

Master Specification

Part RD-EL-C3

Supply and Installation of Conduits and Pits

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Government of South Australia
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and Transport

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RD-EL-C3 Supply and Installation of Conduits and Pits

1 General

- a) This Master Specification Part sets out the requirements for the supply and installation of conduits and pits, including:
- i) the documentation requirements, as set out in section 2;
 - ii) the legislative requirements, as set out in section 3;
 - iii) the requirements for materials, as set out in section 4;
 - iv) the design requirements for conduits and pits, as set out in section 5;
 - v) the trenching, boring, and backfilling requirements, as set out in section 6;
 - vi) the requirements for the installation of electrical and communications conduits, as set out in section 7;
 - vii) the requirements for the termination of conduits in pits or at Stobie poles, as set out in section 8;
 - viii) the requirements for the installation of electrical and communications pits, as set out in section 9;
 - ix) the requirements for electrical trench caution tape and cable position marker posts, as set out in section 10;
 - x) the requirements for verification of conduit condition, as set out in section 11; and
 - xi) the Witness Point requirements as set out in section 12.
- b) The supply and installation of conduits and pits must comply with the Reference Documents, including:
- i) AS/CA S008 Requirements for customer cabling products;
 - ii) AS/CA S009 Installation requirements for customer cabling (Wiring Rules);
 - iii) AS/NZS 61386 Conduit systems for cable management;
 - iv) AS/NZS 2648.1 Underground marking tape, Part 1: Non-detectable tape;
 - v) AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules);
 - vi) AS/NZS 3500.3 Plumbing and Drainage, Part 3: Stormwater drainage;
 - vii) SAPN Drawing E1921 UD LV Service or Junction Pit, Looped, Footpath Use;
 - viii) SAPN Drawing E1922 UD Low Voltage - Service Pillar - Looped;
 - ix) SAPN Technical Standard TS085 - Trenching and Installation of Underground Conduits and Cables (up to and including 33kV);
 - x) SAPN Technical Standard - TS100 Electrical Design Standard for Underground Distribution Networks (up to and including 33kV); and
 - xi) the Department Standard Drawings, including those listed in Table RD-EL-C3 1-1.

Table RD-EL-C3 1-1 Department Standard Drawings

Department Standard Drawing No.	Sheet No.	Title
S-4021	1 to 5	Electrical cable - Fibreglass Draw In Pit (various)
S-4055	56	Road Lighting - Submersible Switchboard / Isolation Pit - Single Phase for P2 and P3 Pit
S-4055	66	Plastic Pits - Non Secured Concrete Lids & Surrounds
S-4055	67	Plastic Pits & Secure Steel Lids - Class A & Surrounds
S-4055	68	Plastic Pits & Secure Steel Lids - Class A & B Surrounds
S-4055	69	Plastic Pits & Lockable Steel Lids Class A & B Surrounds
S-4055	70	Secure & Lockable Steel Lid Components
S-4055	73	Signal Controller - UPS Distribution General Layout & Interconnection Single Line Diagram
S-4516	1	Stobie Pole Power Feed - Mechanical Protection - General Assembly

2 Documentation

2.1 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include evidence of licensing as required by section 3c)i).

2.2 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include:

- a) an update of any existing infrastructure drawings;
- b) as-constructed drawings and model showing actual locations of pits and conduits;
- c) a map of all pits with GPS coordinates in accordance with PC-EDM5 “Digital Engineering”;
- d) an electrical certificate of compliance as required by section 3c)ii);
- e) the method and location of electrical conduits protection, where required by section 7.2d);
- f) the method and location of communications conduits protection, where required by section 7.3d); and
- g) documentary and video evidence as required by section 11g).

3 Compliance with legislation

- a) The Contractor must ensure that the supply and installation of conduits and pits complies with the requirements of the:
 - i) *Plumbers, Gas Fitters and Electricians Act 1995 (SA)*; and
 - ii) *Electricity Act 1996 (SA)*.
- b) The Contractor must ensure that:
 - i) all “licensed contractor's work” as defined by the *Plumbers, Gas Fitters and Electricians Act 1995 (SA)*, is carried out by a worker who is licensed to perform such work;
 - ii) electrical work is carried out by an electrical worker who is licensed to perform electrical work; and

- iii) works incorporating conduits for communications cabling comply with AS/CA S009 Installation requirements for customer cabling (Wiring Rules).
- c) The Contractor must provide:
- i) evidence of the licence:
 - A. of the worker required in section 3b)i); and
 - B. of the electrical worker required in section 3b)ii),to the Principal as part of the Construction Documentation, prior to the commencement of any electrical works by the Contractor; and
 - ii) an electrical certificate of compliance, signed by an electrical worker authorised to carry out such electrical work, certifying that the installation of the conduit and pits comply with the *Electricity Act 1996* (SA), as part of the Quality Management Records.

