NPC Engineering Pty. Limited

# Electrolysis Study Report

## North Eveleigh Railyard Site.
## Refurbishment

## NPC-REP-NERS-R-0001-A

# EXECUTIVE SUMMARY

A proposed seven storey residential Building D4 is to be constructed as part of the City West Development refurbishment of the existing North Eveleigh Railyard Site.

Metal components/structures adjacent to electrified railways may be subject to corrosion due to electrolysis caused by stray DC current originating from the rail network and returned to the supplying substation via the surrounding soil and metal component/structure.

This electrolysis study report provides an overview of the project and identifies and evaluates control elements required for mitigation of possible stray DC current hazards.

The separation distance between possible current source and building combined with insulation of source elements and insulated cladding of the building substructure support members meets all criteria for stray DC current mitigation.

The proposed Building D4 at the North Eveleigh Railyard Site will not be subject to damaging stray DC current originating from either the existing electrified Main Western Line and/or future rail tunnel associated with Redfern Station.

## TABLE OF CONTENTS

# North Eveleigh Railyard Site Refurbishment

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Prepared for

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Prepared by

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16 March 2013

# 1 INTRODUCTION

Enstruct Pty Ltd. are responsible for the structural design of a proposed seven storey residential Building D4 to be constructed as part of the City West Development refurbishment of the existing North Eveleigh Railyard Site.

Refer to Sketch No.1 for further details.

Metal components/structures adjacent to electrified railways may be subject to corrosion due to electrolysis caused by stray DC current originating from the rail network and returned to the supplying substation via the surrounding soil and metal component/structure.

# 2 SCOPE

The scope of this report is to evaluate the possibility of the steel within the building foundations being subjected to electrolysis damage caused by proximity to sources of stray DC current originating from either the existing or proposed future RailCorp 1500V DC electrified networks.

# 3 LOCATION

The proposed Building D4 comprising seven floors and one basement level is to be located adjacent to the existing North Eveleigh Carriage Workshop parallel to the Main South Lines at a nominal distance of 74m from the rail boundary between Chainage 1970m to 2050m.

The existing carriage workshop and building on the Wilson Street side will remain whereas buildings between D4 and the Main Western Line will be (or have been) demolished.

A future electrified heavy rail tunnel and dive is to extend from underground platforms at Redfern Station to beyond the proposed building site in a line below the Up Side surface corridor boundary at an approximate separation distance of 60m from the Building D4 alignment.

Refer to Sketch No.2 for further details.

Existing rail tracks on the northern and eastern sides once associated with the operational life of the adjacent but now obsolete carriage workshop are to remain to retain heritage value.

# 4 REVIEW METHODOLOGY

## 4.1 Introduction

Potential hazardous environments can arise as different electrical and utility systems share common areas within, or adjacent to the rail corridor. Effective earthing, bonding and isolation methods are essential for mitigation of possible inherent electrolysis hazards associated with stray DC current originating from the 1500V DC network and transferred to adjacent infrastructure.

The earthing, bonding and isolation design must be in accordance with relevant standards applicable to each electrical system to mitigate possible stray DC current hazards.

## 4.2 Hazard Evaluation

The strategy for evaluating satisfactory mitigation of possible stray DC current hazards arising from electrified rail networks into adjacent infrastructure involves an assessment of the following key elements:

- The electrified rail network design ensures a high level of insulation of both rail and OHW from earth for all rail overhead wiring (OHW) and track support systems.
- The electrified rail network design ensures physical separation between rail and overhead wiring structures (OHWS) from other mechanical structures.
- The electrified rail network design ensures periodic physical separation of continuous metallic structures (such as cable trays, reinforcement and pipes).
- There is adequate separation between adjacent infrastructure (current recipient) and possible current source (OHWS and rail).
- Minimisation of the parallel length of the adjacent infrastructure to the possible stray DC current source.
- The adjacent infrastructure substructure steel/concrete design utilises adequate cover of water-proof high strength concrete and/or water membranes.

Refer to RailCorp Standard EP 12 30 00 01 SP for guidelines on stray DC current mitigation.

# 5 STANDARDS, CODES AND GUIDELINES

The following RailCorp standard is used as reference in this report:

- RailCorp EP 12 30 00 01 SP – Electrolysis from Stray DC Current

# 6 HAZARD EVALUATION

## 6.1 Hazard Source

Locations of possible sources of stray DC current include:

- The existing RailCorp electrified Main Southern Line rail network located approximately 74m South of the proposed structure.
- A possible future underground electrified heavy rail system located approximately 60m South of the proposed structure.

Refer to Sketch No.2 in Appendix A for further details.

## 6.2 Existing Electrified Rail network

The insulation/isolation elements of the existing electrified rail network must be in accordance with current relevant construction and maintenance RailCorp standards.

## 6.3 Electrified Tunnels

Structure within electrified rail tunnels may be subjected to possible hazards associated with stray DC current. Mitigating controls may include:

- Tunnel lining formed by precast high resistivity concrete segments with isolation between segments.
- Rails supported on noise abating insulated mountings.
- OHW fittings incorporating secondary insulation.
- Metallic services isolated at lengths of 250m maximum.

Isolation/insulation of tunnel components results in elimination of stray DC current hazards within the tunnel boundaries.

Refer to a tunnel typical cross section sketch in Appendix A for further details.

## 6.4 Building Length

The proposed building substructure parallel length is approximately 80m separated by 74m from the existing RailCorp electrified rail corridor boundary and 60m to the proposed underground electrified rail tunnel. The proposed basement will be excavated to a depth of 2.3m to 2.8m below existing ground level.

Refer to Sketch No.2 in Appendix A for further details.

## 6.5 Heritage Value Rails

The existing but not electrified rail tracks located on the Wilson Street side of Building D4 and extending to the main line tracks on the eastern side of the carriage workshop plus the rails in the traversing roadway on the western side of the carriage workshop will be retained for heritage value.

