Technical Note 159

Treatment of Under-depth Underground Wiring Systems (UWS) in Brownfield Installations

November 2020

Queensland Government

Copyright

Licence

CC BY licence summary statement

Translating and interpreting assistance

The Queensland Government is committed to providing accessible services to Queenslanders from all cultural and linguistic backgrounds. If you have difficulty understanding this publication and need a translator, please call the Translating and Interpreting Service (TIS National) on 13 14 50 and ask them to telephone the Queensland Department of Transport and Main Roads on 13 74 68.

Disclaimer

While every care has been taken in preparing this publication, the State of Queensland accepts no responsibility for decisions or actions taken as a result of any data, information, statement or advice, expressed or implied, contained within. To the best of our knowledge, the content was correct at the time of publishing.

Feedback

Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

1 Background

The Department of Transport and Main Roads standards specify compliance and minimum depth requirements for underground wiring systems (UWSs) to ensure durability in the installation environment or protection against inadvertent damage due to manual or mechanical excavation work. UWSs that does not meet the depth requirements are deemed 'under-depth'.

This document is intended for inspectors and project managers who have identified legacy or brownfield installation sites that do not meet the minimum UWS depth requirements and may pose an electrical safety risk to any third parties who would undertake manual or mechanical excavation work in the vicinity of those sites. It is necessary to mitigate those risks by prescribing treatments which will render those sites compliant with the expressed intent of the department's requirements.

Third parties who are unsure about the existence of an underground electrical cable should always seek advice by contacting the relevant Transport and Main Roads District for underground cable location information, before excavation. Obtaining accurate information about a work site significantly minimises the risks for injury, personal liability and death.

This Technical Note is not an exhaustive list of all safety matters that need to be considered.

In many instances, it may be cost-prohibitive to replace the entire underground wiring system to ensure compliance. A suitable alternative approach would be to identify portions or segments within an installation likely to be subjected to manual or mechanical excavation work and then apply the relevant treatment to the identified segments such that the installation becomes compliant by specific design as outlined in Clause 1.9.4 of AS /NZS 3000 *Electrical installations* (known as the *Australian / New Zealand Wiring Rules).*

2 Scope

This Technical Note applies to the treatment of under-depth or non-compliant UWSs in brownfield sites for non-compliances associated with underground conductors. Such installations should comply with the department's Standard Drawings SD1149 and SD1421 which are based on the Category A conduit type (a) (heavy duty conduit) wiring system as described in Part 2 of AS / NZS 3000. Brownfield installations with UWSs that, due to practical reasons, could not meet the department's requirements, shall meet the requirements for compliance by specific design as outlined in Clause 1.9.4 of AS / NZS 3000.

Although this Technical Note provides some recommendations based on the Queensland *Electrical Safety Code of Practice*, it is the responsibility of the District's Principal Representative to ensure compliance with the department's requirements or Part 1 of AS / NZS 3000.

This Technical Note applies to UWSs installed in the department's road network but excludes UWSs installed within the confines of a building.

This Technical Note does not apply to UWSs for greenfield sites, neither does it apply to UWS installed as part of a project and which are still under warranty. Such installations are not considered brownfield sites. Any non-compliances in such installations shall be remedied to the department's standards as per the provisions of contract.

3 Referenced documents

3.1 The Department of Transport and Main Roads Standard Drawings applicable to conduit installation

- SD 1149 – *Traffic signals / Road lighting / ITS – Installation of underground electrical and communications conduit*
- SD 1380 – *Road lighting – Slip base pole and footing installation details for no crossfall*
- SD 1381 – *Road lighting – Slip base pole and footing installation details for crossfalls up to and including 1:6*
- SD 1382 – *Road lighting pole – Slip base pole and footing installation details for crossfalls greater than 1:6 up to and including 1:3*
- SD 1392 – *Road lighting – Base plate mounted pole and footing installation details for crossfalls up to and including 1:2*
- SD 1393 – *Road lighting – Base plate mounted pole and footing installation details for crossfalls greater than 1:2*
- SD 1396 – *Traffic signals / Road lighting – Joint use traffic signal and road lighting pole and footing installation details*
- SD 1403 – *Traffic signals – Mast arm footing installation details*, and
- SD 1429 – *Road lighting – Slip base pole and footing installation details for crossfalls greater than 1:6 up to and including 1:3 using concrete step tread.*