4 Materials

4.1 Pits

- a) The Contractor must ensure that all pits comply with the following:
- i) pits must be made of materials that are capable of being buried in soil without adverse effects (e.g. plastic or polycarbonate materials);
 - ii) all plastic materials used in the pit construction must be UV stabilised;
 - iii) pits and covers must provide sufficient strength to support a wheel loading of at least 2670 kg without any visible damage, including to the underside of the cover; and
 - iv) pits must be made to the approximate dimensions shown on Department Standard Drawings S-4055, sheets 56, 66 and 70.
- b) The Contractor must ensure that:
- i) the pits and conduits are inspected for defects or damage prior to installation; and
 - ii) the details of the inspection required by section 4.1b)i) must be included in an Inspection and Test Plan (ITP).

4.2 Pit lids

- a) The Contractor must ensure that all pit lids used for electrical and communications pits comply with the following requirements:
- i) the pit lids must be made of:
 - A. reinforced concrete; or
 - B. keyed steel,such that it is not possible to remove the pit lids without the use of purpose-designed tools;
 - ii) the pit lids must have appropriately positioned lifting holes;
 - iii) the pit lids must be designed to facilitate the easy removal and replacement of the pit lids with the aid of purpose-design tools;
 - iv) the pit lids must be provided as either:
 - A. unsecured;
 - B. secured; or
 - C. lockable,

- in accordance with the requirements of RD-EL-D3 “Conduit Design for Road Lighting, Traffic Signals and ITS” and the IFC Design Documentation;
- v) all pit lids that are designated in RD-EL-D3 “Conduit Design for Road Lighting, Traffic Signals and ITS” as being:
 - A. unsecured;
 - B. secured; or
 - C. lockable,must be fabricated in accordance with Department Standard Drawing S-4055, sheets 66, 67, 68, 69 and 70;
 - vi) the pit lids must incorporate a permanent non-slip pattern on the top of the pit lid, created by:
 - A. casting;
 - B. engraving; or
 - C. moulding; and
 - vii) all pit lids must be designed to:
 - A. allow ground water to escape without removing the pit lid;
 - B. prevent the entry of soil or any other objects into the pit; and
 - C. fit flush with the pit and the pit surround when a gasket is installed pursuant to section 9.1j).
- b) The Contractor must ensure that all pit lids used for electrical and communications pits are marked with the State logo (i.e. the Piping Shrike State badge) and the following:
- i) “electrical”, where the relevant pit houses electrical power or control cabling; or
 - ii) “communications”, where the relevant pit houses communications cabling.
- c) The Contractor must ensure that:
- i) the pit lid markings for electrical and communications pits are marked permanently on the top of the pit lid:
 - A. by means of:
 - I. casting;
 - II. engraving;
 - III. etching; or
 - IV. moulding; and
 - B. in a clearly legible size and font; and
 - ii) the method of marking adopted for permanently marking the pit lid as required by section 4.2c)i) must be such as to:
 - A. remain legible;
 - B. resist damage from abrasion; and
 - C. resist damage from UV,for the Design Life of the pit lid.

4.3 Conduit

The Contractor must ensure that all electrical and communications conduits comply with the following requirements:

- a) electrical conduits must be:
 - i) heavy duty rigid PVC conduit in accordance with the requirements of AS 2053 Conduits and fittings for electrical installations;
 - ii) coloured orange for underground cable; and
 - iii) UV stabilised for above ground cable;
- b) communications conduits must:
 - i) be coloured white; and
 - ii) comply with the requirements of AS/CA S008 Requirements for customer cabling products and AS/CA S009 Installation requirements for customer cabling (Wiring Rules);
- c) flexible conduits must not be used except for specific applications as detailed in RD-EL-D3 “Conduit Design for Road Lighting, Traffic Signals and ITS”; and
- d) the diameter of conduits must comply with the requirements of:
 - i) RD-EL-D3 “Conduit Design for Road Lighting, Traffic Signals and ITS”; and
 - ii) for consumer mains conduit, the requirements of SAPN.

