Roads

Master Specification

RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS

Document Information	
K Net Number:	13515404
Document Version:	1
Document Date:	2/7/2019
Responsible Officer:	

DEPARTMENT OF PLANNING, TRANSPORT AND INFRASTRUCTURE

Government of South Australia
Department of Planning, Transport and Infrastructure

Document Amendment Record

Version	Change Description	Date	Endorsement record (KNet ref.)
1	Initial issue (formerly TS/ITS 002, LD002). Combined road lighting, traffic signals and ITS conduit design into one document; general document review and update; revised Pit size guide Table 1; added list of Hold Points including response time; updated referencing	2/7/19	

Document Management

Contents

RD-EL-D3 Conduit Design for Road Lighting, Traffic Signals and ITS

1 Introduction

1.1 This Design Standard specifies he requirements for undertaking the design and documentation of conduits for electrical and / or communications systems associated with DPTI road infrastructure, including:

a) Consumer Mains;

b) Road Lighting;

c) Traffic Signals; and

d) Intelligent Transport Systems (ITS).

1.2 It does not cover the design of conduit systems for railways.

2 Design Standards

2.1 The design shall comply with:

a) Electricity Act 1996 (SA).

b) Electricity (General) Regulations 2012 (SA).

c) SAPN Service Rules and Regulations.

d) AS/NZS 2053 Conduits and fittings for electrical installations - General requirements.

e) AS/NZS 3000 Electrical Installations (known as the Australian/New Zealand Wiring Rules).

f) AS/NZS 3008.1 Electrical Installations – Selection of Cables.

g) AS 3996 Access Covers and Grates.

h) Austroads Guide to Road Design Part 6B: Roadside Environment.

i) Relevant Australian Standards and Australian Communications & Media Authority (ACMA) standards.

j) DPTI Technical Standards and Guidelines, which are available from the following web site: https://www.dpti.sa.gov.au/standards.

3 Design Development

3.1 In addition to any other requirement in the Contractor's Design Program, the Contractor shall provide (as an integrated part of its broader civil works design program) a fully detailed conduit design package capturing all milestones and hold points as listed in PC-EDM1 "Engineering and Design Management Framework".

3.2 All conduit design shall be approved by DPTI before the commencement of construction. The Principal's approval for the conduit design shall constitute a **Hold Point**.

4 Designer's Responsibilities

4.1 The person / organisation undertaking the design ("Designer") shall comply with this Design Standard, and liaise with relevant DPTI staff.

5 Design Requirements

5.1 The design of the conduit system shall:

a) optimise the layout of electrical and communications conduits and pits;

b) be compatible with existing DPTI infrastructure;

c) where specified, connect to existing DPTI or other conduit systems;

d) maximise the ease of installation and maintenance of hardware and cabling;

e) take into consideration other services / utilities, road furniture, watercourses, drainage infrastructure and landscaping;

f) take into consideration the future provision and / or expansion of ITS;

g) minimise the possibility of the ingress of water, vermin and contaminants that may affect the performance of cable systems;

h) comply with the requirements of the applicable ACMA standards and relevant Australian Standards; and

i) ensure that the conduits and pits comply with RD-EL-S4 “Supply and Installation of Conduits and Pits” and other relevant DPTI master specifications and standard drawings.

5.2 Unless otherwise specified, the Consumer Mains / Sub-Mains service connection cable shall not share pits or conduits with other services. Where the use of shared pits is approved and / or specified, the Consumer Mains / Sub-Mains service connection cable shall be fixed to the walls of the shared pit with saddles and clearly labelled as “Consumer Mains / Sub-Mains Service”. The label shall also indicate the source and destination of the cable.

5.3 Conduit design for calculated cable requirements shall ensure that each conduit has a minimum of 60% spare cross-sectional capacity on completion of construction.

5.4 Any communications and power conduit and pit system, including any cable tray, cable ladder, and similar methods, shall be designed to meet the requirements of physical separation for redundancy of the communications and power system cabling.

5.5 The conduit design shall ensure that physical damage to a section of conduit or cable ladder does not affect the redundancy of the cabling contained within the conduit. This requirement for physical separation applies to any pits, junction boxes, marshalling cabinets and the like.

5.6 For pit sizes P4 and larger, all conduits shall be designed and installed with permanent bell mouths on conduit ends to assist in cable pulling and prevent cable damage during installation.