3.2 Legislation and Standards

- AS /NZS 3000 *Electrical installations* (known as the *Australian/New Zealand Wiring Rules)*
- AS/NZS 2648.1 *Underground marking tape – Non-detectable tape*
- Queensland *Electrical Safety Code of Practice 2020 – Works – (Electrical Safety Office)*
- *Electrical Safety Act 2002 – (Electrical Safety Office)*
- Electrical Safety Regulation 2013 – *(Electrical Safety Office).*

4 Identifying sites for treatment

Any site with an under-depth electrical LV conduit poses a potential electrical safety risk to third parties who would undertake manual or mechanical excavation work at the site; however, the risk is different from site to site as it depends on the extent of under-depth as well as the likelihood of excavation works being carried at the site. It is the responsibility of the District's' Principal Representative to determine these risks for their site and select the appropriate method of treatment as prescribed in Section 5.

4.1 Selection of sites or portions to be treated

Once the entire under-depth conduits on the site have been identified, the extent of treatment should be determined. Main options include:

- treatment of entire under-depth conduit installation, or
- treatment of a segment of the under-depth conduit installation based on site risk analysis.

4.2 Risk analysis

To determine the risk for each site, the type of hazard, the likelihood of the hazardous event, and the consequence of the hazard must be carefully considered. These three items are discussed below in the context of under-depth conduits as a guide.

4.2.1 Site hazard

The obvious hazard associated with under-depth electrical UWSs is that it may result in persons excavating at the site coming into contact with live electrical wires and receiving electrical shock. This hazard will determine the level of risk associated with the treatment of a site. The Principal Representative may outline additional hazards to be considered in the risk analysis.

4.2.2 Likelihood

The likelihood of a hazard, such as, an excavator or other equipment coming into contact with live wire at the site depends on:

- the UWS site location
- the UWS depth, and
- other features of the site to be determined by the District's Principal Representative.

The UWS site location may be one that no development works are expected or it may be a busy intersection or an area with development proposals which may mean excavations for other services are likely.

The UWS depth may range from a few millimetres, meaning higher risk, to half a metre where the likelihood of the hazard is reduced. Both factors must be included in determining the likelihood. The District’s Principal Representative may consider some brownfield UWSs may not strictly comply with the department’s standards but may still comply with the broader Australian Standard, which could be a risk mitigating factor.

The likelihood shall be allocated in accordance with the Department of Transport and Main Roads *Risk Matrix* (available on request by email to Elec_Infrastructure_Approvals@tmr.qld.gov.au).

4.2.3 Consequence

An excavator or other equipment coming into contact with live wire at the site may result in injury, personal liability or even death; therefore, the consequence of such an event is always classified as severe.

4.2.4 Risk characterisation

The departmental *Risk Matrix* shall be used for the risk analysis of the aforementioned hazards. The aim should always be to introduce treatments that result in reduced risk; that is, 'medium' or 'low' from an initial default of 'Extreme' or 'High'.

5 Treatment process

5.1 Identifying the problem

This is the first step in resolving the non-compliant UWS in a given site location. Typical items to consider include:

- conduit type (heavy duty (HD), medium duty (MD) and so on)
- the depth (mm) of the conduit at the site in question
- the thickness (mm) of concrete, if any, above the conduit
- the likelihood of an excavation work being carried out at the site by other parties (see Section 4.2.2), and
- whether the UWS is under trafficable area or carriageway.