It is assumed for this report isolation of the heritage rails will be determined and corrected if required. Refer to Section 9 for further details.

## 6.6 Building Substructure

The basement walls of Building D4 supporting substructure are formed by a combination of:

- Concrete soldier piles with steel mesh infill, and
- Concrete columns with concrete block wall infill.

### 6.6.1 Soldier Piles

The eastern basement retaining wall is formed by cast in situ supporting soldier piles spaced at intervals of 2.4m and interconnected by an above ground header beam.

Steel mesh infill is attached to respective piles by dowels inserted in situ. The mesh assembly is coated with sprayed concrete.

The piles have a 75mm water proofing cover of 40MPa concrete and the steel mesh have a 40mm water proofing cover of 40MPa concrete.

Refer to Sketch ST-SK-004 in Appendix A for further details.

### 6.6.2 Ground Anchors

Soldier piles will be supported by temporary ground anchors during excavation whereas permanent vertical ground anchors will be provided beneath the building lateral system to prevent overturning under lateral load events.

Anchor corrosion protection is provided by full encapsulation of the entire anchor in a thick walled polyethylene sheath and by 40MPa grout filling the entire borehole.

Refer to both Sketch ST-SK-004 and brochure on ground anchors in Appendix A for further details.

### 6.6.3 Block Walls

The northern, southern and western basement retaining walls are formed by vertical cast in situ columns supported on cast in situ steel reinforced footings with attached concrete block work infill.

The columns have a 50mm water proofing cover of 40MPa concrete whereas the concrete block work and associated reinforcing steel are supported on steel reinforced concrete footings with a 50mm water proofing cover of 40MPa concrete.

The external faces of block walls and supporting concrete columns have a water membrane installed.

Refer to Sketch ST-SK-002 and Sketch ST-SK-004 in Appendix A for further details.

### 6.6.4 Basement Floor Slab

The basement floor slab is not electrically connected to the soldier piles, vertical columns or concrete block walls.

The above ground floor slab steel is conventionally bonded to the steel of the concrete block walls.

Refer to Sketch ST-SK-004 in Appendix A for further details.

## 6.7 Services Data

The water main, sewerage main and gas main are all located parallel to Wilson Street on the street side of Building D4 below the line of the heritage rail tracks.

Refer to the Aecom Drawing 60238089-DRG-C1407 in Appendix A for further details.

# 7 CONCLUSION

Mitigation of electrolytic corrosion hazards associated with stray DC current is based on isolation/insulation of both possible sources and recipient structures. This can be achieved by a combination of source component mounting insulation and possibly affected infrastructure insulated cladding/cover combined with physical separation to minimise transfer via the intervening soil.

Mitigation of possible stray DC current associated with Building D4 as proposed on the North Eveleigh Railyard Site is achieved by the following elements:

- Soil separation distance of Building D4 from the existing RailCorp Main Western Line is a nominal 74m.
- Soil separation distance of Building D4 from a future RailCorp underground electrified rail tunnel is a nominal 60m.
- Building D4 length is a nominal 80m.
- Water main, sewerage main and gas main are located on the Wilson Street side of Building D4.
- Existing adjacent building foundations on the southern (Main Western Line) side are removed.
- Existing Main Western Line etc. maintained in accordance with relevant RailCorp standards.
- Increased inherent isolation/insulation properties of any future underground rail electrified system.
- Use of waterproofing 40MPa concrete in the building basement cast in situ soldier piles, infill sprayed mesh, cast in situ support columns and block wall footings.
- Water membrane covers block walls and supporting columns.
- Heritage rails are isolated from the main line tracks (must be verified by others).

Based on the above criteria the proposed Building D4 at the North Eveleigh Railyard Site will not be subject to damaging stray DC current originating from either the electrified existing Main Western Line or future rail tunnel associated with Redfern Station.

# 8 RECOMMENDATIONS

The following is recommended:

1. To enable future stray current monitoring of the associated structure and/or half cell condition monitoring of the concrete internal steel install accessible test points at:
    - Both ends of any soldier pile interconnecting header beam, and
    - Both ends of any block wall section.

   Refer to the Appendix B for a sample of a test point and test point installation

2. Continue the waterproofing membrane over all block walls and associated vertical columns.

# 9 OUTSTANDING ITEMS

The following must be addressed:

1. The proposed major services including water main, sewerage main and gas main are to be located below the line of the existing rails on the northern side of Building D4. The rails are to be initially removed and re-laid after the main services are installed.

   Isolation of the total existing heritage value rails must be determined and if required isolation breaks are to be installed during the installation of services phase.

# APPENDIX A – REFERENCE DRAWINGS/SKETCHES

Sketch No. 1 - Proposed Building D4 side elevation.

Sketch No. 2 - Proposed Building D4 site layout.

