- 4.5 Table RD-EL-D1 4-1 contains some common issues and resolutions.

Table RD-EL-D1 4-1 Common issues and resolutions

Issue	Resolution
Drawing tables, Lighting Details, Legends may not all fit on appropriate sheets	If required these tables can be put onto a separate sheet with appropriate references

Issue	Resolution
Conduit runs where multiple different infrastructure (e.g. ITS TS RL ELECT) is being fed	CST Common Services Trench with a cross-section or proposed services layout can be shown
When SAPN standards are being incorporated in the design	SAPN standards may be included on a Department title block

5 Lighting Operational Performance

Design Technical Requirements

- 5.1 Unless otherwise specified, the lighting design shall:
- a) illuminate Department infrastructure to the agreed category as per AS/NZS 1158;
 - b) minimise the “whole of life” costs to the Department (i.e. take into account the cost of construction, maintenance, repairs, energy consumption and replacement);
 - c) be appropriate for the site specific circumstances; and
 - d) take into account Work Health and Safety requirements for installation and ongoing maintenance.
- 5.2 Unless otherwise specified, existing network service provider poles (e.g. SAPN poles) shall be used, subject to bracket checks for suitability of proposed mounting height and outreach.
- 5.3 Stobie poles which are no longer used for power distribution shall not be used for provision of new road lighting.
- 5.4 Wherever practicable, the design shall avoid:
- a) placement of poles directly under powerlines;
 - b) interference with other services and structures (e.g. verandas);
 - c) property crossovers (e.g. driveways);
 - d) obscuring traffic signals and signage; and
 - e) placing poles within close proximity to the turning path of heavy vehicles.
- 5.5 The design shall ensure that road lighting poles, bases, luminaires, conduits, pits and associated components comply with Department Master Specifications <https://www.dpti.sa.gov.au/standards>.

Drawing Examples

- 5.6 If design information is unable to fit on a drawing, indicate which drawing and sheet the information resides on.
- 5.7 Where known, existing (E) and proposed (P) changes to installation should be shown.
- 5.8 Where a Department project and design includes SAPN amendments SAPN specific standards may be applied.
- 5.9 Where a Department project and design includes SAPN amendments, specific SAPN notes shall be added to the Department drawing.
- 5.10 Refer Sh101:1a: Circuit Designators specify the circuit number feeding the light pole. A single circuit number is used for single phase installations (e.g. 1, 2, 3, 4.) whereas an R, W or B with the circuit designator number after it indicates three phase installations (e.g. R1, R2, W1, W2, B1, B2.etc.). (Note: Stobie pole luminaires are directly connected, so no circuit numbers are required). Where a combination Lighting and Signal pole is fed from a Signal Controller, the circuit designator should specify “SC”).

- 5.11 Refer Sh101:1b: Where a Stobie mounted switchboard is used, a switchboard symbol shall be shown adjacent to the service point and an earth stake pit shall be placed greater than 3.5 m but within 5 m from SA Power Networks LV or HV earthing system or pole.
- 5.12 Refer Sh101:3a: SA Power Networks is responsible for providing bracket check information. This is then stored by the Department, and SAPN drawing number is shown on the Lighting Details table (e.g. Exxxx).
- 5.13 Refer Sh101:3b: Shows a luminaire mounted on a SAPN pole, indicating height and outreach details in metres.
- 5.14 Refer Sh101:1c Clearance to reticulated overhead and underground AC supplies shall be as specified by the Office of the Technical Regulator requirements.
- 5.15 Refer Sh101:1d: Luminaire numbering needs to make logical sense. Left to right, top to bottom. At intersections number Luminaire Light poles clockwise from north.
- 5.16 Refer Sh101:2a: Shall consult with the Department before using non-Department Standard luminaires and Poles. Current approved Luminaire list can be found here: https://www.dpti.sa.gov.au/data/assets/pdf_file/0012/330105/DPTI_Approved_Products_Contract_Works.pdf.
- 5.17 Refer Sh101:2b: Delete any unused items in the legend so as to minimize sheet clutter.
- 5.18 Refer Sh101:1e: Removal crosses should be shown on any equipment to be removed and / or replaced. E.g. Department Luminaire, SAPN Luminaire, Department pole base, etc.