5.7 Pits and conduits within the lowered motorway should be avoided due to the disruption required if maintenance and access to these services is required in the future. In the event that utility services are proposed within the lowered motorway, DPTI will assess any request on a case by case basis following consideration of a HAZOP approach in addition to cost benefit assessment.

6 Conduit

Layout

6.1 Unless otherwise specified, the conduits shall:

a) be placed in straight lines avoiding unnecessary bends;

b) generally run either parallel or normal to the carriageway;

c) use large sweeping bends for entry into junction boxes and pile footings; and

d) not exceed a 90° total change in direction in any run between pits.

6.2 Where a telecommunications service is required for a device, a telecommunications conduit shall be installed directly from the Telecommunications Service Pit (housing the Telecommunications Service Point) to the device.

6.3 Where an ITS device requires LV, ELV, communications and / or detector feed in cables, conduits for these required cables may terminate in a common cable draw-in pit. Each conduit shall have a minimum of 60% spare cross-sectional capacity on completion of construction. Segregation requirements shall be in accordance with AS 3000 and ACMA standards.

6.4 Unless otherwise specified, the conduit design shall provide separate dedicated conduits for each cable use. E.g. Road lighting cables shall be installed in separate conduits to traffic signals.

6.5 Conduits installed on bridges and other structures shall, wherever possible, be incorporated into the structure and not be visible. Conduits shall terminate in pits no smaller than P4 external to any bridge structure.

6.6 Conduits installed under rail corridors shall terminate in pits no smaller than P4 either side, and external to the rail corridor.

Spare Conduits

6.7 The following spare conduits along the entire length of any Traffic Signals backbone shall be installed as a minimum:

a) 1 x spare communications conduit, minimum diameter 80 mm unless otherwise specified.

b) 1 x spare electrical conduits, minimum diameter 80 mm unless otherwise specified.

6.8 The following spare conduits along the entire length of any ITS backbone shall be installed as a minimum:

a) 1 x spare communications conduit, minimum diameter 100 mm unless otherwise specified.

b) 1 x spare electrical conduit, minimum diameter 100 mm unless otherwise specified.

6.9 Where trenches are required for purposes other than ITS backbone cabling, e.g. to ITS equipment located off the backbone or for Road Lighting which does not use the backbone trench, 1 x spare communications conduit, minimum diameter 100 mm, shall be installed in the trench and connected to the ITS backbone conduit system, unless otherwise specified.

6.10 The spare conduits shall be terminated in a pit no smaller than P4 at the end of the trench.

6.11 Spare conduits installed on bridges and under rail crossings shall include 100% capacity over the number of spare conduits specified. For example, if 1 spare communications and 2 spare electrical conduits are specified in a project and the conduits pass under a rail crossing or across a bridge, the number of spare conduits will be 2 communications and 4 electrical at bridge and rail crossing locations. Spare conduits shall terminate in pits no smaller than P4 outside the rail corridor and / or external to any bridge structure.

Separation and Size of Conduits

6.12 Conduit separation shall be as specified in AS/NZS 3000 and / or relevant ACMA standards. If trenches are to be shared with other services, whenever practicable, conduits and other services shall be placed side-by-side (in the horizontal plane) as opposed to overlaying services vertically.

6.13 Conduit size shall be determined by consideration of all of the following criteria:

a) ability to haul in additional cable infrastructure;

b) for telecommunications conduit, cable accommodation and technology mix, e.g. twisted pair, coaxial and optical fibre cables;

c) costs of conduit laying (direct material and labour costs); and

d) costs of trenching and / or horizontal boring.

Electrical Power Conduit Size and Colour

6.14 Electrical power conduit shall be coloured orange. The diameter shall not be smaller than:

a) Flexible Conduit	25 mm
b) Road Lighting Conduit	80 mm
c) Traffic Signal Conduit	80 mm
d) Power Conduit for ITS Cabinet	100 mm
e) Power Conduit for ITS Device	100 mm

Communications Conduit Size and Colour

6.15 Communications conduit shall be coloured white. The diameter shall not be smaller than:

a) Flexible Conduit 25 mm

b) ITS Conduit 100 mm

c) Traffic Signal Detector Conduit 50 mm

Telecommunications Conduit Size and Colour

6.16 The telecommunications conduit shall comply with RD-ITS-C3 “Telecommunication Cabling”.

6.17 The telecommunications conduit size and layout shall give adequate capacity for reasonable communications systems upgrades. Conduits for telecommunications shall be terminated in dedicated pits.