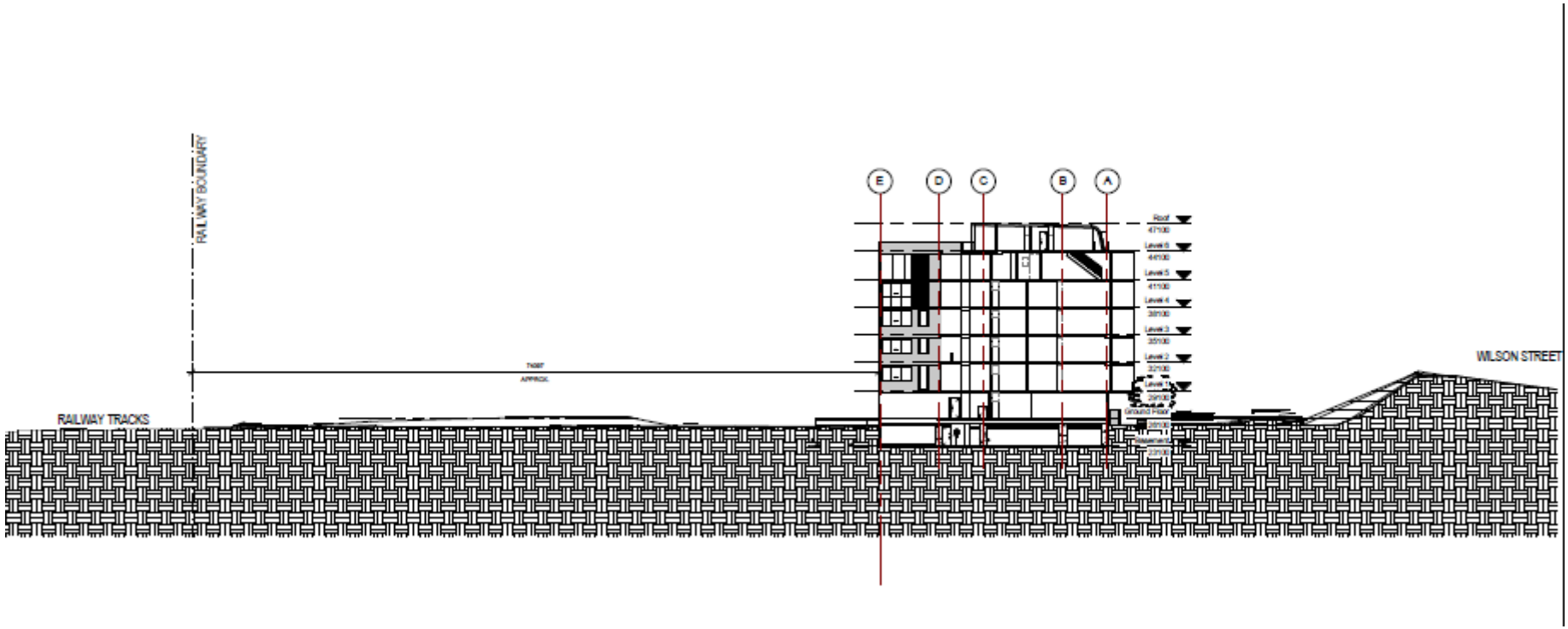
Sketch ST-SK-002 – Building D4 Basement Plan

Sketch ST-SK-004 – Building D4 Basement Plan Cross Sections.

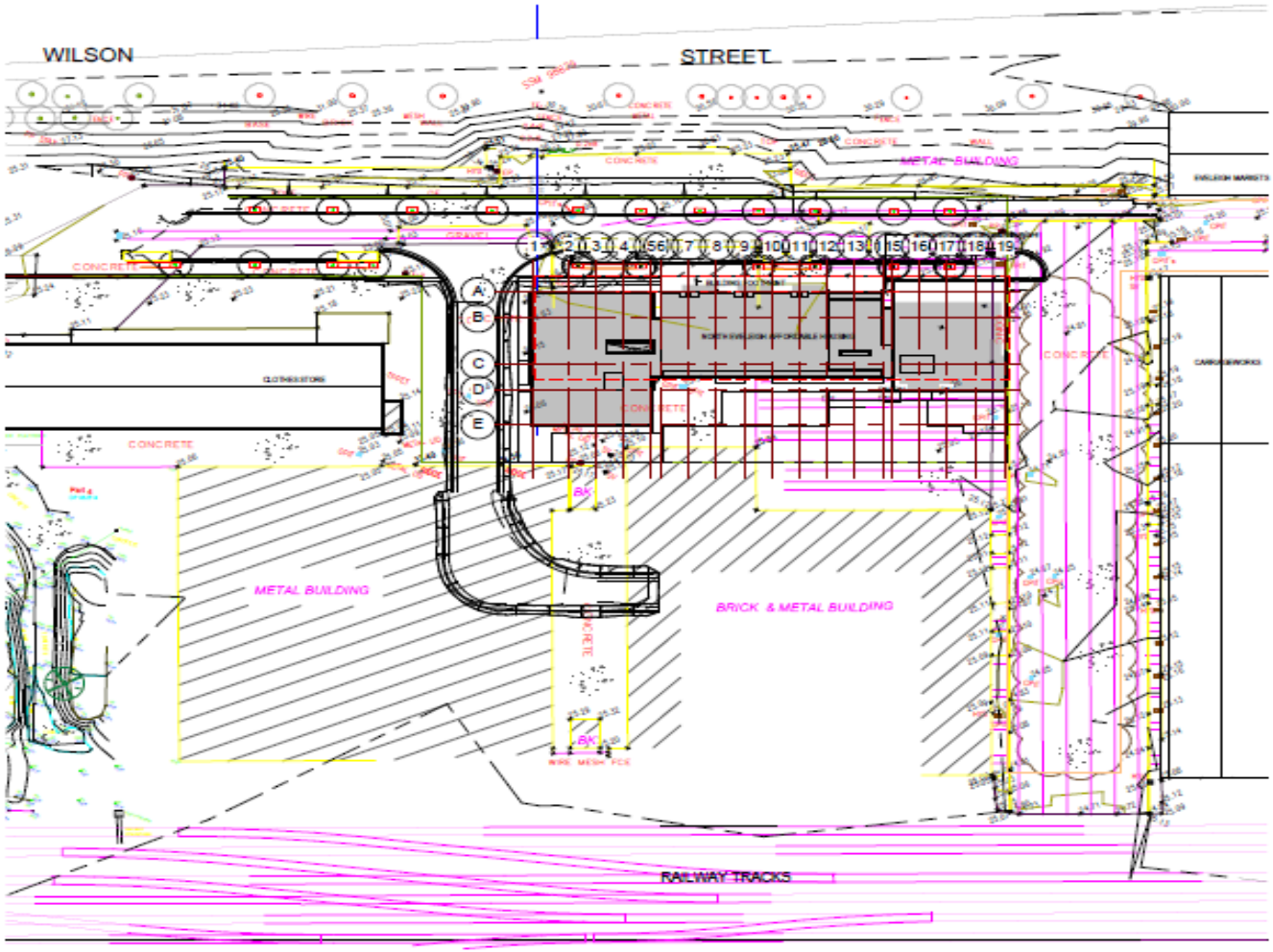
Diagram – Ground Anchors

Sketch SK121 – Typical U/G Tunnel Cross Section in line with Building D4.