4.4 Marking tape

The Contractor must ensure that marking tape used for electrical and communications conduits complies with the requirements of AS/NZS 2648.1 Underground marking tape, Part 1: Non-detectable tape.

4.5 Concrete conduit protection

The Contractor must ensure that all concrete implemented for electrical and communications conduit protection is:

- a) a minimum grade N20; and
- b) in accordance with AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules).

5 Design of conduits and pits

- a) If any details relating to the location and size of conduits and pits have not been provided by the Principal as part of the Contract Documents, the Contractor must prepare a conduit system design for electrical and communications purposes in accordance with RD-EL-D3 “Conduit Design for Road Lighting, Traffic Signals and ITS”.
- b) The Contractor must prepare and submit the conduit system design, including complete details of the location and size of conduits and pits, as part of the Design Documentation required by RD-EL-D3 “Conduit Design for Road Lighting, Traffic Signals and ITS”.

6 Trenching, boring, and backfill

The Contractor must ensure that trenching, boring, and backfill for electrical and communications conduits and pits comply with the following:

- a) the excavation and backfill of trenches must comply with the requirements of RD-EW-C2 “Trench Excavation and Backfill”;

- b) under-road boring must comply with the requirements of RD-EW-C3 “Boring”;
- c) the reinstatement of any existing pavements to be retained must comply with the requirements of RD-PV-C6 “Reinstatement of Existing Pavements”; and
- d) all Works associated with the installation or removal of each conduit and pit must be completed prior to the construction of any new road pavement, verge, or footpath finish above the relevant conduit or pit.

7 Installation of electrical and communications conduit

7.1 General

The Contractor must ensure that the installation of electrical and communications conduits complies with the following:

- a) conduits must be laid out:
 - i) in straight lines;
 - ii) avoiding unnecessary bends; and
 - iii) generally parallel or normal to the carriageway;
- b) conduits must not be placed in the trench until 100 mm of Sa C type C sand has been placed on the trench floor;
- c) variations in levels or changes in direction of underground ducts must be achieved by using the natural flexibility of the conduits;
- d) where the requirements of section 7.1c) cannot be achieved, the Contractor may use pre-manufactured “sweeper”, large-radius, bends matching the conduit size and type;
- e) flexible conduit must not be used for underground conduit connections except for specific applications as detailed in RD-EL-D3 “Conduit Design for Road Lighting, Traffic Signals and ITS”;
- f) large sweep bends must be used to provide entry into junction pits and light pole footings;
- g) where multiple conduits enter or exit pits, conduits must be labelled according to their use (e.g. if a pit has a backbone conduit and a road crossing conduit exiting it, the road crossing conduit must be permanently marked as “Road Crossing” to differentiate it from a backbone conduit);
- h) with respect to conduit direction changes, the Contractor must ensure that:
 - i) no more than 90° of total bends (cumulative in all directions) occur between pits, excluding:
 - A. conduit curvature required by section 7.1h)iii); and
 - B. for a conduit road crossing, the conduit may include a 90° bend at each pit to enable the conduit to exit and enter the short sides of each pit;
 - ii) if the requirements of section 7.1h)i) cannot be achieved, the Contractor must install additional pits to facilitate the direction changes; and
 - iii) direction changes are accomplished by curving the conduit in the ground to a curvature radius of no less than 130 times the conduit diameter;
- i) before being cemented together, where the conduit has been cut to length, conduit joints must be thoroughly cleaned and burrs removed;
- j) conduits must be cemented together using a solvent cement and method approved by the conduit manufacturer;
- k) draw cords must be installed in all electrical and communications conduits and must comply with the following:

- i) the draw cords must be continuous and without joins for the full length of the conduit;
- ii) the draw cords must be provided with a tail of at least 3 m at each end of the draw cord;
- iii) the draw cord tails required by section 7.1k)ii) must be:
 - A. coiled;
 - B. secured; and
 - C. neatly laid,in the pit at each end of the run;
- iv) the draw cords must:
 - A. be made of a minimum 4 mm diameter polyethylene mono rope; and
 - B. have a breaking load of 5 kN;
- v) draw cords must not be used to haul cables; and
- vi) a draw cord must be retained in each conduit following installation of cables;
- l) prior to the commencement of cable installation in conduits in pit sizes P4 or larger, the Contractor must ensure that:
 - i) bell mouths are fitted to the entry and exit of every conduit; and
 - ii) the bell mouths are fitted using an appropriate conduit adhesive and remain in place after installation;
- m) the separation of conduits must comply with the Design Documentation;
- n) the marking tape for all electrical conduits must be installed in accordance with the requirements of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules); and
- o) the marking tape for all communications conduits must be installed in accordance with the requirements of AS/CA S009 Installation requirements for customer cabling (Wiring Rules).