Underground Consumer Mains

6.18 Underground consumer mains shall be installed at a depth and method as specified by AS/NZ 3000, AS/NZS 3008 & SAPN service rules and installation requirements.

7 Pits

General

7.1 Unless otherwise specified, road lighting, traffic signals and ITS shall not share pits. This does not apply to the use of combination road lighting and traffic signal poles at intersections, where road lighting power is fed through the intersection’s backbone from a non-essential distribution board in the traffic signal controller extension housing.

7.2 All pits shall have GPS coordinated positions and orientations provided on the design drawings relative to the local coordinates.

7.3 All pits shall be designed such that they fit adequately within the space provided giving due consideration to adjacent services. The design shall ensure that 1.2 m of clear working width is provided around all pits.

7.4 All pits shall be designed in accordance with DPTI standard drawing S-4055 sheet 66-70.

Service Disconnection Pit

7.5 Refer drawing S4055 sheet 56.

Pit Lid

7.6 According to their use, pit lids shall be specified by the Principal as either:

a) Lockable – secured with restricted access security bolts which are in turn protected by a hatch mechanism which is secured by a padlock;

b) Secured – secured with restricted access security bolts; or

c) Unsecured – no securing mechanism.

7.7 Unless otherwise specified, all road lighting pits shall be Unsecured, and all traffic signal and ITS power and communications pits shall at a minimum be Secured. Pits housing critical power or communications infrastructure in exposed or unrestricted access locations shall be Lockable.

7.8 Single FAP (Fibre Access Pit) pit shall be P7 lockable. Multiple FAP pit shall be P9 lockable. S and D pit can be used as building entry pit into the CER.

7.9 All pits with cable sizes greater than 25 mm^2 and length greater than 30 m shall be lockable.

Pit Sizes

7.10 DPTI utilises the generally accepted industry standard of "P" classification for pit sizes, e.g. P2, P3, P4, P5 and so forth (as shown on DPTI standard drawing S-4055 sheet 66-70).

7.11 Pit sizes shall be selected on the basis of the intended use, including the number and size of conduits entering and exiting the pit, and shall enable the cable(s) to be installed and operated according to the manufacturer's specifications, particularly with regard to minimum bending radiuses. As a guide, nominal pit uses are listed below.

Table RD-EL-D3 7-1 Nominal Pit Size

Pit Size	Nominal Pit Use[1]					
	Power Distribution	Road Lighting	Traffic Signal		ITS	
	Electrical	Electrical	Electrical	Communication	Electrical	Communication
P1	Not Used by DPTI					
P2	Earth stake pit; Isolation pit: Termination pit beneath Type A Switchboard	Slip base and energy-absorbing pole base pits; Direct connects	Not Used	Vehicle detector "end of run" termination pit up to 4 loops	Not used	Vehicle detector "end of run" termination pit up to 4 loops
P3	Not Used by DPTI					
P4	Termination pit beneath large switchboard	Draw-in pits; Road crossings pits; Combination Traffic Signals and Road Lighting pole base pits; Mast Arm pole base pits	Combination Traffic Signals and Road Lighting pole base pits; Termination pit beneath Traffic signal controller	Traffic Signal communication pit; Vehicle detector "end of run" termination pit for more than 4 loops	Intermediate pull-in pits on single device routes or spur distribution (off-alignment)	Intermediate pit for loop detector screen cables; Minimum size for detector road crossing; Vehicle detector "end of run" termination pit for more than 4 loops; "Local" Device cables distribution (e.g. ITS field Cabinet to camera or sign or similar); Draw-in pits for backbone network provided that minimum bending radius is not compromised during hauling.
P5	Not Used by DPTI					
P6	"Local" Submains and final sub-circuit distribution	Not Used	Not Used	Not Used	"Local" Submains and final sub-circuit distribution	Note[1]
P7	Submains and final sub-circuit distribution	Not Used	Not Used	Not Used	Any CST requirements.	Any CST requirements. Backbone network;

Pit Size	Nominal Pit Use(1)					
	Power Distribution	Road Lighting	Traffic Signal		ITS	
	Electrical	Electrical	Electrical	Communication	Electrical	Communication
S	Not Used	Not Used	Not Used	Draw-in pits; Road crossing pits	Not Used	Building entry pit into the CER
D	Not Used	Not Used	Not Used	Traffic signal backbone (typically at corners and in front of controller)	Not Used	Note(1)

(1) Notwithstanding the above, should the number of conduits or the number or size of cables preclude the use of these pit sizes, a larger pit shall be used.
(2) Total number of conduit penetrations shall not exceed 4 conduits for P4 Pit.