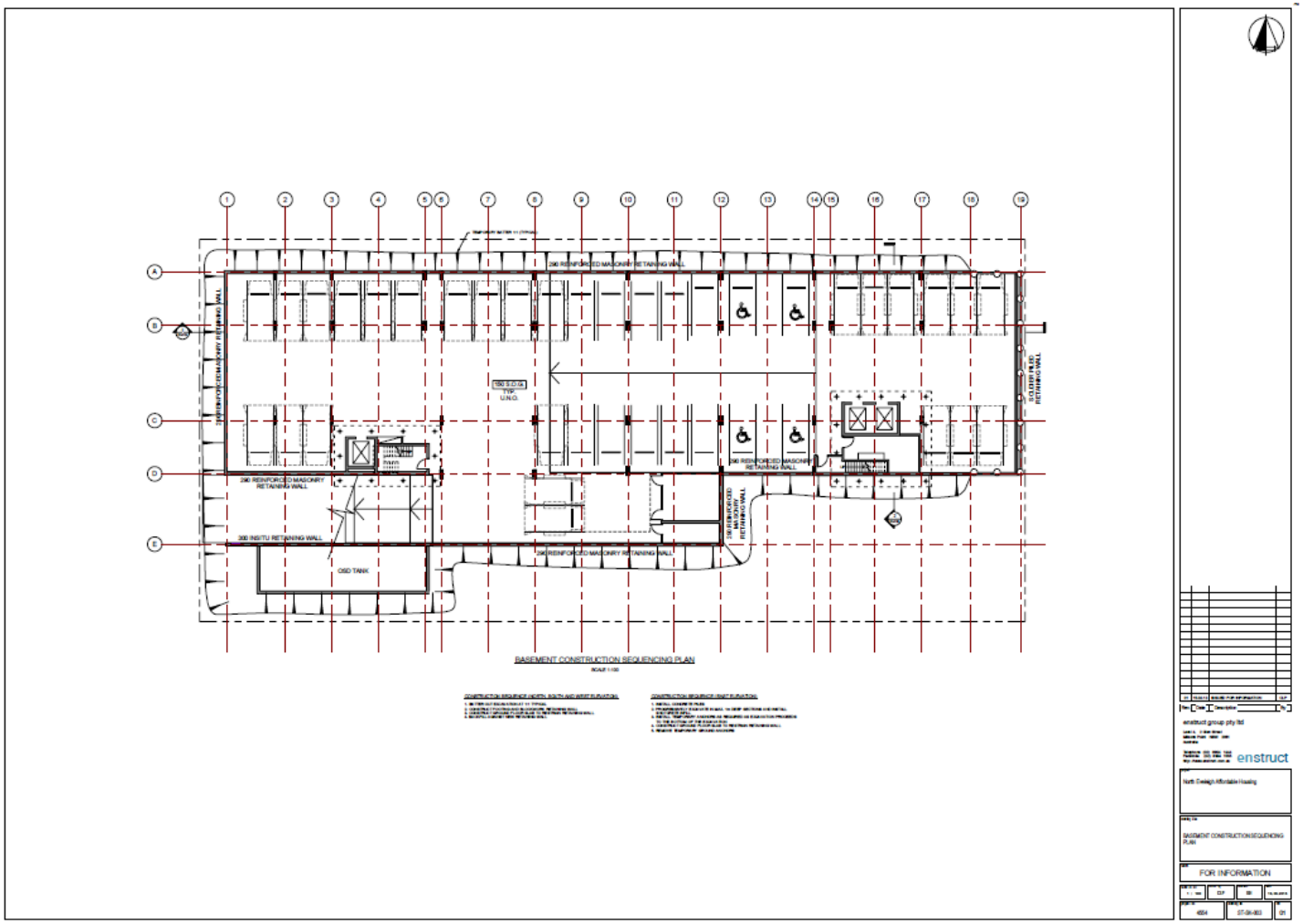
Aecom 60238089-DRG-C1402 – Combined Services Plan