6 Lighting Conduits

- 6.1 Refer to RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS.

Drawings Examples – Conduits

- 6.2 The designation for Road Lighting conduits shall indicate quantity, size and purpose e.g. 2x80RL.
- 6.3 Cross section profile of Common Services Trenches shall be shown on the drawing.
- 6.4 Where Road Lighting conduits cross a road, a spare conduit shall be installed.
- 6.5 Refer Sh101:1f: Unless otherwise specified, underground road lighting conduits shall be 80mm. Stobie riser from SAPN fuse box to 1st pit conduit shall be 50mm.

7 Lighting Pits Location and Type

- 7.1 Refer to RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS.

Drawing Examples

- 7.2 A P4 pit is required either side of a road crossing. For un-kerbed roads, a secure metal lid pit should be used.
- 7.3 Typically P4 pits are used as per Table 1 Nominal Pit Size Guide in RD-EL-D3 “Conduit Design of Road Lighting, Traffic Signals and ITS” (Pit legend blocks shall be sourced from the Department standard CAD support files on <https://www.dpti.sa.gov.au/standards>)
- 7.4 Spacings between pits should be as per RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS.
- 7.5 Refer Sh101:1g: Where a Combination Lighting / Traffic Signals pole is used a P4 pit needs to be installed adjacent / behind the pole. The exception to this is where a Combination pole is within 4m of a D, S or P4 pit.

8 Lighting Poles

Technical Requirements

- 8.1 Poles and luminaires should be aligned linearly where possible (differing kerb styles may need special consideration). Department pole outreaches should be aligned perpendicular to the road.
- 8.2 Designers shall consider the relative risks to motorists and pedestrians for the specific design, when selecting energy absorbing or slip base poles. Slip base poles shall be used on roadways where the road speed is greater than 50 km/h. Slip base poles shall also be used where the speed limit is 50 km/h or lower, except in areas of high pedestrian activity. Energy absorbing poles should be used in areas of high pedestrian activity (as defined in AS/NZS 1158) where the speed limit is 50 km/h or lower.
- 8.3 Combination traffic signal / road lighting poles, including mast arms, should be used at traffic signal sites to minimise the number of poles around an intersection. Where combination traffic signal / road lighting poles are installed in ELV traffic signal intersection, dual Voltage 240V AC and 42V AC voltages present stickers shall be installed to the opening of the door of the Combination Pole.
- 8.4 Unless otherwise specified, poles shall be 10.5 m or 12.0 m high with single or dual 3.0 m or 4.5 m outreaches.
- 8.5 At roundabouts with a centre island diameter greater than 8 m, a 4 way outreach on a 12 m high pole may be considered if technical parameters of AS/NZS1158 are satisfied.
- 8.6 Where it is proposed to use light poles and outreaches that are not currently approved for use by the Department, details of maintenance requirements, crash testing compliance and the process of purchasing replacement poles shall be provided in accordance with RD-EL-S1. The Department is under no obligation to accept unapproved light poles or outreaches.
- 8.7 Pole setback and placement shall be in accordance with AS/NZS1158.
- 8.8 Poles shall be located so that the level of lighting is not compromised by any existing or proposed trees or structures.
- 8.9 New pole locations shall not conflict with other services, trees or property crossovers and shall be located to avoid conflict with traffic signal line-of-sight requirements. In the event of service conflicts, the Contractor is required to review the Department Standard Lighting drawings for details of possible alternative pole footing designs. Clearances from hazardous areas shall be in accordance with AS/NZS 60079.10.1 or Office of the Technical Regulator (OTR) requirements.
- 8.10 Road lighting poles may only be installed in centre medians where the median has a minimum width of 2.0 m. Poles shall be set back at least 1.0 m from the face of kerb.
- 8.11 Road lighting poles shall not be located in front of traffic and pedestrian barriers. Where poles are installed behind non rigid barriers, allowances shall be made for the deflection of the barrier on impact.
- 8.12 In instances where road lighting is in the vicinity of airports the height and placement of light poles shall comply with CASA requirements.