7.2 Electrical conduits cover

The Contractor must ensure that all electrical conduits are covered in compliance with the following:

- a) other than electrical conduits the subject of section 7.2c) and section 7.4, the cover for electrical conduits must be:
 - i) a minimum of 500 mm; and
 - ii) a maximum of 800 mm,below the finished level;
- b) electrical conduits must be installed at a uniform depth;
- c) where the existence of:
 - i) Utility Services;
 - ii) underground obstructions; or
 - iii) ground conditions,require the electrical conduits to be covered in less than 500 mm cover as required by section 7.2a)i), the conduits must be protected in accordance with the requirements of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules); and
- d) where protection as described in 7.2c) is required and has been installed, the method and location of protection must be included in the Quality Management Records.

7.3 Communications conduits cover

- a) The Contractor must ensure that all communications conduits located in a road reserve are located at least 450 mm below the finished level.
- b) If the minimum cover required by section 7.3a) cannot be achieved due to the existence of:
 - i) Utility Services;
 - ii) underground obstructions; or
 - iii) ground conditions,
 this will be considered a Non-Conformance and the associated Hold Point set out in PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable) will apply.
- c) The Contractor must ensure that the communications conduit is installed and covered in accordance with the requirements of AS/CA S009 Installation requirements for customer cabling (Wiring Rules).
- d) Where protection as described in 7.3b) is required and has been installed, the method and location of protection must be included in the Quality Management Records.

7.4 Conduits cover within rail boundaries

The Contractor must ensure that conduits located within rail boundaries are covered:

- a) in accordance with the requirements of Table RD-EL-C3 7-1; and
- b) for a minimum distance of 3 m on either side of the rail, measured perpendicular to the outer rail.

Table RD-EL-C3 7-1 Minimum cover below rail level

Line category	Cover below rail level (m)
Main lines	1.2
Secondary lines	1.0
All other lines except main lines and secondary lines	0.6

8 Termination of conduits in pits or at Stobie poles

8.1 General

The Contractor must ensure that the termination of electrical and communications conduits complies with the following:

- a) in relation to pits:
 - i) the hole for the entry of the conduit into the pits must be:
 - A. neatly drilled to a maximum of 10 mm larger than the outside diameter of the conduit; and
 - B. effectively sealed with a flexible sealant which is specified by the sealant manufacturer as being appropriate for the application;
 - ii) for intermediate pits, being those pits which will have cable running through them but which cable will not exit the conduit system, the entry and exit conduits must align as closely as possible;
 - iii) for electrical terminating pits, being those pits where the cable exits the conduit system and terminates inside above-ground equipment, the ends of conduits must:
 - A. enter at a 45° angle; and

- B. protrude into the electrical terminating pit for a:
 - I. minimum of 25 mm; and
 - II. maximum of 50 mm,to facilitate drawing-in of cables;
- iv) where the conduits are to be connected into an SAPN underground service pit, the hole for the entry of the conduit must be neatly drilled:
 - A. to a maximum of 10 mm larger than the outside diameter of the conduit; or
 - B. as specified by SAPN; and
- v) where bell mouths are required to be fitted to conduits as required by section 7.11), that the conduit extends into the pit a sufficient distance for the bell mouth to be correctly fitted;
- b) in relation to traffic signal post footings, the ends of conduits must terminate no more than 25 mm inside the recess of the concrete traffic signal post footing; and
- c) conduits attached to Stobie poles must be installed in accordance with Department Standard Drawing S-4516, sheet 1.