SKETCH No.1

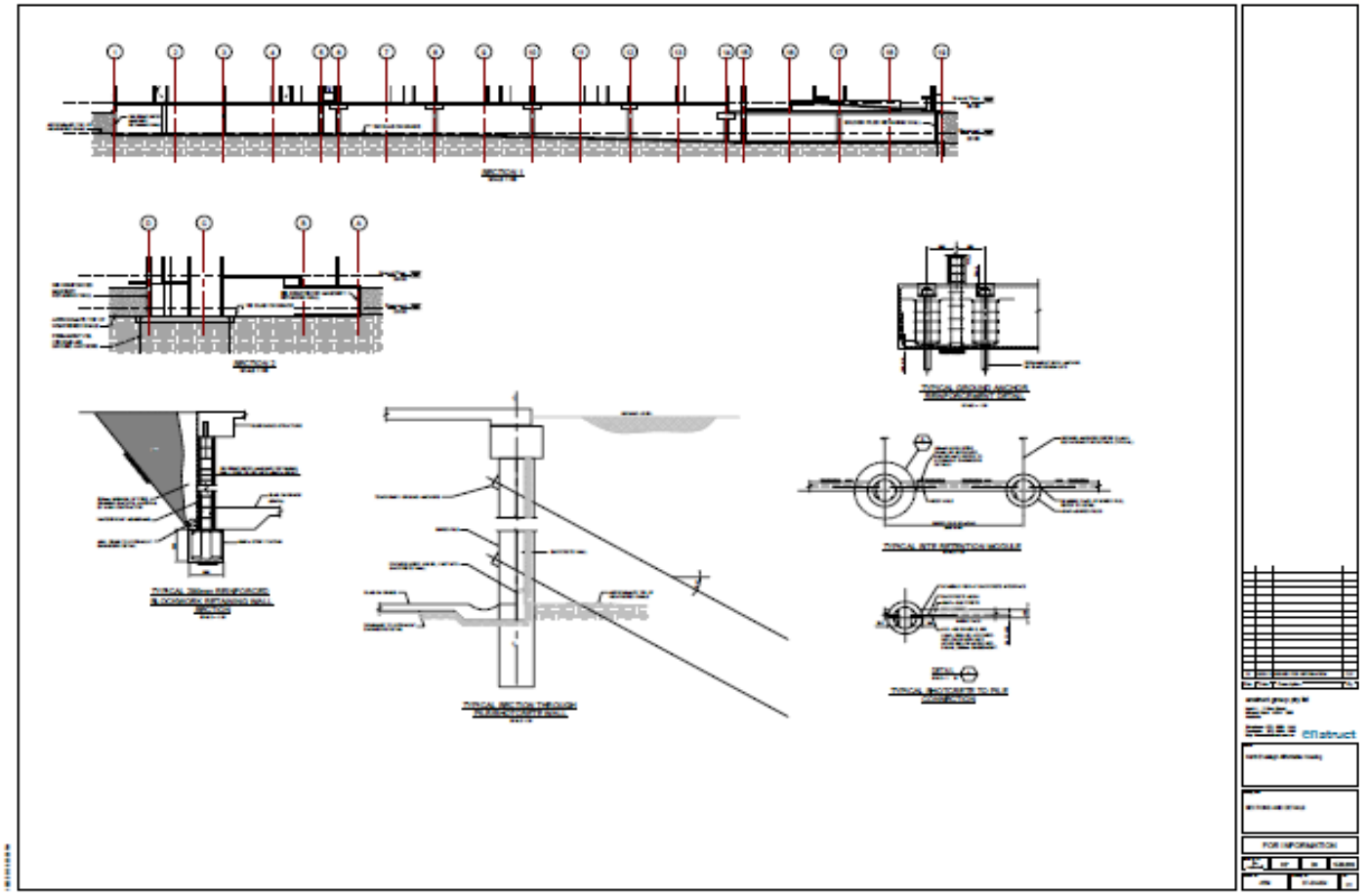

WILSON
STREET
METAL BUILDING
BRICK & METAL BUILDING
RAILWAY TRACKS
CONCRETE

SKETCH No.2

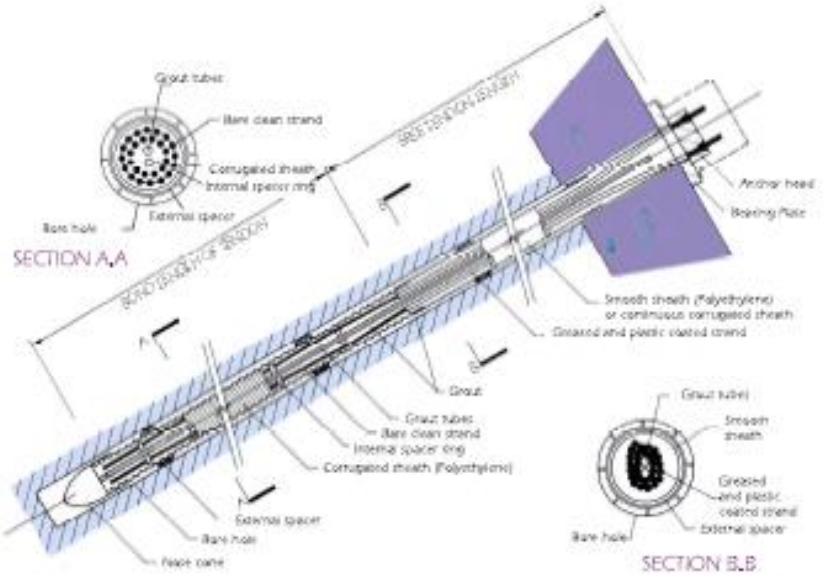



SKETCH ST-SK-002

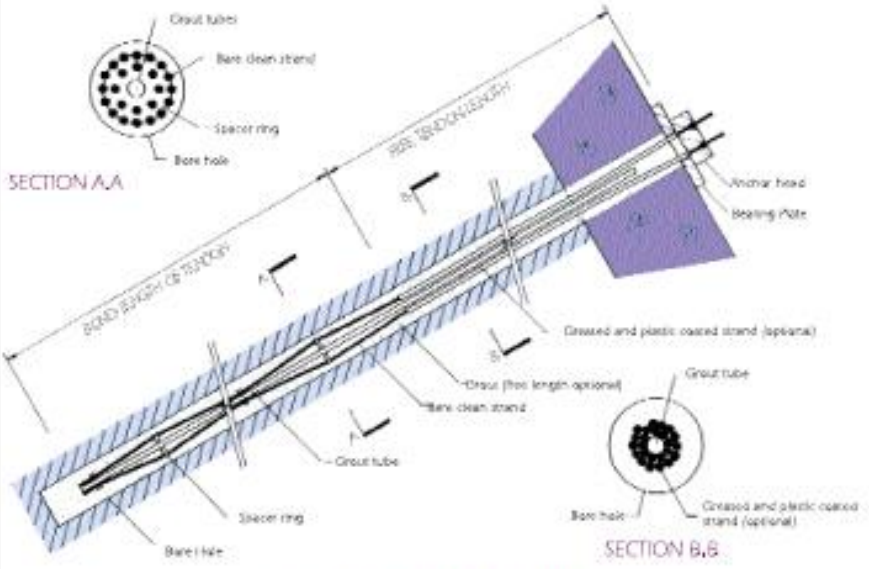
SKETCH ST-SK-004



## GROUND ANCHORS

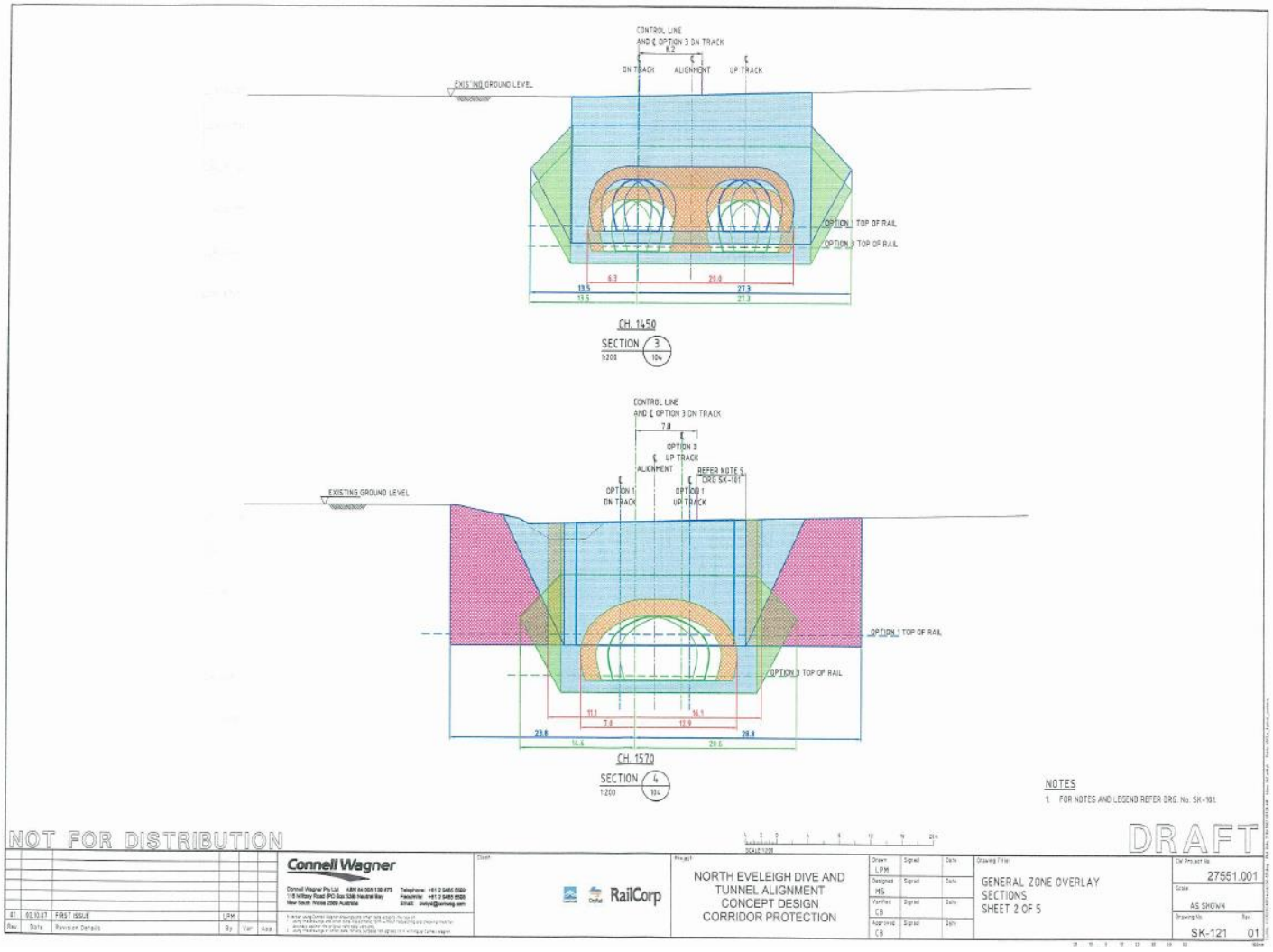



VSL PERMANENT ANCHOR FULLY ENCAPSULATED

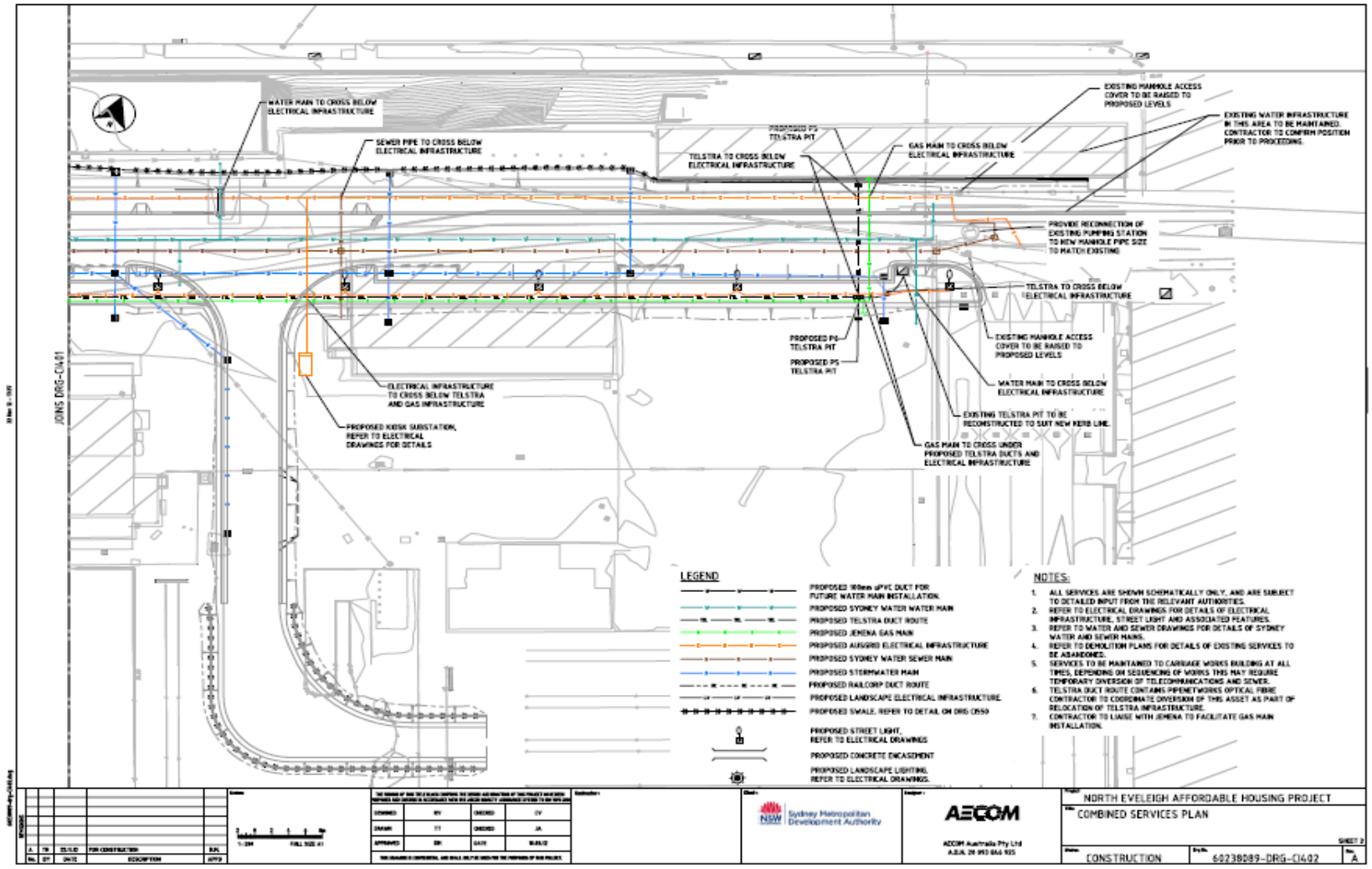



VSL TEMPORARY ANCHOR

42




SKETCH SK121


WATER MAIN TO CROSS BELOW ELECTRICAL INFRASTRUCTURE
SEWER PIPE TO CROSS BELOW ELECTRICAL INFRASTRUCTURE
PROPOSED PS TELSTRA PIT
TELSTRA TO CROSS BELOW ELECTRICAL INFRASTRUCTURE
GAS MAIN TO CROSS BELOW ELECTRICAL INFRASTRUCTURE
EXISTING MANHOLE ACCESS COVER TO BE RAISED TO PROPOSED LEVELS
EXISTING WATER INFRASTRUCTURE IN THIS AREA TO BE MAINTAINED. CONTRACTOR TO CONFIRM POSITION PRIOR TO PROCEEDING.
PROVIDE RECONNECTION OF EXISTING PUMPING STATION TO NEW MANHOLE PIPE SIZE TO MATCH EXISTING
TELSTRA TO CROSS BELOW ELECTRICAL INFRASTRUCTURE