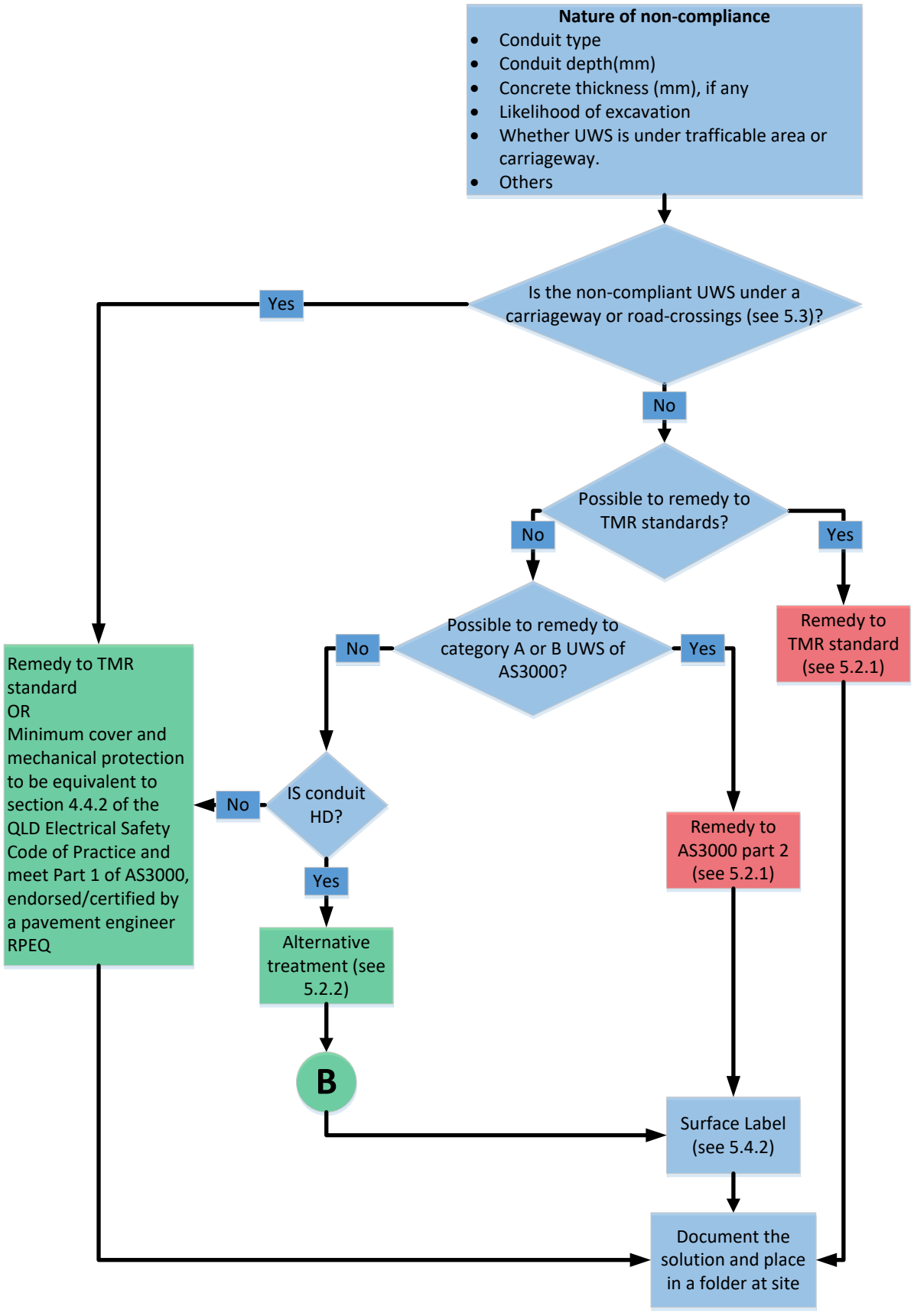
5.2 Treatment options for conduits under footways or islands

Where possible, all non-compliant UWSs under footways or islands must be made compliant to the department's Standard Drawings SD 1149 and SD 1421, followed by appropriate labelling.

The main non-compliance addressed by this document is under-depth UWS; however, the type of conduit is an important feature as it affects depth specification and is also a determining factor in achieving compliance with the department's Standard Drawings SD 1149 and SD 1421 which strictly specify Category A UWS (or HD conduits).

Where it is not possible to achieve compliance with the department's Standard Drawings SD 1149 and SD 1421, other treatment options that would mitigate the electrical risk must be considered, such as compliance with AS /NZS 3000 Part 2. For brownfield sites, remediation to UWS that meet Category A or B of AS /NZS 3000 should be considered as a viable option. The treatment options are as shown in Figure 5.2.

Figure 5.2 – Brownfield under-depth underground wiring systems treatment overall process



5.2.1 Remediation to departmental Standard Drawings or AS /NZS 3000 Part 2

For a UWS to meet to the Department of Transport and Main Roads Standard Drawings listed in Section 3.1 (particularly SD 1149 and SD 1421), it must satisfy the following:

- the conduit must be heavy duty (HD), and
- the depth of the conduit must be as described in Table 5.2.1.