8.2 Additional requirements for consumer power connections

- a) The Contractor must ensure that consumer power connection conduits are laid in accordance with the requirements of:
 - i) SAPN Technical Standard TS085 - Trenching and Installation of Underground Conduits and Cables (up to and including 33kV); and
 - ii) SAPN Technical Standard - TS100 Electrical Design Standard for Underground Distribution Networks (up to and including 33kV).
- b) The Contractor must ensure that low voltage (LV) conduits are terminated in LV service pillars in accordance with:
 - i) the Department Standard Drawings; and
 - ii) the following SAPN documents:
 - A. SAPN Technical Standard TS085 - Trenching and Installation of Underground Conduits and Cables (up to and including 33kV);
 - B. SAPN Technical Standard - TS100 Electrical Design Standard for Underground Distribution Networks (up to and including 33kV);
 - C. SAPN Drawing E1921 UD LV Service or Junction Pit, Looped, Footpath Use; and
 - D. SAPN Drawing E1922 UD Low Voltage - Service Pillar - Looped.
- c) The Contractor must obtain a copy of all required SAPN's documents directly from SAPN utilities.

9 Installation of electrical and communications pits

9.1 General

The Contractor must ensure that all electrical and communications pits are installed in compliance with the following requirements:

- a) all electrical and communications pits, including:
 - i) cable draw-in pits;

- ii) intermediate pits; and
 - iii) junction pits,
must be installed in compliance with the requirements of RD-EL-D3 "Conduit Design for Road Lighting, Traffic Signals and ITS";
- b) all electrical and communications pits must:
- i) be of the same size (or larger if installation constraints require it) as detailed in the IFC Design Documentation;
 - ii) be of a minimum size as defined in RD-EL-D3 "Conduit Design for Road Lighting, Traffic Signals and ITS"; and
 - iii) be installed with the long dimension oriented in the direction of the main conduit run, generally parallel or normal to the carriageway;
- c) prior to backfilling, pit lids must be:
- i) fitted; and
 - ii) visually checked by the Contractor to ensure that the pit:
 - A. is parallel to the edge of the footpath, kerb, or property boundary; and
 - B. is either:
 - I. flush with the surface of the surrounding footpath; or
 - II. built-up at a maximum grade of 1:14, to conform to the fall of the footpath;
- d) all electrical and communications pits must be installed on top of a layer of 10 mm aggregate levelled base and compacted with Sa-C type C sand as detailed in Department Standard Drawing S-4055, sheet 68, in accordance with the following:
- i) the sand must be compacted following the pit manufacturer's recommended procedures and practices;
 - ii) the pit sides must be checked by the Contractor before and after compaction;
 - iii) there must not be any inward bowing of pit sides; and
 - iv) temporary bracing must be used in pits as required to prevent bowing of sides during compaction;
- e) all electrical and communications pits must be surrounded with a reinforced concrete apron of minimum 200 mm thickness and width (measured from each pit side as detailed in Department Standard Drawing S-4055, sheet 66 to 69);
- f) the supply and installation of the reinforced concrete apron required by section 9.1e) must comply with the following:
- i) the edges of the apron must be finished with an edging tool;
 - ii) where multiple pits are installed together (e.g. communications and electrical), a shared apron may be used, with:
 - A. at least 100 mm spacing being provided between pits to allow for the installation of a 100 mm of concrete apron between pits; and
 - B. reinforcing must be installed in the spacing between the pits to prevent cracking;
 - iii) to prevent the pit edges bowing in during pouring or curing of the concrete apron, a template:
 - A. constructed of timber (or other suitable material);
 - B. slightly larger in size than the pit lid; and

- C. at least 25 mm thick,
must be installed in the top of the pits (in place of the pit lid) prior to pouring the concrete apron; and
- iv) pit lids must be checked by the Contractor for proper fit both before and after pouring of the concrete apron;
- g) all electrical and communications pits must be:
 - i) set flush with the finished level of the surrounding area; and
 - ii) shaped so that water does not pond within 1 m of the pit;
- h) wherever there is a possibility that water could drain into pits:
 - i) water must be drained to low points enroute; and
 - ii) conduit plugs must be used to seal any unused conduits;
- i) all debris inside the pit must be cleaned up and cleared at:
 - i) completion of the pit;
 - ii) conduit installation;
 - iii) conduit replacement; and
 - iv) conduit upgrade;
- j) gaskets provided with pits must be fitted under pit lids; and
- k) when adding new pits over existing conduit runs:
 - i) conduits must be fully excavated to allow new pits to fit around the conduits with appropriate sealant which is specified by the sealant manufacturer as being appropriate for the application;
 - ii) conduits must be “ring-barked” with excess conduit removed, leaving a conventional conduit entry to and exit from the new pit above the pit floor;
 - iii) the Contractor must not use “scarfing” of conduits; and
 - iv) uniform cover in accordance with sections 7.1), 7.3 and 7.4 must be achieved and maintained at the end of the installation process.