Pit Location

7.12 Pits shall not be located in positions where it is likely that they will be driven over unless design constraints render this unachievable.

7.13 Pits and pit lids located in any area which may be subject to being driven over, e.g. carriageways, verges, hard shoulders or service bays / maintenance areas, shall be designed to meet the appropriate load classification as described in AS 3996-2006 Table 3.1.

7.14 The pit locations shall wherever possible:

a) be installed at all junctions and sharp changes in direction of conduits;

b) be positioned longitudinally with the 'line' of the roadway / street with sides parallel to the property boundary, footpath or kerb;

c) be installed at the splice point between transverse and longitudinal connections of conduit;

d) be located not less than 1 m from the kerb and not less than 3 m back from the intersection of property lines at street corners or from their projection at truncated corners;

e) not be located at vehicle crossovers or at places where congestion of services and future maintenance activities by other service agencies could affect the security of the Principal's plant / assets;

f) not be installed in flat painted islands or medians;

g) not be located within restricted zones of LV electricity distribution pedestals, pads, domes, Stobie poles or service pits;

h) be a distance of 3 m from driveways and property entries shall be kept as an exclusion zone. No pit shall be in the exclusion zone;

i) not be located in pedestrian ramps;

j) not be located in bicycle paths unless absolutely necessary, and if so, the pit lid is to be provided with a suitable permanent non slip treatment;

k) not be located within rail corridors, unless specified otherwise; and

l) be an earth stake pit in accordance with Clause 7.16.

7.15 Maximum pit spacing shall be as follows:

a) 80 mm conduit 70 m spacing

b) 100 mm conduit 100 m spacing

c) Conduit for fibre optic cable 200 m spacing with the installation of intermediate cable position markers

Earth Stake

7.16 Where a Stobie Pole switchboard is used it will require an earth stake pit to be placed greater than 3.5 m but within 5 m from SA Power Networks LV or HV earthing system or pole.

Drawing Presentation

7.17 For road lighting conduit design, refer to RD-EL-D1 “Road Lighting Design” and DP013 for drawing presentation.

7.18 For traffic signal conduit design, refer to DP012 for drawing presentation.

7.19 For ITS conduit design, refer to DP018 for drawing presentation.

8 Network Identification

8.1 Pits and conduits shall be clearly labelled on the drawings to show the following, as per standard drawings and the DPTI Drawing Legend:

a) Pit use and size (e.g. L3 = Lighting pit, size P3, IT4 = ITS pit, size P4);

b) Non-secure (no label), secure, or lockable (as per labels on Legend); and

c) Lid type (e.g. concrete, metal, composite).

8.2 Conduits shall be labelled as per Table RD-EL-D3 8-1.

Table RD-EL-D3 8-1 Conduit Label

Conduit Allocation	Label
Traffic Signals Power	TS
Road Lighting Power	RL
Intelligent Transport Systems Power	ITS
Intelligent Transport Systems Communication	COMMS
Telecommunications Service	T
Electrical Service	ES

8.3 Conduit labelling shall also include conduit number and size.

9 Records

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

Drawings

9.2 The design drawings in accordance with DPTI Design Presentation Standards, in particular “DP001 – General requirements”, “DP002 - Title and Index”, DP011 “Traffic Signals”, DP012 “Traffic Signal Conduit”, “DP013 Lighting” and DP018 “Intelligent Transport Systems (ITS)”.

9.3 Update of any existing infrastructure drawings.

9.4 “As-Constructed” drawings showing actual locations of pits and conduits at the completion of the project.

Design Report

9.5 A design report detailing the design development in accordance with DPTI Road Design Outputs. Available from: https://www.dpti.sa.gov.au/standards/roads-all.

Digital Engineering Model

9.6 Design model showing 3D representation of the designed location of pits and conduits.

9.7 “As-Constructed” model showing actual locations of pits and conduits.

9.8 For the purposes of integrating the design and construction process, the Principal requires that all pits are mapped with GPS co-ordinates, and that these co-ordinates must be supplied to the Principal in a format specified by the Principal as a part of the completion of the project.

10 Hold Points

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

Document Ref.	Hold Point	Response Time
3.2	The Principal's approval for conduit design.	10 Working Days
9	The submission of design records.	15 Working Days