If the HD conduit depth does not meet the 600 mm requirement in Table 5.2.1, but exceeds a 500 mm depth, it is deemed to comply with AS /NZS 3000 Part 2, without surface covering. For HD conduit depth exceeding 500 mm for brownfield installations, no remedial action is required.

Remediation to UWS that meet Category A or B of AS /NZS 3000 is acceptable for brownfield sites.

The Contractor shall develop a process that will transition the non-compliant UWS to a remediated UWS compliant with the department's Standard Drawings.

The remediation process must be followed by appropriate site labelling, where applicable, and also documentation of the adopted method.

Table 5.2.1 – Underground wiring system – minimum depth of cover

Covering on surface of ground above wiring system	Transport and Main Roads Standard Drawings SD 1149, SD 1421 and AS /NZS 3000 – minimum depth of cover
Poured concrete of 75 mm minimum thickness	300 mm
No surface covering or less than 75 mm thickness of concrete	600 mm (Transport and Main Roads) or 500 mm (AS 3000)

5.2.2 Alternative treatment

Where it is impossible to remedy an under-depth conduit to comply with the department's Standard Drawings or the Queensland *Electrical Safety Code of Practice*, an alternative treatment must be implemented. Section 4.4.2 of the Queensland *Electrical Safety Code of Practice* states:

> *Where physical obstructions such as other services make it impossible to achieve these depths, additional mechanical protection should be provided by means of a minimum cover of 100 mm of 20 MPa concrete or equivalent. Any additional mechanical protection should be marked with the words electric cable or similar along its length.*

The alternative process and associated details are shown in Figure 5.3(a) and Figure 5.3(b).

The remediation process must include appropriate site labelling. Details of the treatment method must also be documented and the documents kept at a suitable location on site, preferably in the electrical switchboard, traffic signal controller or Intelligent Transport System (ITS) cabinet as appropriate.

Table 5.2.2 – Treatment options for heavy duty electrical conduits under footways or islands for brownfield sites

Non-compliant depth	Description of non-compliance	Recommended treatment
500 mm < depth < 600 mm	Does not meet Transport and Main Roads standards, but meets AS /NZS 3000	Meets AS /NZS 3000 Part 2; no further action required
375 mm < depth < 500 mm	Meets neither Transport and Main Roads standards nor AS /NZS 3000	Overlay 75 mm concrete to meet Transport and Main Roads standards / AS /NZS 3000 Part 2
200 mm < depth < 375 mm	Meets neither Transport and Main Roads standards nor AS /NZS 3000	If not possible to comply with Transport and Main Roads standards or AS /NZS 3000, apply alternative remedy; see Section 5.2.2.
depth < 200 mm	Meets neither Transport and Main Roads standards nor AS /NZS 3000	If not possible to comply with Transport and Main Roads standards or AS /NZS 3000, apply minimum cover and mechanical protection to be equivalent to Section 4.4.2 of the Queensland *Electrical Safety Code of Practice* and meet Part 1 of AS /NZS 3000– refer Section 5.2.4. Design to be endorsed / certified by Electrical and Structural RPEQ engineer /s as appropriate.

5.2.3 Mechanical protection

5.2.3.1 Reinforced concrete

The concrete cover for the alternative treatment shall be N25 / 20 and of minimum thickness 125 mm, reinforced by SL 81 steel mesh.

5.2.3.2 Bedding sand and Type 2 filling

The bedding sand and Type 2 filling are as specified in Standard Drawing SD 1149.

5.2.4 Equivalent mechanical protection

Where the conduit depth is below 200 mm, a mechanical protection equivalent to the intended practice in the Queensland *Electrical Safety Code of Practice* and compliant with Part 1 of AS /NZS 3000 shall be proposed and submitted to the Principal Representative for approval.

5.3 Treatment of underground wiring systems under carriageways or road-crossing

Under-depth UWS beneath trafficable surfaces, carriageways or road crossings shall be remedied to comply with the department's Standard Drawing SD 1149. If compliance with the departmental standards is not possible, a minimum cover and mechanical protection equivalent to Section 4.4.2 of the Queensland *Electrical Safety Code of Practice* and meet Part 1 of AS /NZS 3000 shall be applied. Any applied treatment shall be endorsed / certified by a Pavement, Structural and / or Electrical RPEQ Engineer, as appropriate.