9.2 Pit drainage

The Contractor must ensure that all pits have a drain hole which drains into a drainage area under the pit as required by Department Standard Drawing S-4055 Sheet 68, to ensure that water does not accumulate in the pit.

9.3 Additional requirements for communications pits

The Contractor must ensure that communications pits are installed in accordance with the underground cabling requirements of AS/CA S009 Installation requirements for customer cabling (Wiring Rules).

9.4 Isolation pit for signal controllers

The Contractor must ensure that isolation pits for signal controllers are:

- a) installed at a minimum distance of 5 m from the signal controller;
- b) installed in accordance with Department Standard Drawing S-4055, sheet 73; and
- c) not located in painted islands or medians.

10 Electrical trench caution tape and cable position marker posts

The Contractor must ensure that:

- a) with respect to electrical conduit trenches:
 - i) plastic tape marked "Electrical Cable" is laid:
 - A. along the full length of all electrical conduit trenches; and
 - B. 300 mm above the electrical conduit;
 - ii) more than one caution tape is laid in electrical conduit trenches wider than 500 mm; and
 - iii) orange cable slabs may be used as an alternative to the tape;
- b) with respect to communications conduit installations:
 - i) white marking tape marked "Communications Cable" must be installed:
 - A. along all communications conduit installations; and
 - B. at a minimum of 100 mm above the communications conduit;
 - ii) more than one caution tape must be laid in common service trenches; and
 - iii) the marking tape required by section 10b)i) must comply with the requirements of AS/NZS 2648.1 Underground marking tape, Part 1: Non-detectable tape;
- c) cable position marker posts are installed;
 - i) at changes of direction of conduits;
 - ii) with an identification plate indicating the cable type (electrical or communications);
 - iii) showing the alignment direction; and
 - iv) in any case not more than 200 m apart;
- d) buried cable warning posts are installed in accordance with the requirements of Appendix 1: Buried cable warning sign post details and installation; and
- e) all electrical cable position marker signs are installed in accordance with the requirements of Appendix 2: Buried power cable warning sign.

11 Verification of conduit and pit condition

- a) The Contractor must undertake an external and internal inspection of all conduits and pits prior to backfill to confirm that:
 - i) conduits and pits are free of any defects or rough edges;
 - ii) conduits and pits are free of any material that may result in damage to the cables when installing cables;
 - iii) conduits are installed at the appropriate depths;
 - iv) pits are installed at the correct depth to ensure that they will be flush with the finished level of the surrounding area in accordance with section 9.1g)i);
 - v) conduits and pits are supported by sand in accordance with the requirements of sections 7.1b) and 9.1d);
 - vi) conduit entry into pits complies with the requirements of section 8.1a);
 - vii) conduits are glued at each joint; and
 - viii) conduits have cleanly and squarely cut ends.

- b) The Contractor must invite the Principal to witness the condition of the conduit and pit system prior to backfill. The invitation constitutes a **Witness Point**. Backfilling must not commence until the Contractor has progressed past this Witness Point.
- c) The Contractor must undertake an internal inspection of conduits and pits after the completion of all construction work including backfilling, compaction, and installation of pit surrounds directly above the conduit, using a borescope or similar equipment.
- d) Internal inspection of conduits required by 11c) may use a two-stage pig in lieu of a borescope inspection.
- e) Internal inspection is not required for conduits installed in Tunnels that can be externally inspected after the completion of construction work and where the risk of the conduits containing debris that can damage cables is demonstrably low.
- f) The inspections required by section 11c) must confirm that:
 - i) conduits are free of any Defects or rough edges;
 - ii) conduits are free of any material that may result in damage to the cables when installing cables;
 - iii) conduits have not been compressed or distorted by the actions of backfilling and compaction; and
 - iv) pits have not been distorted by the actions of installing pit surrounds, backfilling and compaction.
- g) The Contractor must provide the Principal with documentary evidence (including video evidence where video is used) as part of the Quality Management Records that the verification of conduit condition has been completed in accordance with 11f).
- h) The process of verification of conduit condition, including provision of documentary evidence, must comply with the requirements for Site Acceptance Testing as defined in PC-CN1 "Testing and Commissioning".