Drawing Examples

- 8.13 Refer Sh101:1g: Where road lighting occurs at signalised Intersections designers shall use combination traffic signal / road lighting poles so as to minimise road furniture at the intersection.
- 8.14 Refer Sh101:1h: Pole setbacks should be as per AS/NZS1158, and set back correctly according to the relevant speed zones. A typical example for a 60 km/h road will be 0.7 m minimum, whereas from the tangent point around corners this increases to 1.0 m. Refer to AS1758 for roads with higher speeds.

- 8.15 Refer Sh101:1i: For signalised intersections combination lighting and signal poles should generally be considered in the primary signal pole location.
- 8.16 Refer Sh101:3c: Lighting details table should provide reference to a '3D string' for pole location and orientation. Typical poles orientation should be aligned with the centre line of the road (not the kerb).
- 8.17 Refer Sh101:3d: Department Road and Marine Asset Management allocates Luminaire numbers and switchboards numbers for installations and adjusts ongoing tariffs requirements for the Department.
- 8.18 For multiple outreach poles, the luminaires shall be numbered XXXXa, XXXXb, XXXXc and XXXXd where XXXX is the pole number.

9 Electrical Requirements

General Requirements

- 9.1 This section relates to the general electrical requirements associated with road lighting.

Technical Requirements

- 9.2 Electrical dimensioning needs to be considered for all circuits and sub circuits including any sub-mains feeds associated with the design. This should include any other circuits that may not be included in the design scope but fed off the common distribution point. It should include Circuit Current (I), Voltage drop (V Drop) and Impedance Calculations (Z loop).

Distribution

- 9.3 Electrical feeds to Department Lighting shall be by one of the following methods:
 - a) SAPN stobie pole dedicated service fuse on the pole;
 - b) SAPN Underground / Green Top distribution pillar;
 - c) Direct connect;
 - d) Stobie mounted Road Lighting switchboard as per drawing 4055 sheet 55;
 - e) Ground mounted Road Lighting Type 'A' switchboard with P3 pit;
 - f) Signal Controller extension housing as per 9.15 in the case of combination Lighting / Signal poles; and
 - g) Submersible Switchboard.

Clearance to Electrical Cables

- 9.4 Clearances of new lighting poles to overhead and underground electrical cables (including Transport related distribution cables) should comply with the OTR and Department requirements. In the event that the design fails to comply with minimum clearances, the Designer shall obtain the written approval of the OTR and the Department to use non complying clearances prior to proceeding with the Final Design. Consideration should be given to swing and sag calculations where required, and safe work installations using cranes (if required).
- 9.5 Aerial and underground cabling shall be identified as Low Voltage (LV) or High Voltage (HV). Reference to any swing and sag calculations shall be shown on the drawing.
- 9.6 The Department prefers a working clearance of 6 m. If this cannot be achieved, then a working clearance of 3 m will be permissible with the use of a spotter in accordance with the Office of the Technical Regulators documents 'Working Safely near Overhead Powerlines' and 'Building Safely near Powerlines'.

- 9.7 The Contractor shall provide a copy of any OTR approval(s) and calculations with the Final Design drawings.