EXISTING MANHOLE ACCESS COVER TO BE RAISED TO PROPOSED LEVELS
PROPOSED PS TELSTRA PIT
PROPOSED PS TELSTRA PIT
WATER MAIN TO CROSS BELOW ELECTRICAL INFRASTRUCTURE
ELECTRICAL INFRASTRUCTURE TO CROSS BELOW TELSTRA AND GAS INFRASTRUCTURE
EXISTING TELSTRA PIT TO BE RECONSTRUCTED TO SUIT NEW KERB LINE.
PROPOSED KIOSK SUBSTATION, REFER TO ELECTRICAL DRAWINGS FOR DETAILS
GAS MAIN TO CROSS UNDER PROPOSED TELSTRA DUCTS AND ELECTRICAL INFRASTRUCTURE
LEGEND
PROPOSED 160mm uPVC DUCT FOR FUTURE WATER MAIN INSTALLATION
PROPOSED SYDNEY WATER WATER MAIN
PROPOSED TELSTRA DUCT ROUTE
PROPOSED JEMENA GAS MAIN
PROPOSED AUSGRID ELECTRICAL INFRASTRUCTURE
PROPOSED SYDNEY WATER SEWER MAIN
PROPOSED STORMWATER MAIN
PROPOSED RAILCORP DUCT ROUTE
PROPOSED LANDSCAPE ELECTRICAL INFRASTRUCTURE
PROPOSED SWALE, REFER TO DETAIL ON DRG C550
PROPOSED STREET LIGHT, REFER TO ELECTRICAL DRAWINGS
PROPOSED CONCRETE ENCASEMENT
PROPOSED LANDSCAPE LIGHTING, REFER TO ELECTRICAL DRAWINGS.