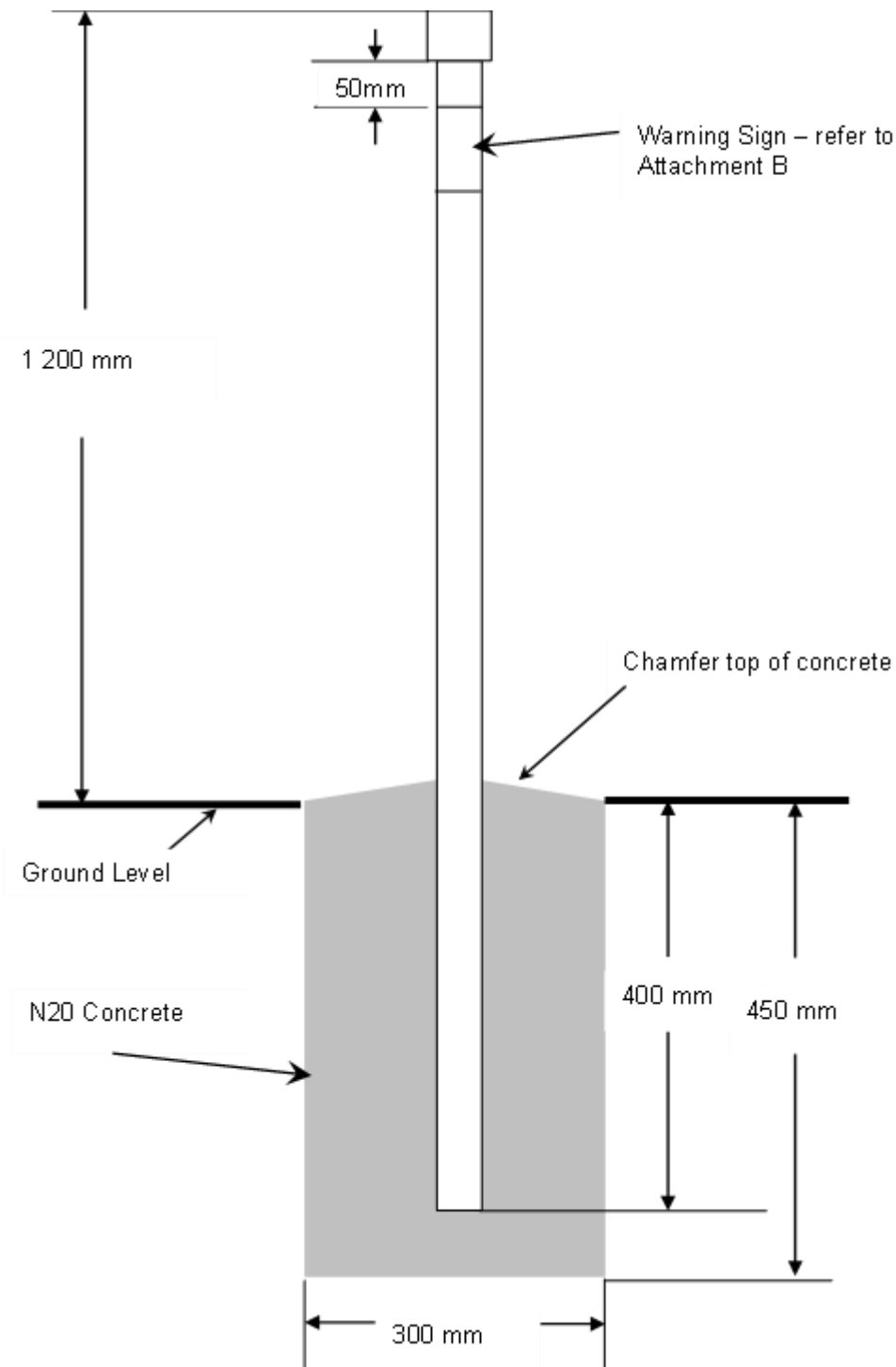
12 Witness Points

Table RD-EL-C3 12-1 details the review period or notification period, and type (documentation or construction quality) for each Witness Point referred to in this Master Specification Part.