Figure 5.3(a) – Alternative treatment process (to be read in conjunction with Figure 5.2)

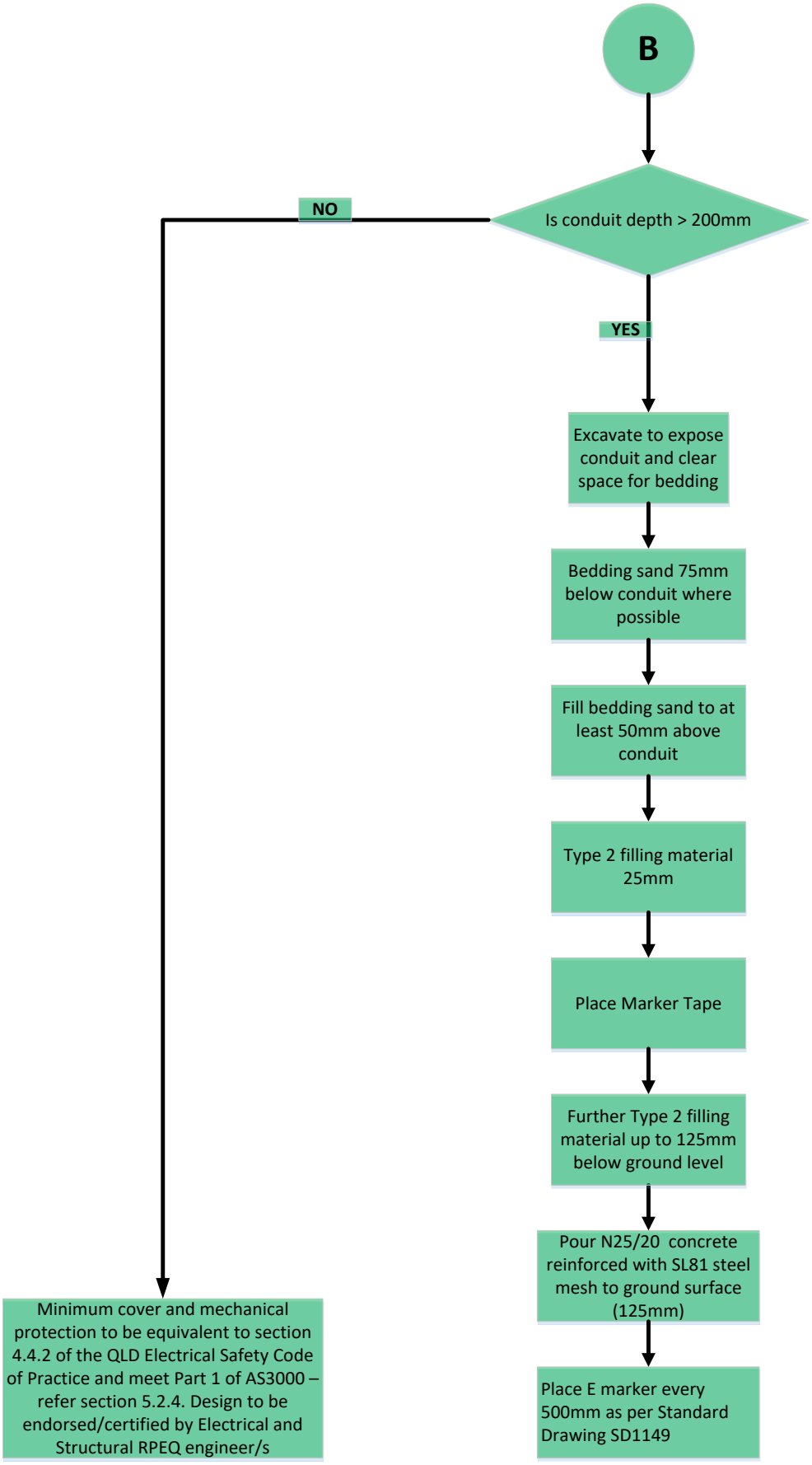
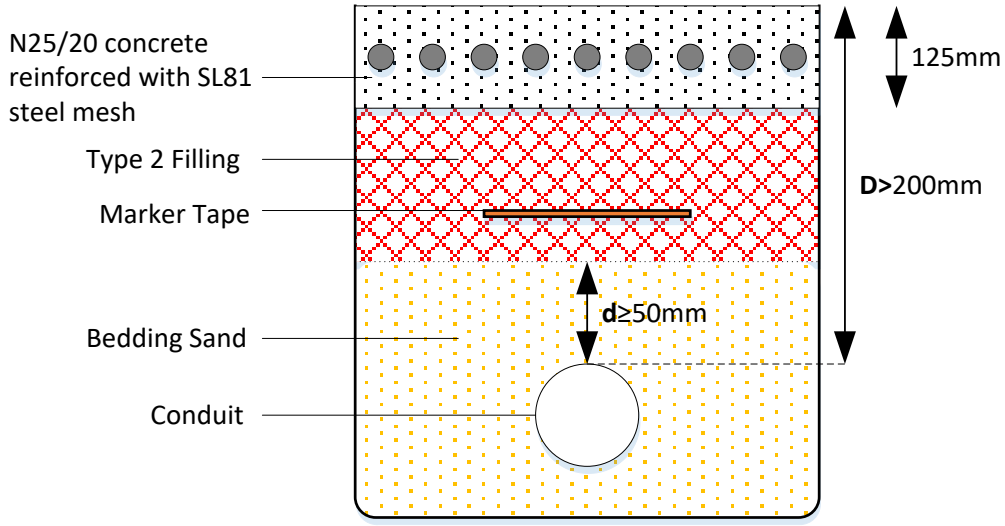