NOTES:
1. ALL SERVICES ARE SHOWN SCHEMATICALLY ONLY, AND ARE SUBJECT TO DETAILED INPUT FROM THE RELEVANT AUTHORITIES.
2. REFER TO ELECTRICAL DRAWINGS FOR DETAILS OF ELECTRICAL INFRASTRUCTURE, STREET LIGHT AND ASSOCIATED FEATURES.
3. REFER TO WATER AND SEWER DRAWINGS FOR DETAILS OF SYDNEY WATER AND SEWER MAINS.
4. REFER TO DEMOLITION PLANS FOR DETAILS OF EXISTING SERVICES TO BE ABANDONED.
5. SERVICES TO BE MAINTAINED TO CARRIAGE WORKS BUILDING AT ALL TIMES, DEPENDING ON SEQUENCING OF WORKS THIS MAY REQUIRE TEMPORARY DIVERSION OF TELECOMMUNICATIONS AND SEWER.
6. TELSTRA DUCT ROUTE CONTAINS PIPENETWORKS OPTICAL FIBRE CONTRACTOR TO COORDINATE DIVERSION OF THIS ASSET AS PART OF RELOCATION OF TELSTRA INFRASTRUCTURE.
7. CONTRACTOR TO LIAISE WITH JEMENA TO FACILITATE GAS MAIN INSTALLATION.
JOINS DRG-C1401
Sydney Metropolitan Development Authority
AECOM
AECOM Australia Pty Ltd
NORTH EVELEIGH AFFORDABLE HOUSING PROJECT
COMBINED SERVICES PLAN
CONSTRUCTION
60238089-DRG-C1402
A