Table RD-EL-C3 12-1 Witness Points

Section reference	Witness Point	Documentation or construction quality	Review period or notification period
11b)	Prior to backfill for conduits and pits	Construction quality	24 hours notification

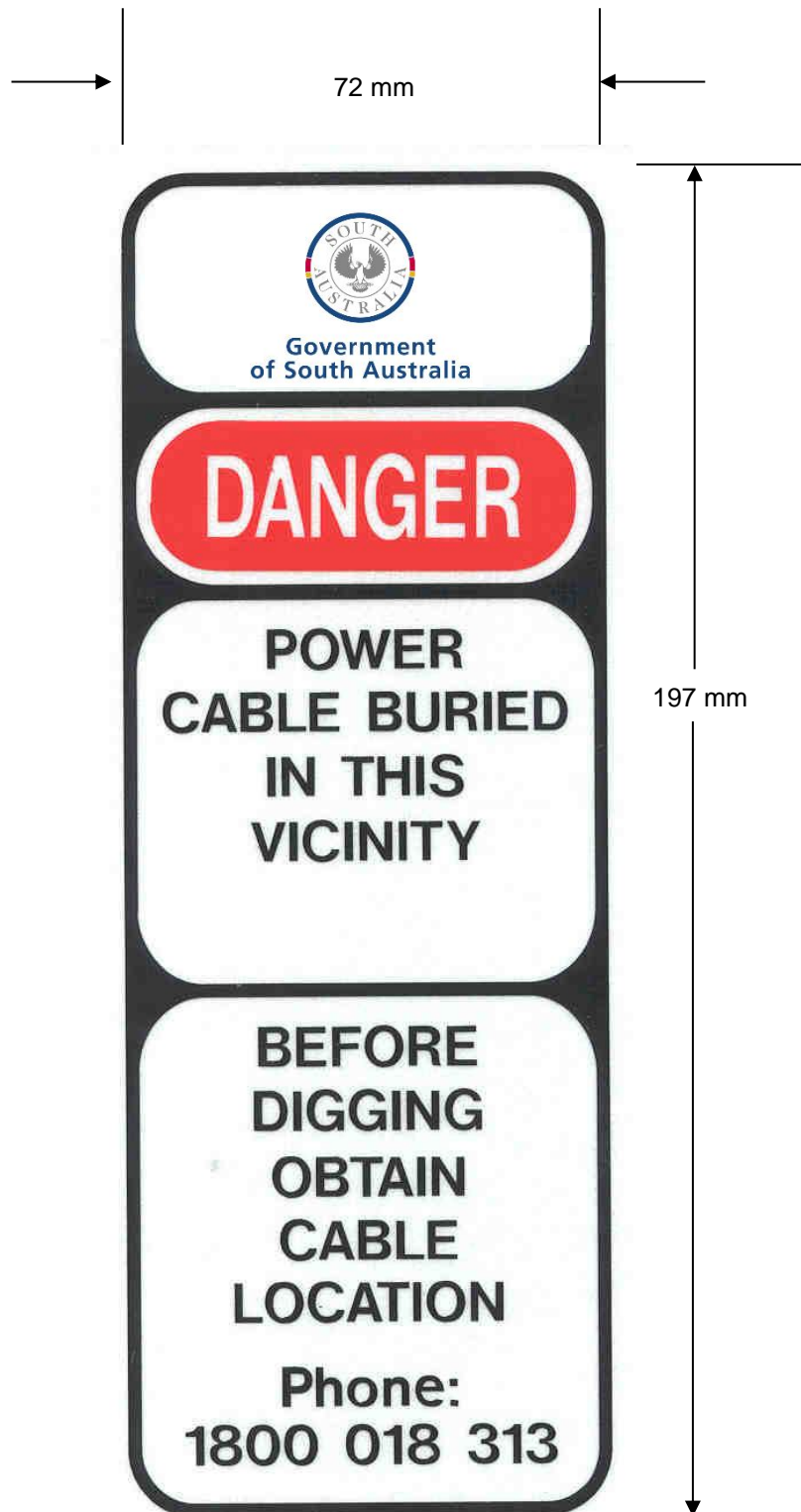
13 Appendix 1: Buried cable warning sign post details and installation



Note:

- Sketch for illustration only - not to scale.
- Capped steel post, 60 mm O/D, wall thickness 2 mm.
- "Signal Red" powder coated finish over full length of post.
- Posts to be located in accordance with the approved IFC Design Documentation.

14 Appendix 2: Buried power cable warning sign

**Note:**

- a) Background is reflective white.
- b) The word "DANGER" is surrounded by red.
- c) All other lettering and borders are in black.