Figure 5.3(b) – Alternative treatment detail (not to scale)



5.4 Labelling

Throughout the remediation process as shown in Figure 5.2 and Figure 5.3(a), labelling has been prescribed as an additional measure to alert other parties of the existence of an electrical service. The two types of labels are underground and above-ground labels / markers.

5.4.1 Underground markers

Underground labels shall be in the form of marker tapes compliant with AS/NZS 2648.1. The marker tape shall be placed within the Type 2 filling substrate, preferably midway between the top of the conduit and the ground surface.

5.4.2 Ground surface labels

E-marker (Figure 5.4.2) labels shall be used to alert other parties of the existence of underground electrical conduits. These labels shall be placed in accordance with SD 1149. Where new concrete is applied, additional marking with the words electric cable or similar may be stamped along the length of the concrete.

Figure 5.4.2 – Brass E-markers

5.5 Documentation

Once the treatment process is completed, the Contractor shall provide detailed documentation of the solution certifying compliance with the applicable standards and guidelines. Such documentation shall

be retained by the Designer and also onsite at the electrical installation by the person with overall responsibility for the installation.

5.5.1 Compliance with the department's standard

Where remedy to the department's standards are adopted, the following shall be provided:

- the original non-compliance, and
- how compliance with the department's standards and this Technical Note have been achieved.

5.5.2 Compliance with Part 1 of AS /NZS 3000

Where an alternative treatment to the department's standard was adopted, the following shall be provided:

- a detailed description of the non-compliance in question
- the Contractor's acknowledgment as to any departure from the department's standards or Part 2 of AS /NZS 3000
- how compliance with Part 1 of AS /NZS 3000 and Section 4.4.2 of the Queensland *Electrical Safety Code of Practice* or equivalent is being achieved
- any requirements where the design requires specific installation use by the owner or operator of the electrical installation and a copy of these requirements for the owner or operator
- the verification undertaken to ensure full compliance with Part 1 of AS /NZS 3000 and the Queensland *Electrical Safety Code of Practice*, and the results of this verification, and
- certification of the design by a competent person. Clause 1.4.30 of AS /NZS 3000 defines a competent person.

6 Earth rods

The standard length for an earth rod installed in a dedicated earth pit is 1.5 m.

In some existing installations where a combined electrical and earth pit was used, the 1.5 m rod was too short to be worked on safely in a larger pit, and an earth rod of length 1.8 m was used instead. For replacement of such rod, an earth rod of length 1.8 m must be used.

If an existing earth rod is found to be damaged or corroded, it must be replaced with a 316 stainless steel equivalent.