Cable Selection

- 9.8 Electric distribution cable shall be sheathed multi-strand copper core with V-90 thermoplastic or X-90 XLPE insulation. Cables shall be rated for underground use and comply with AS/NZS3000 and AS/NZS 3008 requirements for distribution circuits. Active and Neutral distribution cables shall be double-insulated and have cross sectional areas between 6 mm² and 16 mm² unless otherwise specified. Earth cables shall be green / yellow and do not need to be double insulated unless they are bundled with other conductors in a multicore cable.
- 9.9 Consumer main and sub-main supply cable shall be sheathed multi-strand copper core with V-90 thermoplastic or X-90 XLPE insulation. Supply cable conductor cross sectional area shall be a minimum of 16 mm² and shall comply with AS/NZS3000 and AS/NZS 3008 requirements for distribution circuits.

Switchboards

- 9.10 Unmetered road lighting switchboard enclosures may be submersible, ground mounted or Stobie pole mounted. Metered road lighting switchboards shall be ground mounted.
- 9.11 Department standard switchboard drawings are available from: <https://www.dpti.sa.gov.au/standards/roads-all>, under the heading "Road Lighting" - Drawing 4055, Sheets 43, 54-58.
- 9.12 For new installations, Type C Circuit Breakers shall be used for distribution sub-circuits.
- 9.13 Unless otherwise approved, ground mounted switchboard enclosures shall be positioned as far from the road as practical and where possible, beyond the clear zone for the respective road sections as outlined in Austroads Road Design guidelines. If possible, preference shall be given to the door opening away from the road for the safety of maintenance personnel.
- 9.14 Dual purpose switchboards located at signalised intersections may be used to supply the Traffic Signal Controllers (through an isolation pit) and the Road Lighting distribution.
- 9.15 Road Lighting luminaires installed on combined traffic signal poles shall be supplied and controlled from a Traffic Signal Controller extension housing non-essential distribution. Where one does not currently exist, an extension housing cabinet shall be retro-fitted to the existing traffic signal controller. This is not applicable to pedestrian and koala crossings, where the luminaire(s) may be fed from a dedicated circuit breaker within the SC.
- 9.16 For upgraded Lighting installations, "Green top / fibreglass / plastic" Electrical Distribution Pillars shall be replaced with a Department Type A switchboard.
- 9.17 Any equipment not on the Australian Energy Market Operator (AEMO) load tables (refer to https://www.aemo.com.au/-/media/Files/Electricity/NEM/Retail_and_Metering/Metering-Procedures/NEM-Load-Tables-For-Unmetered-Connection-Points.pdf) shall be connected via a metered supply.

Power Supply

- 9.18 The Designer shall determine the power supply points and reticulation in conjunction with SA Power Networks and obtain its written confirmation of the approval of the supply point.
- 9.19 Department pits supplying Consumer Mains to a Department distribution switchboard shall be equipped with secure lids.

Drawing Examples

- 9.20 Where 3 phase distribution circuits are used, they should be balanced as closely as possible.

- 9.21 Because of the way the circuits are wired in 3 phase installations Vdrop and Zloop calculations need to be performed as a single phase calculation.