# APPENDIX B – SUPPORT INFORMATION

1. Typical steel monitoring test point
2. Typical installation of stray current test points.
2. Verification of building substructure concrete cover depth.

Earthing Rods & Accessories

Dulmison

Earthing Rods & Accessories

## Earthing Bond for Commercial Earthing Installations

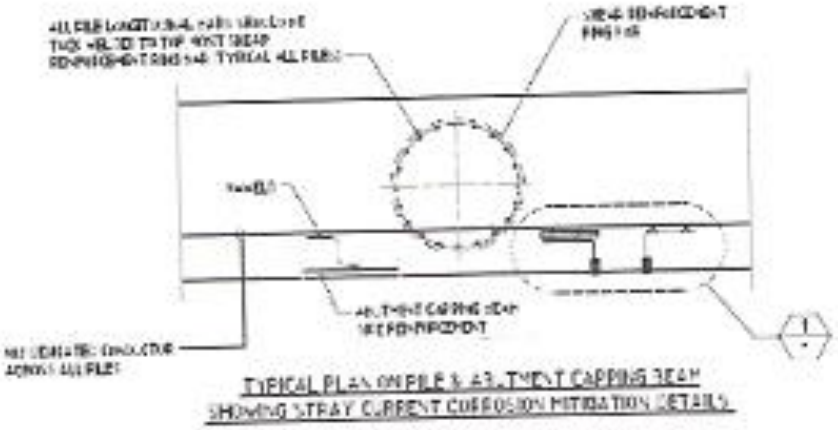
Type C70

The earthing bond system provides an earth connection welded to the steel reinforcement, thus offering a virtually indestructible, stable and low resistance path to earth.

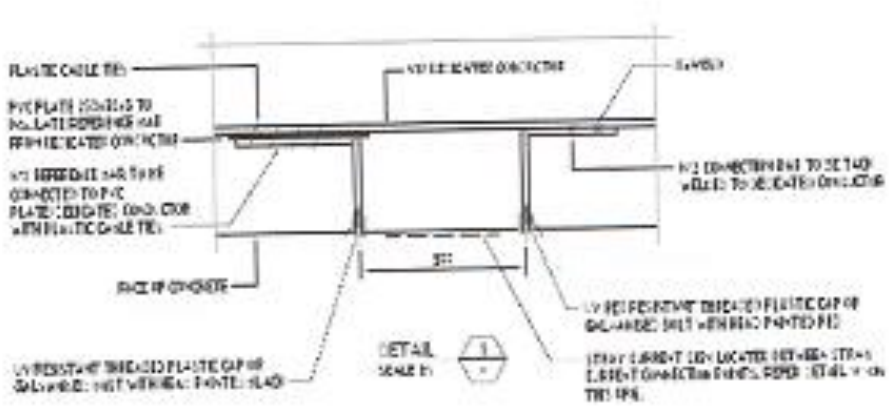
| | Cat No. C70 |
|---|---|
| Bonding Cable | 70mm² |
| 3 sec current rating | 10kA |
| Lug Dia. | 10mm |
| Terminal Thread | M10 |
| Thread Depth | 20mm |
| Cable Length | 3m |

Please enquire for other sizes.

4.10 www.dulmison.com.au



TYPICAL PLAN ON PILE & ATTENT CAPPING BEAM
SHOWING STRAY CURRENT CORROSION MITIGATION DETAILS



Neil,

Please see trailing in red enstruct response to your previously issued queries.

Regards

Brian Healy

**Name and position of the addressee of this report. North Eveleigh Affordable Housing, Eveleigh Rail Yards, Eveleigh 2015**

**What is the depth and location of proposed rail tunnel? As per previously sent attachments**

**Service search between proposed building existing and proposed rail tracks To be provided**

**What is the substructure pier/pile concrete strength MPa?** 40MPa

**What is block wall footing concrete strength MPa? 40MPa**

**What is the concrete cover on substructure piers/piles? 75mm to Piles, 40mm to footings.**

**Is the block wall steel electrically connected to substructure base floor? No. Base slab is likely to be a slab on grade and will be isolated from wall. Suspended ground floor slab will be connected to blockwork wall. Steel is lapped and tied as per typical construction practice but may not be in full contact in all cases**

**Is the block wall and base floor steel electrically connected to pier/pile steel? No. Base slab is likely to be a slab on grade and will be isolated from piles. Block Walls will not be engaged with piles. I do note thought that the piled retention system will be a soldier piled system which involves piles at 2500mm centres with shotcrete infill. Shotcrete will be 40MPa with 40mm min cover.**

- Note the use of permanent ground anchors to prevent overturning of lateral resisting core under lateral load events. Refer to structural engineering report for submission to Railcorp.

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Associate

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