10 Advanced Road Lighting Management System

- 10.1 The Advanced Road Lighting Management System shall provide the following features:
- a) monitoring, control, reporting and mapping functionality;
 - b) remote control and addressing of individual or groups of lights (e.g. by switchboard, individual, group of circuits). Allow for switching and / or dimming lights to a lower sub-category based on the programmed daily / weekly settings for each day of the year, daily, weekly and / or event based on site specific conditions including real-time traffic usage, monitored site lighting levels or other factors such as temporary site works;
 - c) integration with the Department's Traffic Management Centre approved ITS Management platform;
 - d) hold current and historical log of asset information for each luminaire and associated equipment, e.g. switchboard including: asset number, GPS location, luminaire model, type, wattage, install date, pole number, outreach size, drawing number, meter number, site lighting level, status (on / off / failure / maintenance / decommissioned), load energy, voltage, current, temperature, etc.;
 - e) incorporate instantaneous monitoring, recording and displaying logs and graphs of the status of each luminaire including lamp failure, loss of communications, energy use voltage, current, temperature, etc.;
 - f) capable of automatically generating notifications to pre-defined or customized user groups via mobile application push notification, text message (SMS) and / or email;
 - g) storing all system and user activities related to the assets and be capable of searching, generating standard and custom reports for individual or selected groups of assets for current or selected time periods. Capability to exporting reports in a range of accepted industry formats including TXT, CSV, KML (Google Earth, Maps etc), KMZ and PDF;
 - h) web based user interface with both table and map views of individual or groups of selected assets or the entire system and clearly displaying selected asset attributes and status information;
 - i) incorporate comprehensive security access based on system administrator, user groups, with password access for each user-id; and
 - j) capability to be adapted for connection to other industry standard road lighting management systems.
- 10.2 Details of Advanced Road Lighting Management System including interface compatibility with the Department's Traffic Management Centre approved ITS Management platform shall constitute a **Hold Point**.

11 Lamps and luminaires

General Requirements

- 11.1 Unless otherwise specified, LED luminaires in accordance with RD-EL-S2 "Supply of Luminaires" shall be used.
- 11.2 Mounting heights for road lighting luminaires shall be either 10.5m or 12m, in accordance with AS/NZS1158 1.2 Table 8.1, unless constrained by overhead cables or otherwise specified.
- 11.3 Luminaire mounting heights on Stobie poles may vary between 7 m and 12 m. Actual mounting height shall be determined by SAPN.

11.4 LED luminaire upcast angle is 0° for Department and SAPN poles.

11.5 The maintenance factor for LED luminaires shall be 0.8.

Drawings Examples

11.6 Lamps located on other drawing sheets (than where the circuit details reside) need to be identified on the Circuit Details table.

11.7 Refer Sh101:1j: Lamps, poles and SAPN overhead cable which are to be removed, shall be indicated with cross symbols.

12 Tunnel and Underpass Lighting

12.1 Tunnel and underpass lighting shall comply with AS/NZS1158 part 5.

12.2 The Designer shall specify the appropriate TU lighting category(s) and reasons for the determination based on the structural characteristics, Table 2.1 and Clause 2.4 of the above Australian Standard.

13 Records

13.1 The Designer shall prepare and provide the following records. The provision of the following records shall constitute a **Hold Point**.

Drawings

13.2 The design drawings in accordance with Department Design Presentation Standards, in particular "DP001 – General requirements" and "DP013 Lighting".

13.3 Updated lighting and conduit drawings. As-constructed drawing shall be supplied upon completion of lighting installation.

Reports

13.4 A report detailing compliance with AS/NZS1158, providing:

- a) all calculations, including details of the lighting design program used to prepare the calculations;
- b) Maintenance Factor used in the design;
- c) power system, volt drop and fault loop impedance calculations;
- d) pole spacing calculations required for straight road sections; and
- e) Isolux contour drawing with the relevant illuminance level shown.

13.5 Department Lighting and Signals Presentation and Technical check list.

Implementation Records

13.6 Copy of any OTR clearance approval.

13.7 SA Power Networks "Pole Bracket Check and cable sag calculations".

13.8 SA Power Networks supply point availability.

14 Hold Points

14.1 The following is a summary of Hold Points for the documents referenced in this Part:

Table RD-EL-D1 14-1 Hold Points

Document Ref.	Hold Point	Response Time
10.2	Evidence of interface compatibility with Traffic Management Centre approved ITS Management platform	10 Working Days
13.1	The submission of design records	15 Working Days

15 Appendix 1: Road Lighting Instructional Drawing

- 15.1 Road Lighting instructional drawing Sh101 is attached to show practical application of design considerations as specified above.
- 15.2 The drawing shows typical installations that can apply to Road Lighting drawings and designs.
- 15.3 In the legend, only items relevant to the design shall be shown on that sheet.

